SPECIFICATIONS

PROJECT NO. DGS 0403-0087, Phase 1

Contract No. DGS 0403-0087.1 – General Construction
Contract No. DGS 0403-0087.2 – HVAC Construction
Contract No. DGS 0403-0087.3 – Plumbing and Fire Protection Construction
Contract No. DGS 0403-0087.4 – Electrical Construction

For

Ada S. Georges Dining Hall Infrastructure Upgrades

CHEYNEY UNIVERSITY
CHEYNEY, THORNBURY, DELAWARE COUNTY, PA

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF GENERAL SERVICES
HARRISBURG, PA

Josh Shapiro, Governor
Sandra Aguilera, Acting Secretary



Issued for Bidding
October 19, 2026

Kimmel Architecture
482 Norristown Road, Suite 200
Blue Bell, PA 19422
610-834-7805

TABLE OF CONTENTS

SECTION	TITLE
	Specifications Cover Page
	Table of Contents
DIVISION 01	**GENERAL REQUIREMENTS**
Section 010100	Summary of Work
Section 010300	Base Bid Descriptions
Section 010400	Coordination and Control
Section 013100	Sequence of Construction & Milestones
Section 014000	Quality Control Testing Services
Section 014010	Quality Assurance Testing and Inspection Services
Section 015000	Temporary Utilities
Section 019113	General Commissioning Requirements
DIVISION 02	**EXISTING CONDITIONS**
Section 024113	Selective Site Clearing and Demolition
Section 024119	Selective Demolition
Section 028211	Removal of Asbestos Containing Materials
Section 028700	Removal and Disposal of Universal Waste
DIVISION 03	**CONCRETE**
Section 031000	Concrete Forming and Accessories
Section 032000	Concrete Reinforcing
Section 033000	Cast-in-Place Concrete
Section 035400	Cast Underlayment
DIVISION 04	**MASONRY**
Section 040120.63	Brick Masonry Repair
Section 040120.64	Brick Masonry Repointing
Section 042000	Unit Masonry
DIVISION 05	**METALS**
Section 051200	Structural Steel Framing
Section 053100	Architecturally Exposed Structural Steel Framing
Section 053100	Steel Decking
Section 054000	Cold-Formed Metal Framing
Section 055000	Metal Fabrications
Section 055213	Pipe and Tube Railings
Section 055813	Column Covers
Section 057000	Decorative Metal – Expanded Mesh Panels
DIVISION 06	**WOOD, PLASTICS, AND COMPOSITES**
Section 060660	Translucent Resin Panel System
Section 061053	Miscellaneous Rough Carpentry
Section 061600	Sheathing
Section 062023	Interior Finish Carpentry
Section 064100	Architectural Wood Casework and Millwork
Section 066400	Plastic Paneling
DIVISION 07	**THERMAL AND MOISTURE PROTECTION**
Section 071416	Cold Fluid-Applied Waterproofing
Section 072100	Thermal Insulation
Section 072423	Cement Board Finish System

Section 072500 Weather Barriers
Section 074213.23 Metal Composite Material Panels
Section 075300 Thermoset EPDM Membrane Roofing
Section 076200 Sheet Metal Flashing and Trim
Section 077100 Roof Specialties
Section 078413 Penetration Firestopping
Section 079200 Joint Sealants

DIVISION 08 OPENINGS
Section 080671 Door Hardware Schedule
Section 081113 Hollow Metal Doors and Frames
Section 081116 Double Acting Traffic Doors
Section 081200 Interior Aluminum Doors and Frames
Section 083100 Access Doors and Panels
Section 083313 Coiling Counter Doors
Section 083326 Overhead Coiling Grilles
Section 084313 Aluminum-Framed Entrances and Storefronts
Section 084413 Glazed Aluminum Curtain Walls
Section 087100 Door Hardware
Section 088000 Glazing
Section 088700 Window Film

DIVISION 09 FINISHES
Section 092116 Gypsum Board Assemblies
Section 092216 Non-Structural Metal Framing
Section 092953 Partition Gap Closure
Section 093000 Tiling
Section 095113 Acoustical Panel Ceilings
Section 096513 Resilient Base and Accessories
Section 096516 Resilient Sheet Flooring
Section 096519 Resilient Tile Flooring
Section 096813 Tile Carpeting
Section 097200 Wall Coverings
Section 098400 Direct Attached Acoustical Ceiling Panels
Section 098436 Sound Absorbing Ceiling Units
Section 099133 Painting and Coating

DIVISION 10 SPECIALTIES
Section 101419 Dimensional Letter Signage
Section 101423 Panel Signage
Section 102239 Folding Panel Partitions
Section 102600 Wall and Door Protection
Section 102800 Toilet, and Bath Accessories
Section 104313 Defibrillator Cabinets
Section 104413 Fire Protection Cabinets
Section 104416 Fire Extinguishers
Section 105113 Metal Lockers

DIVISION 11 EQUIPMENT
Section 114000 Food Service Equipment

DIVISION 12 FURNISHINGS
Section 123661.16 Solid Surfacing Countertops
Section 123661.19 Quartz Agglomerate Countertops
Section 124813 Entrance Floor Mats and Frame

DIVISION 13 **SPECIAL CONSTRUCTION**
NOT USED

DIVISION 14 **CONVEYING EQUIPMENT**
NOT USED

DIVISION 21 **FIRE SUPPRESSION**
Section 210000 Fire Suppression Scope
Section 210100 Basic Fire Suppression Materials and Methods
Section 210300 Hangers and Supports – Fire Suppression
Section 210553 Fire Suppression Identification
Section 210800 Commissioning of Fire Suppression Systems
Section 211313 Wet-Pipe Fire Suppression System
Section 214000 Fire Suppression Testing, Adjusting, Balancing

DIVISION 22 **PLUMBING**
Section 220499 Plumbing Scope
Section 220500 Basic Plumbing Materials and Methods
Section 220510 Plumbing Restoration and Retrofit
Section 220523 Domestic Water Valves
Section 220529 Plumbing Hangers and Supports
Section 220553 Plumbing Identification
Section 220700 Plumbing Insulation
Section 220800 Plumbing System Commissioning Requirements
Section 221116 Domestic Water Piping
Section 221124 Natural Gas Piping
Section 221316 Sanitary Waste and Vent Piping
Section 221429 Plumbing Pumps
Section 224000 Plumbing Fixtures

DIVISION 23 **HEATING, VENTILATING, AND AIR CONDITIONING**
Section 230505 HVAC Scope
Section 230506 Basic HVAC Materials and Methods
Section 230511 Restoration and Retrofit – HVAC
Section 230519 Piping Specialties - HVAC
Section 230523 HVAC Valves
Section 230529 Piping Hangers and Supports – HVAC
Section 230533 HVAC Pipe Heat Trace
Section 230548 Sound and Vibration Control – HVAC
Section 230549 Inertia Bases
Section 230553 Equipment and Piping Identification – HVAC
Section 230593 Testing Adjusting and Balancing of Systems
Section 230700 HVAC Insulation
Section 230800 Commissioning of HVAC Systems
Section 230900 Instrumentation and Control for HVAC
Section 230993 Sequence of Operation
Section 230995 Variable Frequency Drives
Section 232113 HVAC Piping
Section 232123 HVAC Pumps and Accessories
Section 232510 Closed Loop Water Treatment
Section 233113 Ductwork
Section 233114 Exterior Ductwork – Manufactured Pre-Insulated
Section 233115 Existing Ductwork Cleaning
Section 233300 Duct Accessories
Section 233423 Supply and Exhaust Fans
Section 233424 Roof Mounted Equipment Accessories

Section 233600 Variable and Constant Volume Boxes
Section 233713 Air Outlets and Inlets
Section 235100 Breeching and Stacks - Insulated
Section 235233 Gas-Fired Condensing Boilers – Hot Water
Section 236416 Centrifugal Water Cooled Chillers
Section 237300 Modular Air Handling Units
Section 237330 Packaged Rooftop Units
Section 237335 Packaged 100% Outdoor Air, Heating Cooling Makeup Air Units
Section 238126 Indoor Wall – Mounted Ductless Air Conditioners
Section 238213 Terminal Heating-Cooling Units

DIVISION 26 ELECTRICAL
Section 260500 Common Work Results for Electrical
Section 260500.10 Abbreviations and Definitions
Section 260500.19 Maintenance Manuals
Section 260500.22 Equipment Wiring
Section 260500.24 Food Service Equipment
Section 260508 Testing, Acceptances, and Certifications
Section 260519 Low Voltage Electrical Power Conductors and Cables
Section 260526 Grounding and Bonding for Electrical Systems
Section 260529 Hangers and Supports for Electrical Systems
Section 260533 Raceways and Boxes for Electrical Systems
Section 260553 Identification for Electrical Systems
Section 260574 Overcurrent Protective Device Arc Flash Study
Section 260800 Commissioning of Electrical
Section 260943 Distributed Digital Lighting Controls
Section 262213 Dry-Type Distribution Transformers
Section 262413 Switchboards-Low Voltage
Section 262416 Panelboards
Section 262726 Wiring Devices
Section 262813 Fuses
Section 262816 Enclosed Switches
Section 263600 Transfer Switches
Section 264313 Surge Protective Devices
Section 265200 Solid State Lighting
Section 269500 Local Sound-AV

DIVISION 27 COMMUICATIONS
Section 270500 Communication Documentation
Section 271116 Communications Rack
Section 271119 Communications Patch Panels
Section 271123 Communications Cable Management
Section 271500 Communications Horizontal Cabling
Section 271513 Communications Copper Horizontal Cabling
Section 271514 Communications Copper Horizontal Cabling Cable Life Cycle Activities
Section 271543 Communications Faceplates and Connectors
Section 271649 Communications Patch Cords, Station Cords

DIVISION 28 ELECTRONIC SAFETY AND SECURITY
Section 280540 Power Supplies
Section 281511 Access Control
Section 282300 Video Surveillance
Section 283111 Digital, Addressable Fire Alarm System

DIVISION 31 EARTHWORK
Section 311000 Site Clearing

Section 311001 Soil Erosion and Sedimentation Control
Section 312000 Earth Moving
Section 312319 Dewatering
Section 321216 Asphalt Paving

DIVISION 32 EXTERIOR IMPROVEMENTS
Section 321313 Concrete Paving
Section 321373 Concrete Paving Joint Sealants
Section 323200 Segmental Retaining Walls
Section 329200 Turf and Grasses
Section 329300 Plants

DIVISION 33 UTILITIES
Section 331000 Site Water Utility Distribution
Section 334000 Storm Utility Drainage

APPENDIX
Existing Hazardous Material Information

SECTION 010100

SUMMARY OF WORK

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 LOCATION

A. The building is located on the campus of Cheyney University at the intersection of Alumni Drive and Creek Road.

1.3 PROJECT DESCRIPTION

A. The existing building is two stories, one partially subgrade. The upper floor is used for dining and the lower floor is used for mechanical systems and storage and is largely unused. The existing structure consists of masonry exterior walls with cast-in-place concrete floors and steel framed roof. The building will be renovated and will receive new systems. Some portions of the existing building will be removed including stair towers and projections on the north side. The main entrance will be reconfigured. The existing upper floor is approximately 28,404 sf after selective demolition and will be fully renovated, with updated kitchen, student dining, and banquet hall. The existing lower floor is approximately 18,038 sf after selective demolition, will be partially renovated as needed to support work above. The exterior of the existing building will be selectively repaired and have materials replaced as appropriate. Windows will be replaced. A new screen wall and canopy will be installed at the entry. The existing building roof is new but will be modified and patched for new work at perimeter and for new mechanical equipment. Renovated areas will be sprinklered. The existing structure is non-combustible of steel, concrete and masonry construction.

1.4 CONTRACT DURATION

A. The Construction Contract duration shall be **450** calendar days commencing on the date of the Initial Job Conference.

B. Sequence 1 duration shall be **240** calendar days commencing on the date of the initial job conference.

C. There shall be a **30** day transition period of no contractor work to allow the Client Agency to shift operations from existing dining/kitchen to new dining/kitchen commencing at the end of sequence 1.

D. Sequence 2 duration shall be **180** days commencing at the end of the transition period.

E. Refer to Section 013100 for how the contract duration may be impacted by long lead-time materials and equipment.

1.5 WORK INCLUDED

A. The Work of this Project consists of, but is not necessarily limited to, the following. Detailed requirements of the Work are described in the pertinent specification Sections and/or shown on the Drawings.

B. General Construction (.1) Contract:

1. Project coordination.
2. Set-up temporary construction and erosion control facilities.
3. Hazardous materials abatement.
4. Existing building selective demolition.
5. Removal of existing furniture and kitchen equipment.
6. Plumbing and storm utility services.
7. Watertight construction of the building.
8. Windows and doors.
9. Cladding,
10. Interior construction and finishes.
11. Toilet compartments and vanities.
12. Casework.
13. Fire extinguishers and cabinets.
14. Signage.
15. Sitework.
16. Site utilities to 5 feet outside building.
17. Site walls (and guardrails).
18. Landscaping.
19. Kitchen equipment.
20. With the exception of finished switches, controls, outlets, fixtures and cassettes, all new mechanical work (specifically including but not limited to pipes, lines, wiring and the like are to be concealed in ceilings or walls in any finished areas. The General Contractor, Mechanical Contractor, Electrical Contractor and Plumbing Contractor are all responsible for coordination of this work and must ensure that this requirement is met. The .2, .3 and .4 Contractors are responsible for cutting as required to install their work and for patching as required in all concealed or unfinished areas. The .1 contractor is responsible for all finishing and patching in exposed areas in finished spaces.

C. HVAC Construction (.2) Contract:

1. Selective demolition.
2. Complete, new, HVAC equipment, ductwork and devices.
3. Fans and ductwork connections to exhaust hoods.
4. Coordination with Commissioning Agent.
5. With the exception of finished switches, controls, outlets, fixtures and cassettes, all new mechanical work (specifically including but not limited to pipes, lines, wiring and the like are to be concealed in ceilings or walls in any finished areas. The General Contractor, Mechanical Contractor, Electrical Contractor and Plumbing Contractor are all responsible for coordination of this work and must ensure that this requirement is met. The .2, .3 and .4 Contractors are responsible for cutting as required to install their work and for patching as required in all concealed or unfinished areas. The .1 contractor is responsible for all finishing and patching in exposed areas in finished spaces.

D. Plumbing Construction (.3) Contract:

1. Selective demolition.
2. New plumbing fixtures and associated branch piping, valves, etc.
3. New sprinkler service, heads, piping, branch piping, mains, valves, etc. for a complete new sprinkler system.
4. Utilities from 5 feet outside of building into and throughout the building.
4. Connections to kitchen equipment.
5. With the exception of finished switches, controls, outlets, fixtures and cassettes, all new mechanical work (specifically including but not limited to pipes, lines, wiring and the like are to be concealed in ceilings or walls in any finished areas. The General Contractor, Mechanical Contractor, Electrical Contractor and Plumbing Contractor are all responsible for coordination of this work and must ensure that this requirement is met. The .2, .3 and .4 Contractors are responsible for cutting as required to install their work and for patching as

required in all concealed or unfinished areas. The .1 contractor is responsible for all finishing and patching in exposed areas in finished spaces.

E. Electrical Construction (.4) Contract:

1. Selective demolition
2. Temporary power.
3. New electrical equipment.
4. New lighting, power (electrical outlets, junction boxes, etc.), smoke detectors, telephone jacks, data jacks, and associated wiring to each.
5. Wiring to HVAC and plumbing equipment.
6. Wiring for kitchen equipment.
7. Infrastructure for: I.T., CATV, Security, and A/V equipment.
8. Access Control System and devices
9. Data systems and equipment.
10. Building security systems and equipment.
11. With the exception of finished switches, controls, outlets, fixtures and cassettes, all new mechanical work (specifically including but not limited to pipes, lines, wiring and the like are to be concealed in ceilings or walls in any finished areas. The General Contractor, Mechanical Contractor, Electrical Contractor and Plumbing Contractor are all responsible for coordination of this work and must ensure that this requirement is met. The .2, .3 and .4 Contractors are responsible for cutting as required to install their work and for patching as required in all concealed or unfinished areas. The .1 contractor is responsible for all finishing and patching in exposed areas in finished spaces.

1.6 SPECIFICATION FORMAT

A. The Specifications for the work of the separate prime Contracts are bound in one volume. Technical provisions which apply to each prime Contract are included in the Divisions listed below:

B. General Construction (.1) Contract: Divisions 01 through 14 and Divisions 31, 32 and applicable Sections of Division 33

C. HVAC Construction (.2) Contract: Divisions 01, 23 and applicable Sections of Divisions 02, 03, 05, 07, 09, 25, 31, 32 and 33.

D. Plumbing Construction (.3) Contract: Divisions 01, 21, 22 and applicable Sections of Divisions 02, 03, 05, 07, 09, 25, 31, 32 and 33.

E. Electrical Construction (.4) Contract: Divisions 01, 26, 27, 28 and applicable Sections of 02, 03, 07, 08, 09, 31, 32, and 33.

Note: The term Professional refers to the Architectural or Engineering firm retained by the Department to design and document the work of the Project, or the Professional's authorized representative. The term Professional may also refer to the Client Agency if the Project design was delegated to the Client Agency. Throughout the Specifications and Drawings wherever the terms 'A/E', 'Architect' or 'Engineer' are used it shall mean Professional.

1.7 WORK BY OTHERS

A. Coordinate work being provided by others including FFE.

B. Roller shades are part of FFE package.

1.8 QUESTIONS DURING BIDDING PERIOD

A. Direct all questions pertaining to the Project to the Project Professional utilizing the Trimble e-Builder Enterprise Software Program (e-Builder) as described in the Instructions To Bidders.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 010300

BASE BID DESCRIPTIONS

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. This Section includes identification of each Base Bid and description of the changes to be associated with each Base Bid.

1.3 DESCRIPTION OF SEPARATE BASE BIDS

A. GENERAL CONSTRUCTION CONTRACT (DGS 0403-0087 PHASE 1.1)

1. Base Bid No. 1:

   a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications except that work specifically called out as being part of another Base Bid.

2. Base Bid No. 2:

   a. Same as Base Bid No. 1, except add:
      1. All work associated with renovating the banquet hall.
      2. All work associated with renovating the corridor from the dining hall entry to the banquet hall.
      3. All work associated with renovating the stairs from the banquet hall to the basement, including fire separations and doors and hardware.

3. Base Bid No. 3:

   a. Same as Base Bid No. 2, except add:
      1. Replacement of existing curtainwall system in existing openings on east between E & G and H & S, west between B & G and H & S, and south between 3 & 5 and 6 & 8 sides of the upper floor. Structural work for support of curtainwall. New curtainwall at the east and north walls of the dining hall, at the removed stair towers and at the entry are part of Base Bid 1.
      2. Exterior brick repair and soffit repair work beyond areas completed for base bid

4. Base Bid No. 4:

   a. Same as Base Bid No. 3, except add:
      1. Demolition of basement hazardous materials as indicated.
      2. Refinishing of the basement including select floor finishes, ceilings, painting and toilet room renovations.

B. HVAC CONSTRUCTION CONTRACT (DGS 0403-0087 PHASE 1.2)

1. Base Bid No. 1:

a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications except that work specifically called out as being part of another Base Bid.

2. Base Bid No. 2:

a. Same as Base Bid No. 1, except add:
1. All air distribution and equipment work associated with renovating the banquet hall and west corridor.

3. Base Bid No. 3:

a. Same as Base Bid No. 2:

4. Base Bid No. 4:

a. Same as Base Bid No. 3, except add:
1 Toilet room exhaust in the basement.

C. PLUMBING CONSTRUCTION CONTRACT (DGS 0403-0087 PHASE 1.3)

1. Base Bid No. 1:

a. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications except that work specifically called out as being part of another Base Bid.
b. Fire suppression service and in base bid 1 work areas.

2. Base Bid No. 2:

a. Same as Base Bid No. 1, except add:
1. Sprinkler distribution work in all base bid 2 banquet and corridor work areas.

3. Base Bid No. 3:

a. Same as Base Bid No. 2, except add:
1. Sprinkler work for outdoor soffits.

4. Base Bid No. 4:

a. Same as Base Bid No. 3, except add:
1. All work associated with replacement of plumbing fixtures in the basement toilet rooms.
2. Sprinkler work throughout base bid 4 basement work areas.

D. ELECTRICAL CONSTRUCTION CONTRACT (DGS 0403-0087 PHASE 1.4)

1. Base Bid No. 1:

b. Shall include all the work indicated on the Contract Drawings and described in the Contract Specifications except that work specifically called out as being part of another Base Bid.
c. A complete fire alarm system covering the entire building.

2. Base Bid No. 2:

a. Same as Base Bid No. 1, except add:

1. All electrical and lighting work associated with renovating the banquet hall.
2. All electrical and lighting work associated with renovating the corridor from the entry to the banquet hall.
3. All lighting work associated with renovating the stairs from the banquet hall to the basement.
4. All communication and security work associated with renovating the banquet hall, corridor and toilet rooms.

3. Base Bid No. 3:

   a. Same as Base Bid No. 2:

4. Base Bid No. 4:

   a. Same as Base Bid No. 3, except add:
      1. Electrical and lighting work associated with refinishing of the basement.
      2. All communication and alarm work associated with refinishing of the basement.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 010400

COORDINATION AND CONTROL

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. This section includes the on-site provisions that govern the performance of the work to complete this Project.

1.3 CONTRACTS - FOR THIS PROJECT CONSTRUCTION

A. DGS 0408-0087 PHASE 1.1 General Construction (Lead Contractor)

B. DGS 0408-0087 PHASE 1.2 HVAC Construction

C. DGS 0408-0087 PHASE 1.3 Plumbing Construction

D. DGS 0408-0087 PHASE 1.4 Electrical Construction

1.4 VISIT TO SITE

A. For access to the site during the bidding period contact the Client Agency site personnel with phone number listed below:

1. Client Agency Site Representative: Omar Robinson
2. Telephone Number: (267) 897-4697

A. Access to the facility during the bidding period will be restricted to a tour associated with the Pre-Bid Conference or other scheduled events.

1.5 UNIDENTIFIED HAZARDOUS MATERIALS (ASBESTOS, CHEMICALS, ETC.)

A. There is a possibility that hazardous materials not identified in the contract documents may be discovered on this project. Should it be determined that some or all of the hazardous materials must be removed, the Contractor shall obtain an estimate for said removal from a Subcontractor who is experienced in the field, has insurance and is knowledgeable of the regulations as they apply. The Contractor may provide the estimate itself if it is qualified in the applicable hazardous materials field. The Department shall consider authorizing a Change Order for the removal of the hazardous material to the extent necessary.

B. The Contractor or Subcontractor must comply with all requirements of the General Conditions, including the maintenance of insurance up to the limit required under the General Conditions.

C. Should a hazardous material be encountered on the job, the Contractor shall comply with all statutes and regulations of the Commonwealth of Pennsylvania and all rules and regulations of the United States Environmental Protection Agency as they apply during construction and demolition work and the disposal of hazardous material. Particular attention is drawn to Code

of Federal Regulations, Title 40, Part 61, Section 112 of Clean Air Act and PA Department of Labor and Industry, Act 194 for asbestos.

D. The Contractor shall comply fully with the regulations of OSHA as they pertain to the protection of workers exposed to the emission of asbestos fibers, chemicals, etc. and shall take all steps necessary to protect its employees, as well as all other people occupying the building.

E. Whenever a hazardous material is to be removed or disposed of, the Contractor is required to make proper notification to the Bureau of Air Quality in the PA Department of Environmental Protections' Regional Office, PA Department of Labor and Industry and EPA as applicable, and is required to obtain and pay for any permits required. Disposal shall conform to all applicable regulations and documentation shall be required when, applicable.

1.6 LEAD PAINT

A. All work is to be performed with the assumption that all painted surfaces are lead containing. Each Prime Contractor is responsible for following all required OSHA 1926.62 'Lead In Construction' standards when disturbing or impacting these painted surfaces during the course of the renovations, including but not limited to activities such as: cutting and patching, core drilling, penetration, anchoring, fastening, etc. The area(s) shall be visually clean upon completion of any of these activities.

1. Action Plan: Contractor(s) shall submit an Action Plan that conforms to Paragraph 1.6.A.1-3 herein for approval at the Initial Job Conference, which specifically outlines details of means and methods to be used for each dust-generating activity involving lead-painted surfaces, erection of critical barriers and plastic sheeting for dust control, subsequent exposure assessment, personal protective equipment, hygiene and clean-up.
2. Contractor(s) shall utilize means and methods that preclude dust generation to complete work that disturbs/impacts lead-containing paint (i.e., paint stripper, HEPA-assisted drills, etc.).
3. Contractor(s) shall ensure areas beyond work area are not contaminated, and shall immediately stop work and erect plastic sheeting to prevent the spread of dust, anytime means and methods inadvertently create dust.

1.7 MOLD

A. In the event mold is encountered, the Contactor shall implement corrective actions to protect workers, other building occupants, and to prevent the disturbance of mold in affected areas. Although not presently regulated by EPA and/or OSHA, the EPA does provide industry standards regarding worker safety and abatement procedures, which are the minimum procedures to be followed if mold is encountered.

B. Any mold that appears as a result of construction shall be abated immediately by the Contractor responsible for this condition. The affected surface shall be cleaned, removed, and replaced. Inspection and testing shall be done by a qualified testing agency to confirm the mold has been removed in its entirety.

1.8 TESTING OF EQUIPMENT

A. After any equipment furnished under the contract and any permanent heating, ventilating, plumbing, drainage or electrical systems and equipment have been installed or modified, it shall be the responsibility of the Contractor to operate its equipment for a satisfactory period of time, as required by the Department for proper testing and instructing the operating personnel. Fuel, electricity and water required for proper testing of permanent equipment and for the period of instructing personnel, shall be paid for by the Contractor testing its equipment.

1.9 PROJECT PHOTOGRAPHS

A. Digital Images: Provide images in uncompressed JPEG or TIFF format, produced by a digital camera with minimum sensor size of 4.0 megapixels, and at an image resolution of not less than 1600 by 1200 pixels.

B. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.

C. Preconstruction Photographs: Before commencement of any demolition take digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Architect.
   1. Take eight photographs to show existing conditions adjacent to property before starting the Work.
   2. Take eight photographs of existing buildings either on or adjoining property to accurately record physical conditions at start of construction.
   3. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

D. Periodic Construction Photographs: Take digital photographs weekly. Select vantage points to show status of construction and progress since last photographs were taken. Progress photos are to be submitted monthly with the Contractors Application for Payment.

E. Final Completion Construction Photographs: Take color photographs after date of Substantial Completion for submission as Project Record Documents.

1.10 INSTRUCTIONS AND TRAINING

A. Refer to the General Conditions of the Construction Contract, as specified in the applicable technical portion of each specification for "Operations and Maintenance Instruction Manuals" and “Record Drawings” requirements.

B. Unless approved by the Department, training shall not be scheduled/conducted until Record Drawings, Operation and Maintenance Instruction Manuals, valve tag lists, equipment and piping system identification, and all software programming is complete.

C. Provide full on-site training and instruction to designated Commonwealth personnel given by competent manufacturer's authorized personnel thoroughly familiar with all technical and operational aspects of the installed items. Instructions are to cover operation and maintenance of all systems, equipment components and other items as specified and furnished under this contract. Instructional digital video recordings may be used to augment required instructions and training but may not be substituted for the in person on-site training. All on-site training shall be digitally recorded by the Contractor. The digital video files are to be turned over to the Client Agency.

D. Contractor shall provide an outline of the training and course content, which shall be submitted and accepted by the Professional and the Department prior to conducting training.

E. Conduct instruction and training during regular working hours. For training on complicated systems, allow at least one-half of the training time to be at and/or with the system equipment.

F. Provide additional training and instructions for all significant modifications and/or changes made under the terms and/or conditions of the manufacturer's and/or Contractor's warranty.

G. The Contractor shall maintain and submit a sign-in list that clearly documents all personnel attending the training.

1.11 PROJECT SIGN

A. Provide a Project Sign. Refer to the General Conditions of the Construction Contract.

1.12 REUSE OF MATERIALS

A. No removed materials or equipment shall be reinstalled in the work, unless so noted on the Drawing or in these Specifications.

1.13 GENERAL

A. All construction trailers, offices, equipment and materials required to be on-site shall be located as shown on the Drawings, or at the direction of the Department.

1.14 WORKING HOURS

A. The Contractor's available working hours shall be from 6:00 A.M. to 6:00 P.M., Monday through Friday.

B. Work during different hours, or work on Saturdays, Sundays, State and National Holidays or overtime work, must have the Regional Director's or his designee's prior written approval. Work on these days if approved shall be at no additional cost or time to the Contract.

C. This shall not apply in those unforeseen isolated and/or emergency instances when a particular operation must be performed in a continuous sequence that extends the working day beyond the approved working hours. Coordinate with the Department in these instances.

D. The Department's failure to approve different working hours, weekend or holiday working hours, or overtime hours is not cause for a claim against the Department for delay or any added costs or time to the Contract.

E. Utility shut-downs required for tie-ins to existing systems shall be done in off-hours, weekends, and/or holidays to minimize the impact on the operations of the Client Agencies (and/ or surrounding buildings). These costs shall be anticipated and included in the Contractor's bid.

1.15 DELIVERY, STORAGE AND HANDLING

A. Prefinished materials shall arrive at job site in their original unopened cartons or other protective packaging necessary to protect finishes. Materials shall be stored in such packages until time of application. Flat materials such as panels shall arrive and remain on adequate support to ensure flatness and prevent damage.

B. Store all materials, equipment and bulk items prior to installation in clean, dry, well ventilated locations away from uncured concrete, masonry or damage of any kind. Waterproof tarpaulin or polyethylene sheeting must allow for air circulation under covering.

C. Coordinate storage location with the Department.

D. Refer to each section for specific delivery, handling and storage instructions of items specified.

1.16 PARKING

A. Parking shall be limited to areas indicated on the Site Plans. All parking is subject to prior approval of the Department and Client Agency.

1.17 TRAFFIC

A. The Lead Contractor shall establish at the Initial Job Conference a construction staging and traffic plan for the project which minimizes the construction interference with the Client Agency's operation. This plan is subject to the Department's and the Client Agency's review

and acceptance. This acceptance does not relieve the Contractors of their responsibilities regarding safety coordination, and adherence to all traffic laws and ordinances.

1.18 SUBSURFACE INFORMATION

A. Due to the limited amount of subsurface work and limited new building foundations, a subsurface geotechnical report has not been prepared.

B.

1.19 SITE FENCE

A. The .1 GC is to provide a chain link fence and lockable gates that are 6'-0" in height and of sufficient width for materials with white slats around all designated construction staging areas.

1.20 ENVIRONMENTAL QUALITY CONTROL

A. The Prime Contractor and its Subcontractors shall perform their work in a manner which shall minimize the possibility of air, water, land and noise pollution, in accordance with the General Conditions of the Construction Contract.

B. The name, address and telephone number of the Department of Environmental Protection Regional Office is furnished below. This office shall be contacted for waste disposal permits and for information concerning sites already approved for conducting waste disposal.

Southeast Regional Office
2 East Main Street
Norristown, PA 19401-4915
(484) 250-5900

Counties: Bucks, Chester, Delaware, Montgomery, and Philadelphia

1.21 OFFICE FOR CONTRACTOR

A. Each Prime Contractor shall provide and maintain, at its cost, a suitable office on the premises, at a location shown on the Lead Contractor's accepted staging plan. The Contractor shall provide and maintain heating facilities and supply fuel for same in cold weather, and shall remove the office from the premises at completion of all work. Provide electrical, telephone and internet service.

1.22 DGS CONSTRUCTION MANAGER OFFICE

A. Office space is provided by Cheyney University (Client Agency).

B. The Lead Contractor shall clean this office at least bi-weekly, including emptying the trash.

C. Equipment: The Lead Contractor shall furnish, within the existing DGS job trailer, the following items in the quantity indicated. The Lead Contractor shall maintain all items in good condition and furnish all supplies (i.e. toner, paper, pens/markers, common alkaline batteries, water filters, drinking cups, bathroom and general cleaning supplies) for the duration of the Contract. If any equipment fails, it shall be repaired or replaced by the Lead Contractor within twenty-four (24) hours of being notified by the Department.

1. (2) KI Task Chairs model # KIDE84C, with weight activated tilt with seat slide and 4 D arms
3. (1) HP Color LaserJet Pro MFP 4301fdw Wireless Printer
4. (1) HP 210X Black Original LaserJet Toner Cartridge, W2100X

5. (1) 120v 2.5 Gallon or better- Point -of-use electric water heater installed in DGS job trailer

Other Items:

16. _____ Plain white ANSI approved hardhats

D. Cheyney University (Client Agency) to provide broadband internet access. Lead contractor to provide, install and wire replacement wireless router if required by the Department.

1.23 SANITARY FACILITIES

A. The following conditions shall pertain:
1. Sanitary facilities will, within the limitations of the existing facilities, be provided by the Client Agency at no cost. The Lead Contractor shall provide all supplies and maintain the facilities in a clean and sanitary manner at all times.

1.24 SMOKING POLICY

A. Smoking and use of smokeless-tobacco, chewing tobacco, snuff, Vape machines and similar paraphernalia are strictly prohibited in all buildings.

1.25 CONCRETE AND EARTHWORK

A. All Contractors shall perform concrete work and earthwork required for their work, and shall comply with applicable Division 2, 3, 31, 32, and 33 sections. If any specification section contains language conflicting with requirements of applicable Division 2, 3, 31, 32, and 33 sections, the most stringent requirements shall prevail.

1.26 QUALITY CONTROL TESTING

A. Structural-related testing and inspections required to be performed by the Contractor(s) are listed in Section 014000 – Quality Control Testing Services. If Quality Control testing or inspections required appear in Section 014000 and in a technical section, the most stringent requirements shall prevail. If Quality Control testing or inspections required appear in a technical section and not in Section 014000, they shall be required as if specified in Section 014000. Conditions pertaining to Quality Control testing and inspections may appear in the technical sections. All testing herein is to be by the Contractor. Testing by the Department, Quality Assurance Testing, is for the purpose of checking the results of the Contractor's Quality Control Testing. Testing is to be by the Contractor, unless specifically stated to be "by the Department" or required by Section 014010 – Quality Assurance Testing and Inspection Services.

B. Non-structural testing is in the technical specifications.

1.27 CADD FILE WAIVER

A. The Professional will make graphic portions of the bid drawings available for use by the Contractor by uploading files to e-Builder.

B. Electronic files shall be uploaded only after all construction contracts have been executed.

C. The files are provided as a convenience to the Contractor, for use in preparing shop drawings and/or coordination drawings related to the construction of this Project only. These files and the information contained within are the property of the Department, and may not be reproduced or used in any format except in conjunction with this Project.

D. The Contractor acknowledges that the information provided in these files is not a substitution or replacement for the Contract Documents and does not become a Contract Document. The Contractor acknowledges that neither the Professional nor the Department warrant or make any representation that the information contained in these files reflect the Contract Documents in their entirety. The Contractor assumes full responsibility in the use of these files and acknowledges that all addenda, clarifications and changes to the drawings executed as a part of the Contract Documents may or may not be incorporated in these electronic files.

E. The Contractor acknowledges that the furnishing of these files in no way relieves the Contractor from the responsibility for the preparation of shop drawings or other schedules as set forth in the Contract between the Contractor and the Department.

F. The electronic documents shall be stripped of the Professional's name and address, and any professional licenses and signatures indicated on the contract documents. Use of these electronic documents is solely at the Contractor's risk, and shall in no way alter the Contractor's Contract for Construction.

G. Disclaimer: The Professional and Department make no representation regarding fitness for any particular purpose, or suitability for use with any software or hardware, and shall not be responsible or liable for errors, defects, inexactitudes, or anomalies in the data, information, or documents (including drawings and specifications) caused by the Professional's or its Consultant's computer software or hardware defects or errors; the Professional's or its Consultant's electronic or disk transmittal of data, information or documents; or the Professional's or its Consultant's reformatting or automated conversion of data, information or documents electronically or disk transmitted from the Professional's Consultants to the Professional.

H. By the Contractor's or their subcontractor's use of the electronic files (e.g., AutoCAD files), the Contractor and their subcontractor waive all claims against the Department the Professional, its employees, officers and Consultants for any and all damages, losses, or expenses the Contractor incurs from any defects or errors in the electronic documents. Furthermore, the Contractor shall indemnify, defend, and hold harmless the Department, the Professional, and its Consultants together with their respective employees and officers, from and against any claims, suits, demands, causes of action, losses, damages or expenses (including all attorney's fees and litigation expenses) attributed to errors or defects in data, information or documents, including drawings and specifications.

1.28 DELEGATED DESIGN SERVICES

A. Performance and Design Criteria: Where design services or certifications by a design professional are specifically delegated to the Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated in the technical specification sections.

1. If criteria indicated in the technical sections are not sufficient to perform services or certification required, submit a written request for additional information to the Professional.

B. Delegated Design Services Submittals: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement signed and sealed by the responsible design professional registered in the Commonwealth of Pennsylvania, for each product and system specifically assigned to the Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

1.29 COORDINATION DRAWINGS

A. General:

1. Refer to the General Conditions of the Construction Contract regarding the preparation of Coordination Drawings and the responsibilities of all Prime Contractors. Any conflicts between or questions regarding the requirements in this Section and the requirements in the General Conditions should be brought to the attention of the Professional.
2. Refer to Technical Specification sections for specific Coordination Drawing requirements for mechanical and electrical installations. Other Technical Specifications sections may also identify requirements for Coordination Drawings.
3. The Prime Contractors shall indicate the value of this effort as a line item on the Schedule of Values.
4. Submission of Coordination Drawings shall be included as a milestone on the Construction Schedule. The General Contractor shall initiate this action and acquire the necessary dates from the other Prime Contractors as part of their overall scheduling responsibilities.
5. Coordination drawings shall be completed within (60) calendar days of the Effective Date of the Contract.
6. The Department's receipt of Coordination Drawings does not in any way constitute approval, or relieve the Prime Contractors of the responsibility to accurately coordinate and install their work.

B. Coordination Procedures:

1. The HVAC Contractor shall have the lead role in this process and shall initiate Coordination Drawings by producing background drawings in electronic format. Electronic drawing files will be available in e-Builder to all Prime Contractors. These background drawings shall include walls, partitions, structural elements, finished floor elevations, dimensions, ductwork, piping, conduit, system devices, associated equipment, etc.
2. Electronic drawings shall then be forwarded to the other Prime Contractors, one at a time, including the General Contractor, for inclusion, layout and interface of all relative equipment, material and penetrations associated with the Work.
3. Each Prime Contractor is responsible for the accuracy and completeness of all Coordination Drawings and shall review all other Prime Contractor's drawings so that there will be no interference and/or conflict with its portion of the work.
4. Upon completion of the preliminary Coordination Drawings, the HVAC Contractor shall schedule a coordination meeting with all Prime Contractors in order to resolve all interference issues. Altering structural elements, bearing elevations, established dimensions, partition locations and ceiling/bulkhead heights or any other aesthetic effect is prohibited without the consent of the Professional.
5. Upon resolution of all interference issues, the Coordination Drawings shall be revised as required, and upon acceptance by all Prime Contractors, the HVAC Contractor will upload the final Coordination Drawings to e-Builder.

    a. Coordination Drawings shall contain a signature block for each Prime Contractor to provide signatures and dates indicating concurrence.

6. Coordination Drawings may be formulated and submitted in partial submittals to facilitate the construction schedule and sequence of work within the Project. This must be agreed to by all Prime Contractors and a priority of sequence must be established that has the concurrence of all parties, including the Department. Approval of partial sets of Coordination Drawings shall not relieve the Contractors of their responsibility for properly coordinating work appearing in subsequent submissions. Any revisions to subsequent work necessitated by such partial approvals shall be performed at no additional cost to the Department.

C. Coordination of Work:

1. Each Prime Contractor shall clearly show, and coordinate with the other Prime Contractors, the following:

    a. Arrange for pipe spaces, chases, slots, sleeves, and openings with general construction work, and arrange in building structure during progress of the Work, to allow for and facilitate distribution line and equipment installation.
    b. Coordinate installation of required supporting devices for ductwork, piping, and conduit, as well as sleeves, and other structural components, as they are constructed.
    c. Coordinate requirements for access panels and doors for HVAC, Plumbing and Electrical items requiring access where concealed behind finished surfaces.
    d. Coordinate electrical connections to equipment provided by all Contractors.
    e. Sequence, coordinate, and integrate installing materials and equipment for efficient flow of the Work. Coordinate installing large items of equipment requiring positioning before closing in the building.

2. Each Prime Contractor shall coordinate its construction operations with those of other Prime Contractors and entities to ensure efficient and orderly installation for each part of the Work. Each Prime Contractor shall coordinate its operations with other operations, included in different Sections that depend on each other for proper installations, connection, and operation. All Prime Contractors shall:

    a. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
    b. Coordinate installation of all components with other Prime Contractors to ensure adequate accessibility/clearance for required maintenance and service.
    c. Make provisions to accommodate items scheduled for later installation.

1.30 PERMIT CONDITIONS

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 013100

SEQUENCE OF CONSTRUCTION AND MILESTONES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 GENERAL REQUIREMENTS

A. Before beginning work, the Contractor will be required to prepare a schedule in consultation with the Department. The work must be carried out in full accordance with the schedule. The Contractor shall arrange to perform the work without any unnecessary interference with the Institution's operation.

1.3 CRITICAL MATERIALS AND EQUIPMENT

A. The Contractor is cautioned that all necessary and required critical materials and equipment shall be ordered as quickly as possible, in order that the shipping will not delay the progress of the work or completion of the project.

1.4 CRITICAL ITEMS TO BE NOTED AS MILESTONES

A. Refer to the General Conditions, Article 8 'Project Schedule', regarding construction progress Milestones to be established by the Lead Contractor.

B. The project will be completed in two sequences as indicated on drawings and as described below. Basement work including mechanical and electrical rooms may span both sequences. Complete basement work such as ceiling removal and replacement based on the work being done above. Basement areas have more flexibility for construction duration than first floor. Maintain access for Client Agency to the loading dock and a path from loading dock to elevator throughout construction.

1. Sequence 1: Construction of the north student dining, toilet rooms and portions of the kitchen.
    a. During Sequence 1 the south dining will be actively used for student dining and the existing kitchen and part of the west servery will operate to serve the south dining area.
    b. The existing kitchen will need an operable hot line, prep area, dish area and walk-in cooler.
    c. Access will need to be maintained from the elevator to the kitchen. Access to the existing toilet rooms will need to be maintained.
    d. HVAC, plumbing and electrical shall remain active for student dining, kitchen and toilet rooms for the duration of Sequence 1.
    e. Student access through the existing entry doors will need to be maintained until the new entrance is sufficiently completed to allow transition.
    f. RTU-1 will be installed early in the project to maintain conditioning and ventilation in the corridor.
    g. Sprinkler service.
    h. Sanitary line installation.
    i. Gas service upgrades.
    j. Exterior work including curtainwall around dining, at removed stair towers and at vestibule and north terrace.
    k. Transition work such as work on and around the main entrance and other shutdowns shall be scheduled for the summer when student occupancy is low.

l. Stabilize disturbed exterior areas.

2. Sequence 2: Construction of the south banquet hall, executive dining and the remainder of the kitchen.
   a. During Sequence 2 the north dining will be actively used for student dining and the new kitchen and servery will operate to serve the north dining area. All HVAC, plumbing, electrical, alarm and sprinkler services shall be active for Sequence 1 areas that have been turned over to the Client Agency.
   b. Access will need to be maintained from loading dock and the elevator to the kitchen. Access to the existing toilet rooms will need to be maintained.
   c. Student access through the new entry doors will need to be maintained.
   d. Electrical switchgear.
   e. Exterior work including remaining existing window replacement.
   f. Landscaping.

C. The Contractor shall include the following critical items as Milestones:

1. General Construction (.1) Contract:

   a. Construction Start
   b. Initial job conference.
   c. Long lead time submittals.
   e. Summer transition work including main entry change and shutdowns.
   f. Sequence 1 final inspection.
   g. Sequence 1 punch list.
   h. Sequence 1 completion.
   i. Transition period.
   j. Sequence 2 start.
   k. Sequence 2 final inspection.
   l. Sequence 2 punch list.
   m. Sequence 2 completion.

2. HVAC Construction (.2) Contract:

   a. See General Construction for milestones established by the General Contractor.
   b. Long lead time submittals.
   c. RTU-1 installation and building shutdown for setting. Installed early in the project to maintain conditioning and ventilation in the corridor.
   d. Chiller replacement during winter months.
   e. Boiler and pump replacement to maintain heating in the building (replace boilers and pumps one at a time).

3. Plumbing Construction (.3) Contract:

   a. See General Construction for milestones established by the General Contractor.
   b. Long lead time submittals.
   c. Sanitary line changeover.
   d. Gas shutdown for service upgrade.
   b. Water and Alumni Drive shut down for connection of sprinkler service.

4. Electrical Construction (.4) Contract:

   a. See General Construction for milestones established by the General Contractor.
   b. Long lead time submittals including main switch board.
   c. Delivery of main switch board.
   d. Switchgear installation and power changeover, target summer or winter break.

1.5 SEQUENCING OF CONSTRUCTION AND OTHER REQUIREMENTS

A. When the Work of this Project includes longer than industry standard lead-times for materials or equipment for which all other tasks on the Project Schedule become dependent, the Department may issue a notice of a temporary suspension of the Work. If temporarily suspended, the Contractor must notify the Department at least thirty (30) days prior to the delivery date of the materials or equipment. Upon such notice, the Department will terminate the suspension and direct resumption of the Work to occur on or about the delivery date. The Contractor, in consultation with the Department, will evaluate the length of time needed to complete the project and a non-compensatory Extension of Time Change Order may be submitted by the Prime Contractor(s), which the Department will review in accordance with the Administrative Procedures governing Extensions of Time. During the temporary suspension, the Contractor will be responsible to maintain all installed temporary facilities.

B. The building will be occupied throughout the construction project. During Base Bid 1 Sequence 1 work the existing dining hall will remain operational. Work will be sequenced so the existing kitchen, including hot line, coolers and freezers, and dishwashing remain operational for the existing dining hall. When the new dining hall is operational Sequence 2 will commence and equipment serving the existing dining hall will be removed. Base Bid 2 work, if accepted, will be completed in sequence after all Base Bid 1 work is completed. Base Bid 3 and 4 work, if accepted, can be completed in sequence with Base Bid 2 Sequence 2.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 014000

QUALITY CONTROL TESTING SERVICES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections, "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 GENERAL

A. The Contractor is responsible for verifying and enforcing compliance with all requirements of the Contract Documents. Contractor's responsibility includes, but is not limited to, the following:

1. Supervision of field work to enforce contract compliance of all construction activity.
2. Verification of compliance with plans and specifications of all manufactured materials or equipment. Provide certificates of compliance, or other approved proof of compliance, by the manufacturers and submit to the Professional.
3. Performance of all necessary field measurements and/or inspections to verify compliance with requirements of the plans or specifications requiring adherence to measurable standards of field performance.
4. Engaging an independent testing laboratory to perform tests and inspections as required by this specification section, hereafter referred to as Quality Control Testing and Inspection Services or Quality Control Testing Services.
5. Providing support services for all Quality Control Services, including cutting and patching and repair or replacement as required.

B. Work not included: Quality Assurance Services by the Department are specified in Section 014010. The Department reserves the right to perform tests under the Quality Assurance Testing program and to use those as the basis for approval or rejection at its sole discretion.

1.3 DESCRIPTION OF QUALITY CONTROL TESTING

A. Quality Control Services include inspections, tests and reports by an independent testing laboratory or other approved agency, hereafter referred to as the Quality Control Agency. All Quality Control Services shall be at the Contractor's cost, which shall be included proportionally in all items of payment or contained in any Base Bid or Unit Price on the Proposal. Tests and Inspections are to include those specifically required by this section and within technical sections of the Project Manual.

B. The Quality Control Agent shall submit a Testing and Inspection Plan to the Professional for its approval, and the approval of the Quality Assurance agent for all tests and inspections required by this section and within technical sections of the Project Manual.

C. Quality Control Services by a Quality Control Agency or Agencies is intended to assist in the determination of probable compliance of the work with requirements specified or indicated and do not relieve the Contractor of the responsibility for compliance with Contract Document requirements.

D. Specific testing or inspections of a structural nature required to be performed by independent Quality Control Agencies for individual construction activities are specified in this Section only. If testing or inspection requirements appear in this section and a technical section, the most stringent requirements shall prevail. If Quality Control Testing or Inspection is specified in a technical section and not in this section, it shall be required as if specified in this section. Non-structural tests and inspections are in the technical specifications.

E. Inspections, tests and related actions specified are not intended to limit the Contractor's quality control procedures that facilitate compliance with Contract Documents requirements.

F. Quality Control Services required by the local municipality or other governing authorities are the responsibility of the Contractor, regardless of whether or not specified hereinafter or in the applicable specification section.

G. Each prime Contractor will pay for all costs in connection with its Quality Control Services. Whenever the word "Contractor" is used it shall be interpreted to mean Prime Contractor or Contractors as applicable. All Contractors performing work for which testing or inspection is required by this section are required to perform said tests/inspections appropriate for the quantity of work performed as indicated by this specification section and as required by all Contract Documents.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 RESPONSIBILITIES AND DUTIES OF CONTRACTOR

A. The Contractor shall engage Quality Control Agencies to provide all Quality Control Services required to comply with the Contract Documents. These services shall be at no cost to the Department.

B. The Contractor is responsible for retesting where results of required inspections, tests or similar services prove unsatisfactory and indicate non-compliance with Contract Document requirements. Likewise, the Contractor is responsible for retesting when the Department's Quality Assurance Test results prove unsatisfactory. If Quality Assurance Tests were in error, the Contractor shall be reimbursed for his retesting costs.

C. Cost of retesting construction revised or replaced by the Contractor is the Contractor's responsibility.

D. Provide the Quality Control Agency with preliminary representative samples of materials to be tested in quantities requested. If the source, quality or characteristics of an approved material changes or indicates lack of compliance with Contract requirements, submit additional samples of materials to the Quality Control Agency.

E. When requested by the Professional, the Department, or the Quality Control Agency, the Contractor shall immediately provide reports, cutting lists, material bills, shipping bills, time and place of shipment of materials to shop and field and any relevant data on previous testing and investigations of materials.

F. Provide casual labor and facilities:

1. To provide access to the work inspected or tested by any authorized party.
2. To obtain and handle samples at the site.
3. To facilitate inspections and tests by the Quality Control Agency or Quality Assurance Agency.
4. For security and protection of samples and test equipment at the project site.

G. To facilitate the timely sequence of inspection and testing, the Contractor shall give advanced notification to the Quality Control Agency and the Department that work has progressed to a point where inspection and testing may proceed.

H. Contractor shall pay for additional cost of Quality Control Agency services which, in the opinion of the Professional and the Department, are required because of the following:

1. Failure of materials or workmanship to meet Contract requirements.
2. Materials or practices not complying with the technical specifications which could possibly result in defective and unacceptable work.
3. Changes in source, quality or characteristics of materials.
4. Site cured concrete cylinders requested by the Contractor.

I. The Quality Control Agency shall submit a certified written report of each inspection, test or similar service to the Design Professional, the Quality Assurance Agent, the Bureau of Construction Regional Director, Project Manager and Assistant Project Manager, and the Contractor, with additional copies directly to any governing authority when that authority so directs. All reports shall be uploader to e-Builder within 24 hours of when the inspection occurs, test is conducted, test results obtained or similar service was conducted.

J. Report Data: Written reports of each inspection, test or similar service shall include, but not be limited to:

1. Date of issue.
2. Project title and number.
3. Name, address and telephone number of testing agency.
4. Dates and location of samples and tests or inspections.
5. Names of individuals making the inspection or test.
6. Designation of the Work and test method.
7. Identification of product and specification section.
8. Complete inspection or test data.
9. Test results and an interpretation of test results.
10. Ambient conditions at the time of sample taking and testing.
11. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.
12. Name and signature of Quality Control Agency inspector.

K. The QC Agent shall cooperate in using standard forms/procedures developed by the Department that assist in accomplishing the tasks required.

L. Engage independent testing laboratories, whose employees assigned to the Project and tests performed comply with ASTM E 329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction. The testing laboratory must be accredited and audited by a qualified national authority. The Contractor is to submit the name and credentials of the proposed QC Agent to the Design Professional and the Department for acceptance.

M. Upon completion of inspection, testing, sample taking and similar activities, repair the damaged work and restore substrates and finishes to eliminate deficiencies, including deficiencies in the visual qualities of exposed finishes. Comply with the Contract Document requirements for "Cutting and Patching". Protect work exposed by or for Quality Control Testing activities, and protect repaired work.

N. All required testing/inspection, including that stated in the body of the technical specification sections (be it referenced in the technical specifications as “Quality Control”, “Quality Assurance”, or any other referenced testing and/or inspection) shall be performed by the Contractor, unless it explicitly states it shall be performed by the Department. If stated to be performed by the Department, the Contractor shall still be required to perform all necessary testing/inspection in advance of the Department to assure the work meets all the requirement of the contract documents.

O. Contractor shall coordinate closely with the Department, the Professional and the Professional’s QA Agencies and Consultants so that any required or desired QA testing can be performed concurrently or immediately after the Contractor’s QC testing.

3.2 RESPONSIBILITIES AND DUTIES OF QUALITY CONTROL AGENCIES

A. Quality Control Agencies engaged to perform inspections, sampling and testing of materials and construction shall cooperate with the Professional, the Quality Assurance Agent, the Department, the Department of Labor and Industry, and the Contractor in performance of its duties, and shall provide qualified personnel to perform required inspections and tests. If it is determined by the Department that the personnel provided are not qualified or are not working in the best interests of the Project for the tests performed, the Contractor, through their Quality Control Agent, shall immediately replace or supplement the subject personnel.

B. Quality Control Agencies shall notify the Department, the Quality Assurance Agent, the Professional, and the Contractor immediately of irregularities or deficiencies observed in the Work during performance of its services.

3.3 QUALITY CONTROL SERVICES TO BE PERFORMED

A. Testing and inspections by the Quality Control Agency or Agencies shall include, but are not limited to, the following list.

LIST OF TESTS AND INSPECTIONS

DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	QUANTITY OR FREQUENCY
EARTHWORK[1]		
Laboratory Compaction Characteristics of Soil Using Standard Effort	ASTM D698	One for each type and variation of cohesive soil to be compacted
Density of Soil and Soil-Aggregate In Place by Nuclear Methods	ASTM D6938	As often as required to ensure contract compliance
Inspect and comment on suitability of subgrades. Test footing excavations and paving subgrades regardless if it is native material or fill and record resultant foundation bearing capacity or compaction results as applicable.	N/A	As often as required to ensure the minimum required bearing capacity is present. Bearing Capacity tests must be witnessed and/or reviewed by the Department, Professional, Professional's Geotechnical Engineer or QA Agent.
Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill.	ASTM D6938	Continuous
CONCRETE		
Practice for Sampling Freshly Mixed Concrete. (5 cylinders/test) Perform air tests when sampling concrete. Perform slump tests and record temperature for all concrete deliveries. Compressive Strength of Cylindrical Concrete Specimens	ASTM C143, C1064, C231 or C173 or C138, C172, C31 C39	For each mix, 1 test for each day of concreting or for each 50cy, whichever is greater. For non-structural concrete, 1 test for each 100cy is adequate.
Inspection of bolts to be installed in concrete prior to and during placement of concrete, where allowable loads have been increased or where strength design is used	AWS D1.4; ACI 318: 3.5.2	
Inspection of concrete placement for proper application techniques	ACI 318: 5.9, 5.10	Continuous

DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	QUANTITY OR FREQUENCY
CONCRETE CONTINUED		
Verification of slump flow and VSI as delivered to the site for self-consolidating grout	ACI 530	Continuous
MASONRY		
Constructing and Testing Masonry Prisms Used to Determine Compliance with Specified Compressive Strength of Masonry (3 prisms/test)	ASTM C1314	1 Test
Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry, Annex A7 Compressive Strength (3 cylinders/test) (Contractor makes cylinders.)	ASTM C 780	1 Test/5000 units of masonry for each mortar type.
Sampling and Testing Grout (3 cubes/test) (Contractor makes cubes)	ASTM C1019	1 Test/25 CY grout.
Observation of any grout specimens and/or prisms	ACI 30.1/ASCE 6/TMS 602 Art 1.4	Continuous
STRUCTURAL STEEL		
High Strength Bolting	AISC ASD or LRFD M2.5	Comply with current requirements of RCSC
Liquid Penetrant Examination	ASTM E165	Test 15% of critical field welds using dye penetrant solvent removable method
Guide for Magnetic Particle Examination	*ASTM E709*	
Practice for Ultrasonic Contact Examination of Weldments	ASTM E164	
Guide for Radiographic Examination	ASTM E94	

Footnotes:

1. Refer to Earthwork Section for additional details.

END OF SECTION

SECTION 014010

QUALITY ASSURANCE TESTING AND INSPECTION SERVICES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 GENERAL

A. All testing and inspecting specifically called for and/or described in this section of the specifications are referred to as Quality Assurance Services and are the responsibility of the Quality Assurance Agency. Except as hereinafter specified, Quality Assurance Services will be performed without expense to the Contractor. The Quality Assurance Agency is an independent testing and inspecting agency engaged by the Department through the Professional. Testing required because of changes in materials or proportions at the request of the Contractor shall be at the Contractor's expense. The Professional may engage more than one Quality Assurance Agency to perform services. Whenever the word "Contractor" is used it shall be interpreted to mean Prime Contractor or Contractors as applicable.

B. Work Not Included: Quality Control Testing to be performed by the Contractor is specified in Section 014000.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.1 RESPONSIBILITIES AND DUTIES OF THE CONTRACTOR

A. The use of Quality Assurance Services shall in no way relieve the Contractor of its responsibility to furnish materials and construction in full compliance with the plans and specifications or to perform Quality Control Testing where specified.

B. To facilitate Quality Assurance Inspection or Testing, the Contractor shall:

1. Secure and deliver to the project site, without cost, representative samples of materials it proposes to use and which are required to be tested under Paragraph 3.4, ‘Tests and Inspections’.
2. Furnish such casual labor as is necessary to obtain and handle samples at the project or at other sources of material.
3. Provide means of safe access to work areas, provide conditions that allow testing and inspection to take place, provide materials for testing as requested, patch test sites when completed and furnish incidental labor and assistance necessary for inspectors of the Quality Assurance Agency to perform their tests and inspections.

3.2 AUTHORITY AND LIMITATIONS OF QUALITY ASSURANCE AGENCY

A. Personnel representing the Quality Assurance Agency will not act as foremen nor perform other duties for the Contractor.

B. Work will be checked as it progresses, but failure to detect any defective work or materials shall not in any way prevent later rejection when such defect is discovered, nor shall it obligate the Department or the Professional for final acceptance.

C. The Quality Assurance Agency is not authorized to revoke, alter, relax, enlarge, or release any requirements of the specifications, nor to approve or accept any portion of the work.

D. The Quality Assurance Agency shall report all test and inspection results to the Professional, the Department and the Contractor immediately after they are performed. Selection and frequency of tests shall be at the discretion of the Professional and the Department. All reports shall be uploader to e-Builder within 24 hours of when the inspection occurs, test is conducted, test results obtained or similar service was conducted.

E. Written reports of each inspection, test or similar service shall include but not be limited to:

1. Date of issue.
2. Project title and number.
3. Name, address and telephone number of testing agency.
4. Dates and location of samples and tests or inspections.
5. Names of individuals making the inspection or test.
6. Designation of the Work and test method.
7. Identification of product and specification section.
8. Complete inspection or test data.
9. Test results and an interpretation of test results.
10. Ambient conditions at the time of sample taking and testing.
11. Comments or professional opinion as to whether inspected or tested work complies with Contract Document requirements.
12. Name and signature of Quality Control Agency inspector.

F. When it appears that any material furnished or work performed by the Contractor fails to fulfill contract requirements, the Quality Assurance Agency shall report such deficiency to the Professional, the Department and the Contractor.

3.3 CONTRACTOR'S FAILURE TO MEET CONTRACT REQUIREMENTS

A. The Department and the Professional reserve the right to reject any items which do not meet the requirements of the plans and specifications and will require the contractor to replace these items and bear all expenses in connection with such replacements.

B. The Contractor shall pay all costs incurred in providing additional testing and/or analysis (including engineering fees) required because of deficient test results or construction not in compliance with requirements of the Contract Documents.

3.4 TESTS AND INSPECTIONS

A. Tests and inspections listed below may, at the discretion of the Professional and the Department, be performed by an independent Quality Assurance Agency engaged by the Department through the Professional, without expense to the Contractor. The Department reserves the right to change this list at any time.

SECTION 1

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
	CONCRETE		
IBC	1. Inspection of reinforcing steel, including prestressing tendons, and placement	ACI 318: 3.5, 7.1-7.7	1913.4
IBC	2. Inspection of bolts to be installed in concrete prior to and during placement of concrete, where allowable loads have been increased or where strength design is used	ACI 318: 8.1.3, 21.2.8	1911.5 1912.1
IBC	3. Inspection of anchors installed in hardened concrete	ACI 318: 3.8.6, 8.1.3, 21.2.8	1912.1
IBC	4. Verifying use of required design mix	ACI 318: Ch. 4, 5.2-5.4	1904.22, 1913.2, 1913.3
IBC	5. At the time fresh concrete is sampled to fabricate specimens for strength tests, perform slump and air content tests, determine the temperature of the concrete	ASTM C172, C31; ACI 318: 5.6, 5.8	
IBC	6. Inspection of concrete and shotcrete placement for proper application techniques	ACI 318: 5.9, 5.10	1913.6, 1913.7, 1913.8
IBC	7. Inspection for maintenance of specified curing temperature and techniques	ACI 318; 5.11-5.13	1913.9
DGS	Review Contractors' design mixes, Certificates of Compliance and material test reports		
DGS	Compressive Strength of Cylindrical Concrete Specimens[2]	ASTM C39	
	MASONRY		
DGS	Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry, Annex A7 Compressive Strength[6]	ASTM C780	
DGS	Method of Sampling and Testing Grout[6]	ASTM C1019	
	Level 1 Special Inspection		
IBC	1. Compliance with required inspection provisions of the construction documents and the approved submittals shall be verified.	Art. 1.5[5]	
IBC	2. Verification of f'_m and f'_{AAC} prior to construction except where specifically exempted by this code.	Art. 1.4B[5]	
IBC	3. Verification of slump flow and VSI as delivered to the site for self-consolidating grout.	Art. 1.5B.1.b.3[5]	

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
IBC	4. As masonry construction begins, the following shall be verified to ensure compliance: a. Proportions of site-prepared mortar b. Construction of mortar joint c. Location of reinforcement connectors, prestressing tendons and anchorages d. Prestressing technique e. Grade and size of prestressing tendons and anchorages	 Art 2.6A[5] Art 3.3B[5] Art 3.4, 3.6A[5] Art 3.6B[5] Art 2.4B, 2.4H[5]	
IBC	5. The inspection program shall verify: a. Size and location of structural elements b. Type, size and location of anchors, including other details of anchorage of masonry to structural members, frames or other construction. c. Specified size, grade and type of reinforcement, anchor bolts, prestressing tendons and anchorages. d. Welding of reinforcing bars e. Preparation, construction and protection of masonry during cold weather (temperature below 40°F) or hot weather (temperature above 90°F) f. Application and measurement of prestressing force	 Art 3.3F[5] Sec 1.2.2(e)[4], 1.16.1[4] Sec 1.15[4], Art 2.4, 3.4[5] Sec 2.1.9.7.2, 3.3.3.4(b)[4] Art 1.8C, 1.8D[5] Art 3.6B[5]	 Sec 2104.3, 2104.4
IBC	6. Prior to grouting, the following shall be verified to ensure compliance: a. Grout space is clean b. Placement of reinforcement and connectors and prestressing tendons and anchorages c. Proportions of site-prepared grout and prestressing grout for bonded tendons d. Construction of mortar joints	 Art 3.2D[5] Sec 1.13[4], Art 3.4[5] Art 2.6B[5] Art 3.3B[5]	
IBC	7. Grout placement shall be verified to ensure compliance with code and construction document provisions a. Grouting of prestressing bonded tendons	Art 3.5[5] Art 3.6C[5]	
IBC	8. Preparation of any required grout specimens, mortar specimens and/or prisms shall be observed	Art 1.4[5]	Sec 2105.2.2, 2105.3
	STEEL CONSTRUCTION		
IBC	1. Material verification of high-strength bolts, nuts, and washers: a. Identification markings to conform to ASTM standards spec in the approved CDs. b. Manufacturer's Certificate of Compliance required	AISC 360, Section A3.3 and applicable ASTM material standards	
IBC	2. Inspection of high-strength bolting: a. Snug-tight joints b. Pretensioned and slip-critical joints using turn-of-nut with matchmarking, twist-off bolt or direct tension indicator methods of installation. c. Pretensioned and slip-critical joints using turn-of-nut without matchmarking or calibrated wrench methods of installation (N/A; DGS requires twist-off bolt or direct tension indicator)	AISC 360, Section M2.5	1704.3.3

REQ'D BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
IBC	3. Material verification of structural steel and cold-formed steel deck: a. For structural steel, identification markings to conform to AISC 360 b. For other steel, identification markings to conform to ASTM standards specified in the approved CDs c. Manufacturer certified test reports	AISC 360, Section M5.5 Applicable ASTM material standards	
IBC	4. Material verification of weld filler materials: a. Identification markings to conform to AWS specification in the approved CDs b. Manufacturer's Certificate of Compliance required	AISC 360, Sect A3.5 and applicable AWS A5 documents	
IBC	5. Inspection of welding: a. Structural steel 1) Complete and partial penetration groove welds 2) Multi-Pass fillet welds 3) Single-pass fillet welds > 5/16" 4) Plug and slot welds 5) Single-pass fillet welds < 5/16" 6) Floor and deck welds	AWS D1.1	1704.3.1
IBC	6. Inspection of steel frame joint details for compliance with approved CDs: a. Details such as bracing and stiffening b. Member locations c. Application of joint details at each connection		1704.3.2
DGS	Liquid Penetrant Examination	ASTM E165	
DGS	Guide for Magnetic Particle Examination	ASTM E709	
DGS	Practice for Ultrasonic Contact Examination of Weldments	ASTM E164	
DGS	Guide for Radiographic Examination	ASTM E94	
	GENERAL OVERVIEW OF QC TESTING		
DGS	Review of Contractor QC Testing and Reports		

SECTION 2

REQD BY[1]	DESCRIPTION OF TEST OR INSPECTION	REFERENCED STANDARD	IBC REFER-ENCE[2]
	SOILS		
IBC	1. Verify materials below shallow foundations are adequate to achieve the design bearing capacity		1704.7
IBC	2. Verify excavations are extended to proper depth and have reached proper material		1704.7
IBC	3a. Perform testing of compacted fill materials	ASTM D6938	1704.7
	3b. Perform classification of proposed compacted fill		1704.7
	3d. Perform Standard Proctor testing of proposed compacted fill	ASTM D698	1704.7
IBC	4. Verify use of proper materials, densities and lift thicknesses during placement and compaction of compacted fill		1704.7
IBC	5. Prior to placement of compacted fill, observe subgrade and verify that site has been prepared properly		1704.7
	ENGINEERING SERVICES		
DGS	Review of Contractor QC Test Reports.		
DGS	Review of Contractor QC Soil Bearing Test Reports.		
DGS	On-site Engineering Consultation[7]		
DGS	Office Engineering Consultation[7]		
DGS	Hazardous Material Removal Air Monitoring		

Footnotes:

1. "DGS" are tests required by DGS and "IBC" are test required by Chapter 17 of the 2009 International Building Code.
2. IBC 2021.
3. Not used.
4. Refers to reference ACI 530/ASCE 5/TMS 402.
5. Refers to reference ACI 530.1/ASCE 6/TMS 602.
6. Concrete, mortar or grout molds are to be made by QA Agent under Special Inspection hours.
7. Principal(s) shall be Registered Professional Engineer(s). The Engineer making decisions and recommendations shall be a Registered Pennsylvania Professional Engineer.

END OF SECTION

SECTION 015000

TEMPORARY UTILITIES

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 - General Requirements” form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 TEMPORARY SERVICES DURING CONSTRUCTION

A. The designated Contractor shall install, operate, protect and maintain the temporary services, as hereinafter specified, during the construction of the entire Project.

B. Temporary connections to new and/or existing permanent service lines shall be made at the appropriate locations as determined by the designated Contractor, and coordinated with the Department, in conjunction with the Client Agency (as applicable). When the temporary service lines are no longer required, they shall be removed by the Contractor. Any part or parts of the permanent service lines, grounds and building, disturbed and damaged by the installation and/or removal of the temporary service lines, shall be restored to their original condition by the Contractor responsible for the temporary installation.

C. If the Contractor fails to carry out its responsibility in supplying temporary services as set forth in this Contract, it is responsible for such failure, and the Department may take such action as it deems proper for the protection and conduct of the work, and shall deduct the cost involved from the amount due the Contractor. Only those temporary utilities required for construction need to be extended to the work area(s).

D. Temporary utilities for Prime Contractors’ office trailers shall be arranged and paid for by each responsible Prime Contractor. The Lead Contractor shall arrange, provide, install, and pay for all temporary utilities required for the DGS Construction Project Manager’s office/ trailer.

1.3 TEMPORARY WATER SUPPLY

A. The Plumbing Contractor shall install, operate, protect and maintain an adequate water supply during the period of construction, by means of the permanent water supply line of the building. Water from Client Agency's existing water system is available for use without metering and without payment of use charges. Provide connections and extensions of services as required for construction operations. The temporary connections and extensions shall be in place within fifteen (15) days of any Prime Contractor’s written request for such services.

1.4 TEMPORARY HEAT

A. The temporary heat requirements on this Project are divided into two (2) categories: (1) temporary heat required prior to the enclosure of the building, buildings, or portions thereof; and (2) temporary heat required subsequent to the enclosure of the building, buildings or portions thereof.

B. A building or portion thereof shall be considered to be enclosed when (a) the roof is on and tight; (b) the exterior walls have been completed; and (c) when openings, doors and windows are closed with permanent closures, or with substantial temporary closures which will affect the retention of heat within the building or portion thereof.

C. Prior to enclosure of building, buildings or portions thereof, and when official local weather predictions indicate below freezing temperatures or temperatures that may damage the work, each Contractor shall provide, maintain, operate and pay all costs, including fuel, for a sufficient number of approved portable heaters, so that the progress of its work is not impeded, and

proper protection of its work from freezing is maintained. Self-contained oil/gas/propane-fired portable heaters, if used, must be vented to the outside of the enclosed structure. Unvented fuel-fired portable heaters may be used only when the building is not enclosed.

D. After the building, buildings or portions thereof are enclosed, and temporary heat is required for proper construction, the HVAC Contractor, at its own cost and expense, shall provide equipment and heating personnel for the temporary heat. The HVAC Contractor may, with the Department's and Client Agency's approval, utilize the permanent system or portions thereof, or may install temporary steam or hot water radiation or convectors or a combination of both. Use of the permanent systems for temporary heat shall not be permitted if it affects the warranty conditions or start date, in which case temporary heat shall be provided. The HVAC Contractor shall operate portable steam or hot water generating equipment for supply to permanent or temporary building heating facilities. The HVAC Contractor may install, operate, protect and maintain a temporary heating system through connections to existing steam or hot water lines

E. Temporary heating system, as hereinafter noted, shall be of sufficient capacity to heat the interior of the building to 60^0F when outside temperature is 0^0F. The interior temperature must be 60^0F or above at all times. This service shall be continued until the entire Project is completed, except as hereinafter noted.

F. Where electricians or plumbers are required to install, operate supervise or maintain equipment used in the provisions of temporary heat, the payment of the services of such material and personnel shall be the responsibility of the Electrical and the Plumbing Contractors respectively. It will be the responsibility of the Electrical and Plumbing Contractors to coordinate with the HVAC Contractor for temporary heat.

G. The Lead Contractor shall pay for all fuel and electricity for the temporary heat in conjunction with the operation of heating equipment for enclosed buildings, or enclosed portions thereof, unless provided by the Client Agency as noted above.

H. The Lead Contractor shall remove normal soot, smudges, and other deposits from walls, ceilings and exposed surfaces which are the result of the use of any temporary heating equipment after enclosure, including the use of the permanent heating system for temporary heating purposes. Finish work shall not start until all such surfaces are properly cleaned. Soot, etc. caused by equipment malfunction shall be removed by the responsible Contractor. Each Prime Contractor shall correct/replace any of their respective work that is identified by the Department or Professional as not meeting the project specifications as a result of the failure of any Prime Contractor to maintain or provide appropriate temporary heat, cooling, dehumidification, or ventilation in accordance with the contract requirements or the manufactures requirements. Each Prime Contractor will follow the requirements of the General Conditions regarding any disputes due to another Prime Contractor's failure to provide or maintain proper temporary heating, cooling, dehumidification, or ventilation of the conditioned space. Each Prime Contractor shall correct/replace any of their respective work that does not meet Contract requirements due to use of temporary heat.

I. All permanent heating equipment used to supply temporary heat shall be completely cleaned and reconditioned by the HVAC Contractor, in the presence of the Department personnel, prior to Final Acceptance. Cleaning of permanent HVAC ducts utilized for temporary heat shall be required. The HVAC Contractor should filter the return air at grilles, and wherever necessary to prevent dust accumulation. All permanent heating equipment, such as radiator trap seats and diaphragms, valve sets and discs, strainer internals or any other equipment found to be damaged due to being used for temporary heat shall be replaced. All replacements must be inspected by the Professional and accepted by the Department personnel. The HVAC Contractor shall pay for all replacement parts and labor.

J. The cost of temporary heat shall be made a part of the lump sum bid submitted by each Contractor, as applicable. The cost of temporary heat after enclosure shall be shown on the Contract Schedule of Values, to include the number of calendar days, cost per twenty-four (24) hour day and extended price. Any adjustment to the number of days of temporary heat, used

or not used, may be based on this unit price. Each Contractor shall include ***150*** calendar days of temporary heat after building enclosure, in its bid.

K. Temporary Ventilation and Temperature Control: The Lead Contractor shall provide electronic daily temperature/humidity readings equipment and log the conditions throughout the building to assure the proper and adequate temperature/humidity levels are recorded and maintained. The Lead Contractor shall provide the appropriate temporary ventilation, dehumidification, humidification or cooling equipment to assure the interior humidity/temperature levels are provided to meet all building finish requirements in accordance with the manufacture requirements.

1.5 CONSTRUCTION LIGHT AND POWER

A. The Electrical Contractor shall install, operate, protect and maintain the temporary service for construction light and power. The Contractor shall extend the temporary wiring throughout the project work areas, properly insulated and installed in accordance with Article 300 of the National Electrical Code. All wiring shall be installed by a licensed electrician.

B. The Electrical Contractor shall furnish this service within fifteen (15) days of any Prime Contractor's written request for such services. The service shall be sized to satisfy project requirements, but shall not be less than 200 amp, single-phase, 3-wire 120/240 volts, with fused safety switch protection required. Additional capacity in the form of other independent services and panels shall be provided as needed at required location throughout the site to meet the requirements of this section.

C. The Electrical Contractor shall extend electrical wiring into the building to provide adequate light and power, for the proper execution of the work. The Electrical Contractor shall also provide three-phase, 208 volt power service, if required. As construction progresses, it shall extend the temporary services to all areas where required, with a minimum of 100W incandescent equivalent light and duplex power outlets at 20 feet on center minimum, and at least in every room or space. The maximum size motor to be used at any power service shall be limited to 5 hp. Construction light and power provided shall fully comply with all provisions for this service of the National Electric Code and OSHA.

D. Where a service of a type other than that as herein mentioned is required, each Contractor requiring same shall provide such service and necessary equipment at its own expense.

E. The Electrical Contractor, prior to the installation of the permanent service, shall provide portable generators or shall extend a temporary service line to the site, and shall sign for the meter and pay all electrical connection costs.

F. The Electrical Contractor shall provide all transformers necessary to provide temporary power.

G. The Electrical Contractor shall provide all meters and/or submeters required and necessary to meter usage.

H. The Lead Contractor shall pay all electric consumption and associated costs for its use and that of all Prime Contractors, until Closeout Inspection occurs, and all items of work are certified to be complete.

1.6 WELDING

A. Any Contractor using electrical power for welding on the site shall use self-contained engine generating units.

B. Each Contractor shall provide necessary exhaust/ventilation/filtration to prevent accumulation of welding fumes and smoke generated by welding their operations.

C. Each Contractor shall have all precautions and protection in place while welding to assure no sparks cause fire or smoke damage to all surrounding areas; during and after all welding activities.

1.7 FIRE EXTINGUISHERS

A. Each Contractor shall provide UL listed, NFPA approved fire extinguishers, ten (10) lb. minimum, at the construction site during operations, suitable for all types of fires in accordance with OSHA.

1.8 INTERRUPTION OF SERVICES

A. Each Prime Contractor shall have all needed equipment and material to complete planned work at the site, prior to shutting down any system.

B. No additional compensation or time will be given to the Contractor, if work must be performed on State or National Holidays or on weekends or on overtime. See paragraph on 'Working Hours' under Section 010400.

1.9 SNOW/ICE REMOVAL

A. The Lead Contractor shall be responsible to provide snow removal and anti-skid material into to site and at the project site and indicated laydown areas (including construction trailer), unless directed otherwise.

B. All related work shall be performed to provide proper and safe access throughout the site subsequent to each related work day. Any delay and potential related costs generated by failure to meet this requirement shall be the responsibility of the Lead Contractor.

1.10 DEWATERING

A. Each Prime Contractor shall provide adequate attention, equipment and manpower to the project to assure the work area is dewatered as required to eliminate ponding, excessive water, depressions, etc. as affected by and for their work activities. Such action shall occur no later than 24 hours after a rain or water producing event. This effort shall be sustained for the time period necessary to bring the affected area back into conformance.

1.11 HOISTING FACILITIES

A. Each Prime Contractor must provide hoisting facilities for its own work. All hoisting facilities must comply with the safety regulations of the Department of Labor and Industry.

1.12 ELEVATORS AND STAIRS

A. Temporary Elevator Use: Use of elevator is not permitted. Elevator must remain available for Client Agency use throughout the project.

B. Temporary Stairs: Until permanent stairs are available, provide temporary stairs where ladders are not adequate.

i. Use of Client Agencies existing stairs at the south side of the building is not permitted during Sequence 1. Stairs must be maintained for means of egress.

ii. Contractors will be permitted to use stairs indicated for demolition during Sequence 1 if delay of demolition is permitted by schedule.

iii. Use of Client Agencies existing stairs at the south side of the building will be permitted for Sequence 2 work provided stairs are protected and finishes restored to new condition at time of Substantial Completion.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION

SECTION 01 91 00 – GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

B. Section includes general requirements that apply to the implementation of commissioning without regard to specific systems, assemblies, or components.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of this contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this section.

B. Specification 21 08 00 COMMISSIONING OF SPRINKLER SYSTEMS

C. Specification 22 08 00 COMMISSIONING OF PLUMBING

D. Specification 23 08 00 COMMISSIONING OF HVAC

E. Specification 26 08 00 COMMISSIONING OF ELECTRICAL

F. Specification 27 08 00 COMMISSIONING OF COMMUNICATIONS SYSTEMS (STRUCTURED CABLING, WIRED, WIRELESS, AND FIBER OPTIC SYSTEMS)

G. Specification 28 08 XX COMMISSIONING OF ELECTRONIC SYSTEMS WHERE XX=:
   1. 10 ELECTRONIC SAFETY AND SECURITY (ESS)
   2. 20 PERIMETER INTRUSION DETECTION SYSTEMS (PIDS)
   3. 30 AUDIO INTERCOM AND PAGING
   4. 40 VIDEO
   5. 50 PROGRAMMABLE LOGIC CONTROLLERS (PLC) OR PROGRAMMABLE AUTOMATION CONTROLLERS (PAC)
   6. 60 HUMAN MACHINE INTERFACE (HMI)
   7. 70 SUPERVISORY CONTROL AND DATA ACQUISITION (SCADA)
   8. 80 DISTRIBUTED CONTROL SYSTEMS (DCS)

H. DGS Commissioning Guide (latest edition)

1.3 REFERENCES

A. Conform all work to applicable standards and regulations. Refer to specific discipline reference materials as identified in related Specifications and manufacturer’s product literature. Standards and regulations include documents provided by:
   1. AABC Commissioning Group (ACG),
   2. American National Standards Institute (ANSI),

3. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE), www.ashrae.org
4. Associated Air Balance Council (AABC)
5. American Society of Testing and Measurement (ASTM), www.astm.org
6. Building Institute Construction Specifications Institute (BICSI)
7. Factory Mutual Global (FM), www.fmglobal.com
8. International Building Code (IBC)
9. International Code Council (ICC), www.iccsafe.org
10. International Energy Conservation Code (IECC)
11. National Electrical Code (NEC)
12. National Electrical Manufacturers Association (NEMA)
13. National Fire Protection Association (NFPA)
14. National Institute of Building Sciences (NIBS)
15. Pennsylvania Uniform Construction Code (UCC), www.dli.pa.gov
16. Underwriters Laboratories (UL)
17. Unified Facilities Criteria (UFC)
18. United States Department of Defense (USDoD)
19. United States Department of Energy (USDoE)
20. United States National CAD Standard, www.nationalcadstandard.org
21. Whole Building Design Guide (WBDG), www.wbdg.org

1.4 COMMISSIONING DESCRIPTION

A. This Section 019100 GENERAL COMMISSIONING REQUIREMENTS shall form the basis of the commissioning process and procedures. The Commissioning Agent shall add, modify, and refine the commissioning procedures, as approved by DGS, to suit field conditions and actual manufacturer's equipment, incorporate test data and procedure results, and provide detailed scheduling for all commissioning tasks.

B. Various sections of the project specifications require equipment start-up, testing, and adjusting services. Requirements for start-up, testing, and adjusting services specified in the Division 22, Division 23, and Division 26 or other sections of these specifications are intended to be provided in coordination with the commissioning services and are not intended to duplicate services. The Contractor shall coordinate the work required by individual specification sections with the commissioning services requirements specified herein.

C. Where individual testing, adjusting, or related services are required in the project specifications and not specifically required by this commissioning specification section, the specified services shall be provided and copies of documentation, as required by those specifications, shall be submitted to the Department and the Commissioning Agent to be indexed for future reference.

D. Where training or educational services for the Department are required and specified in other sections of the specification, these services are intended to be provided in addition to the training and educational services specified herein.

E. Commissioning is a systematic process of verifying that the building systems perform interactively according to the construction documents and the Department's operational needs. The commissioning process shall encompass and coordinate the system documentation, equipment start-up, control system calibration and adjustment, testing and balancing, performance testing, and training.

F. At the Commissioning Agent's discretion, an automated software system can be used to collect data and issue reports. If software is used, access to the project must be available to all members of the design and construction teams involved in the project.
   1. The Commissioning Agent is responsible to document all reports by exporting them from the specific software and uploaded to eBuilder in .pdf format.

G. Commissioning during the construction, acceptance, and warranty phases is intended to achieve the following specific objectives according to the contract documents:
   1. Verify that the applicable equipment and systems are installed in accordance with the contract documents and according to the manufacturer's recommendations.
   2. Verify that all equipment and system components are identified with labels and nameplates that reflect the unique tag names established for the project.
   3. Verify the functionality of individual systems and integrated systems.
   4. Verify and document proper integrated performance of equipment and systems.
   5. Verify that O&M documentation is complete.
      a. Verify that all O&M materials reference equipment tag names to allow easy location of appropriate information.
      b. Verify that draft O&M documentation, including installation instructions, is available and posted to e-Builder prior to pre-functional installation inspection.
      c. Verify that final O&M documentation is correct, complete, and posted to e-Builder prior to Final Inspection.
   6. Verify that all components requiring servicing can be accessed, serviced, and removed without disturbing nearby components including ducts, piping, cabling, or wiring.
   7. Verify that the Client Agency's operating personnel are adequately trained.
   8. Verify that the Client Agency's maintenance personnel are adequately trained.

H. The Commissioning Agent, in coordination with and assisted by the Prime Contractors, will document the successful achievement of the commissioning objectives listed above.
   1. Create and maintain a Commissioning Matrix spreadsheet that identifies every item to be commissioned by unique tag name and description and tracks performance of commissioning tasks for item. Commissioning tasks to be documented for each item include but are not limited to:
      a. Tag Name/ Number
      b. Equipment Name
      c. System
      d. Submittal Status
      e. Submittal Approval Date
      f. Final O&M Submittal Status
      g. Final O&M Submittal Approval Date
      h. Start-up Date
      i. Pre-functional Checklist Status
      j. Pre-functional Checklist Complete Date
      k. Functional Checklist Status
      l. Functional Checklist Complete Date
      m. Operation & Maintenance Training Date
      n. Warranty Start Date
      o. Deferred Seasonal Test Date
      p. 10-Month Warranty Inspection Date
      q. Notes

I. Commissioning does not relieve Prime Contractors of responsibility to provide a finished and fully functioning Project.

J. Commissioning Process Overview and General Order of Commissioning Tasks:
   1. Commissioning begins with initial commissioning kickoff meeting.
   2. Conduct progress commissioning meetings throughout construction to plan, scope, coordinate, schedule future activities, and to resolve problems.
   3. Equipment documentation is submitted to Commissioning Agent during normal submittals with detailed start-up procedures. Include manufacturer's installation instructions with submittals for all products to be commissioned.
   4. Commissioning Agent works with responsible Prime Contractor and equipment and system installation subcontractors to develop start-up plans, documentation formats, and verification checklists to be completed by installers and signed off by Commissioning Agent during verification check and start-up process.
      a. Commissioning Agent is responsible to customize plans, forms, and checklists based on the project technical specifications and submit them to the Design Professional for approval.
   5. In general, checkout and performance verification proceeds from simple to complex, that is, from component level to equipment to systems and intersystem levels, with component verification checklists being completed before functional testing.
   6. Equipment and system installers execute and document verification checklists and perform verification check and start-up.
      a. Commissioning Agent verifies that checklists and start-up were completed according to approved plans.
      b. Commissioning Agent then schedules a time to inspect each component to be commissioned with the installing contractor.
      c. Commissioning Agent will document any deficiencies in materials, installation, or coordination with other contractors for correction.
      d. Corrected work may be inspected the same day or at a later date as agreed upon with Prime Contractor.
   7. Commissioning Agent develops specific equipment and system functional performance test procedures.
      a. Equipment and system installers and Prime Contractor review procedures.
      b. Equipment and system installers execute procedures under direction of and documentation by Commissioning Agent.
      c. Items of noncompliance in material, installation, or setup are corrected at Prime Contractor's expense, and system is retested.
   8. Commissioning Agent reviews operation and maintenance documentation for correctness and completeness and incorporates same into Systems Manual.
   9. Functional testing is completed before the Final Inspection.
   10. Commissioning Agent reviews, approves, and coordinates training provided by equipment and system installers and verifies training was completed.
   11. Deferred testing is scheduled by the Commissioning Agent, included on the Master Project Schedule during construction by the Lead Contractor, and conducted as specified.

1.5 DEFINITIONS

A. The following is a list of definitions to be utilized with this specification. Other definitions defined in the General Conditions, Supplementary Conditions or Technical Specifications or other Contract Documents shall remain in effect.

1. ACCEPTANCE PHASE: Phase of construction after initial checkout when functional performance tests occur.
2. APPROVAL: Acceptance that a system or system component has been properly installed and is functioning in the tested modes according to the Contract Documents.
3. PROFESSIONAL/ARCHITECT/ENGINEER (A/E): The prime design consultant who comprises the design team along with their subconsultants.
4. BASIS OF DESIGN (BOD): The basis of design is the documentation of the primary thought processes and assumptions behind design decisions that were made to meet the design intent. The basis of design describes the systems, components, conditions, and methods chosen to meet the intent.
5. COMMISSIONING AGENT (CxA): An independent authority, not otherwise associated with the A/E team members or the Prime Contractor, though he/she may be hired as a subcontractor to them. The Commissioning Agent directs and coordinates the day-to-day commissioning activities. The Commissioning Agent does not take an oversight role.
6. COMMISSIONING PLAN: An overall plan, developed before or after bidding that provides the structure, schedule, and coordination planning for the commissioning process.
7. CONSTRUCTION CHECKLIST (CC): A list of items to inspect and elementary component tests to conduct to verify proper installation, provided by the Commissioning Agent to the Subcontractors. Construction checklists are primarily static inspections. The word construction refers to before functional testing. This may also be called the Pre-functional Checklist
8. CONTRACT DOCUMENTS: The documents binding on parties involved in the construction of this Project (Drawings, Specifications, Change Orders, Amendments, other Contracts, Commissioning plans, etc.) as defined in the General Conditions of the Contract.
9. CONTRACTOR: The Contractor or their authorized representative generally refers to all the Contractor's subcontractors as well.
10. DEFICIENCY: A condition in the installation or function of a component or system that is not in compliance or conformance with the Contract Documents
11. DESIGN INTENT: A dynamic document that provides the explanation of the ideas, concepts, and criteria that are considered to be very important to the Department. It is initially the outcome of the programming and conceptual design phases.
12. FACTORY TESTING: Testing of a component or system at the factory by factory personnel with a Project Manager present
13. FINAL ACCEPTANCE: The date when all systems, components, and equipment are completed including all punch list items, deferred testing, and resolution of all outstanding issues.
14. FINAL INSPECTION: A review of the Work conducted by the Professional, when requested by the Contractor, to determine whether the Project is substantially complete. If, as a result of this inspection, the Work is determined to be substantially complete, the Professional generates a certificate of completion and a Punch List of uncompleted items and a reasonable cost of completion.
15. INSTALLING CONTRACTOR/SUBCONTRACTOR: Contractor/Subcontractor who installs specific component and/or systems.
16. MANUAL TEST: Using hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the “observation”)
17. DEPARTMENT-CONTRACTED TESTS: Tests paid for by the Department outside the Prime Contractor's Contract and for which the Commissioning Agent does not oversee. These tests will not be repeated during functional tests if properly documented.

18. PHASED COMMISSIONING: Commissioning that is completed in phases due to the size of the structure or other scheduling issues, in order minimize the total construction time
19. PROJECT DESIGN CRITERIA (PDC or DC): The single source of design documentation for the project during the schematic and design development stages. Created and maintained by the Design Professional and its consultants, the DC serves as the primary way for the Professional to communicate the design intent to the Department providing a common reference for analysis, evaluation, and cost monitoring during planning and early design stages in lieu of design narratives.
20. SAMPLING: Functionally testing only a fraction of the total number of identical or near-identical components.
21. SEASONAL PERFORMANCE TESTS: Functional Tests that are deferred until the system(s) will experience conditions closer to their design conditions.
22. SIMULATED CONDITION: Condition that is created for the purpose of testing the response of a system.
23. SITE ACCEPTANCE TESTING (SAT): Similar to Factory Acceptance Testing, however performed on site. This type of testing may be suitable for commodity components that are relatively easy to replace if defective. SAT testing may also be used when new systems have few dependencies upon other site systems such as communications or IT connectivity.
24. SPECIFICATIONS: The construction specifications of the Contract Documents.
25. START-UP DATE: The date the equipment was fully connected and was initially energized to confirm operation. The system the equipment is connected to does not need to be operational at the time of start-up.
26. SUBCONTRACTORS: The companies hired by the Prime Contractors who provide building components and systems.
27. TEST PROCEDURES: The step-by-step process that must be executed to fulfill the test requirements. The Commissioning Agent shall develop the test procedures.
28. TEST REQUIREMENTS: Requirements specifying what modes and functions, etc. shall be tested. The test requirements are not the detailed test procedures. The test requirements for each system are specified in the respective section of the Contract Documents.
29. VENDOR: Supplier of equipment.
30. WARRANTY PERIOD: Warranty period for entire project, including equipment components. Warranty begins at the date of Final Acceptance of the Work and extends for at least one year, unless specifically noted otherwise in the Contract Documents and accepted submittals.

1.6 COMMISSIONING SERVICES

A. Commissioning Agent hired for this project is:
   1. Aramark Engineering Solutions
   2. 2400 Market Street, Philadelphia PA 19103
   3. 215.238.3000
   4. Charles DiFazio
   5. difazio-charles@aramark.com
   6. 612.545.7511

1.7 COMMISSIONING TEAM

A. The Commissioning Team will be comprised of the members appointed by Prime Contractors with commissioning responsibility and members appointed by DGS.

B. Members Appointed by Prime Contractors:
   1. The commissioning team shall consist of, but not be limited to, the representatives of the Contractor, including Project Superintendent and subcontractors, installers, suppliers, and manufacturers' representatives. Team members must have the authority to act on behalf of the entity he or she represents.
   2. Each Prime Contractor with commissioning responsibility shall identify a qualified primary point of contact (POC) for each system to be commissioned.

C. Members Appointed by DGS:
   1. Commissioning Agent: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. DGS will engage the Commissioning Agent under a separate contract.
   2. Client Agency (CA) Staff: Representatives of the facility user and operation and maintenance personnel.
   3. Department of General Services (DGS) Representative
   4. Design Professional
   5. If applicable, the Construction Manager (CM).

1.8 DGS REPRESENTATIVE RESPONSIBILITIES

A. The DGS Representative shall represent DGS during the commissioning process as follows:
   1. Assist in coordinating the A/E, Commissioning Agent, CM and Prime Contractors.
   2. Provide the Construction Documents, prepared by the Design Professional and approved by Department, to the Commissioning Agent for use in directing the commissioning process, developing the commissioning plan, systems manuals, and reviewing the operation and maintenance training plan.
   3. Arrange for facility operating and maintenance personnel to attend various field commissioning activities and field training sessions according to the Commissioning Plan.
   4. Provide final approval for the completion of the commissioning work by reviewing work products and coordinating technical reviews with Design Professional and DGS SMEs as required.
   5. Ensure that any seasonal or deferred testing is conducted and any deficiency issues are addressed.
   6. Attend commissioning meetings and additional meetings as necessary.
   7. Ensure the Cx Team executes the Commissioning Plan.
   8. Coordinate resolution of design non-conformance and design deficiencies identified during construction.
   9. Review Commissioning Agent insurance certificates.
   10. Evaluate Commissioning Agent progress reports.
   11. Approve Commissioning Agent pay applications based upon completed deliverables.

1.9 DESIGN PROFESSIONAL AND SUBCONSULTANT RESPONSIBILITIES

A. The Design Professional and their subconsultants responsible for systems to be commissioned shall participate in and perform commissioning process activities including, but not limited to, the following:
   1. Attend the commissioning kickoff meeting and selected commissioning team meetings as deemed necessary by the Commissioning Agent and DGS.

2. Perform normal submittal review, construction observation, as-built and record drawing preparation, O&M manual preparation, and other scope tasks as contracted.
3. Provide any design narrative and sequence information requested by the Commissioning Agent.
    a. The Design Professional shall clarify the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures..
4. Coordinate resolution of system deficiencies identified during commissioning, according to the contract documents.
5. Prepare and submit final as-built design intent documentation, project design criteria (DC), record drawings, and control sequences for inclusion in the O&M manuals.
6. Review and approve the O&M manuals.
7. Participate in the resolution of non-compliance, non-conformance and design deficiencies identified during commissioning during warranty-period commissioning.

1.10 PRIME CONTRACTOR RESPONSIBILITIES

A. Prime Contractors shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
    1. Follow the Commissioning Plan.
    2. Review commissioning progress and deficiency reports.
    3. Evaluate performance deficiencies identified in test and observation reports and provide corrective action.
    4. Cooperate with the Commissioning Agent for resolution of issues recorded in the Issues Log.
    5. Attend commissioning team meetings and additional meetings as necessary.
    6. Integrate and coordinate commissioning process activities with construction schedule.
    7. Provide schedule for operation and maintenance data submittals, equipment start-up, and testing to Commissioning Agent for incorporation into the commissioning plan. Update schedule on a bi-weekly basis throughout the construction period.
    8. Review and accept construction checklists provided by the Commissioning Agent.
    9. Complete paper or electronic construction checklists as Work is completed and provide to the Commissioning Agent when complete.
    10. Complete start-up checklists incorporating required information including:
        a. The unique tag number for the equipment being started.
        b. Photographs of the installed equipment showing maintenance clearance and equipment name plate.
        c. The serial number for each specific piece of equipment.
    11. Review and accept commissioning process test procedures provided by the Commissioning Agent.
    12. Complete commissioning process test procedures.
    13. Include the cost of commissioning in the total contract price. Include all costs of testing to be performed.
    14. Generate the O&M training plan and systems manual and furnish to Commissioning Agent for comments.
    15. Provide training to CA personnel and provide the times and dates of training to the Commissioning Agent for coordination.
    16. Provide a list of final settings, setpoints, ranges, schedules, and / or trend logs required by the Commissioning Agent.

17. From the red-line drawings, edit and update one-line diagrams developed as part of the design narrative documentation and those provided by the vendor as shop drawings for all systems to be commissioned.
18. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of DGS to keep warranties in force.
19. Provide all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price, except for stand-alone data logging equipment that may be used by the Commissioning Agent.
20. Provide all calibrated testing equipment, gauges, meters, etc. required for Commissioning. Calibration to be by a third party testing laboratory within 12 months of test.
21. Provide information requested by Commissioning Agent regarding equipment sequence of operation and testing procedures.
22. Review test procedures for equipment installed by factory representatives.
23. Execute seasonal or deferred functional performance testing witnessed by the Commissioning Agent to facilitate the Cx process.
24. Provide an authorized representative at the 10 month warranty review to assist with equipment operation and functional testing as required.
25. Provide all utilities needed by the Commissioning Agent to perform all tests.
26. Provide access, including scaffolding, lifts, ladders, and other means as required for Commissioning Agent to inspect, test, and review installed materials.

1.11 EQUIPMENT SUPPLIER

A. The equipment suppliers shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
   1. Provide all requested submittal data, including detailed start-up procedures and specific responsibilities of the DGS to keep warranties in force.
   2. Assist in equipment testing as required.
   3. Provide all special tools and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment according to these Contract Documents in the base bid price, except for stand-alone data logging equipment that may be used by the Commissioning Agent.
   4. Analyze specified products and verify that the Design Professional has specified the newest, most updated, and proven equipment reasonable for this project's scope and budget.
   5. Provide information requested by Commissioning Agent regarding equipment sequence of operation and testing procedures.
   6. Review test procedures for equipment installed by factory representatives.
   7. Follow the Commissioning Plan.
   8. Attend commissioning meetings and additional meetings as necessary.

1.12 COMMISSIONING AGENT RESPONSIBILITIES

A. The Commissioning Agent is not responsible for design concept, design criteria, compliance with codes, design or general construction scheduling, cost estimating, or construction management.
   1. The Commissioning Agent may assist with problem-solving non-conformance or deficiencies of work or materials, but ultimately that responsibility resides with the Prime Contractor and the Design Professional.

2. The primary role of the Commissioning Agent is to develop and coordinate the execution of a testing plan, observe, and document performance to verify that systems are functioning in accordance with the documented design intent and in accordance with the Contract Documents.
3. The Prime Contractors will provide all tools or the use of tools to start, check-out and functionally test equipment and systems, except for specified testing with portable data-loggers, which shall be supplied and installed by the Commissioning Agent.

B. Coordinate and direct the commissioning activities using consistent protocols and forms, centralized documentation, clear and regular communications, and consultations with all necessary parties, schedules, and technical expertise.
   1. Upload all documentation to e-Builder.

C. Coordinate the commissioning work and ensure that commissioning activities are being scheduled into the master schedule.

D. Revise, as necessary, the Commissioning Plan. Upload latest plan upon revision to e-Builder and inform Cx Team of the revision.

E. Plan and conduct commissioning meetings.
   1. Commissioning Agent will schedule meetings, prepare agenda and meeting minutes with copies for participants, and preside at meetings.
      a. Initial Commissioning Meeting:
         1) Commissioning Agent will schedule meeting after coordination with DGS.
         2) Attendance Required: Commissioning Agent, DGS, CA facility operating personnel, Design Professional, Prime Contractors, Subcontractors, and testing, adjusting, and balancing agency. Require attendance by installers of all equipment and systems indicated to be commissioned.
         3) Agenda:
            a) Designation of personnel representing parties for commissioning activities.
            b) Review commissioning process and responsibilities.
            c) Review commissioning plan implementation procedures.
            d) Review required commissioning submittals.
         4) Present initial commissioning schedule.
      b. Progress Commissioning Meetings:
         1) Commissioning Agent will schedule meetings throughout progress of the Work at monthly or more frequent intervals.
         2) Beginning three months before Final Inspection, meetings will be scheduled at bi-weekly or more frequent intervals.
         3) Attendance Required: As specified for initial commissioning meeting.
         4) Agenda:
            a) Coordination of commissioning activities.
            b) Commissioning deficiency resolution.
            c) Commissioning schedule.
            d) Planning for future commissioning activities.

F. Review and comment on Prime Contractor submittals applicable to systems being commissioned for compliance with functionality performance requirements and commissioning needs, concurrent with the A/E reviews.

G. Request and review additional information required to perform commissioning tasks, including O&M materials, contractor start-up and checkout procedures.

H. Before start-up, gather and review the current control sequences and interlocks and work with Prime Contractors and Design Professional until sufficient clarity has been obtained, in writing, to be able to write detailed testing procedures.

I. Provide pre-functional tests and checklists to the Prime Contractor.

J. Perform site visits, as necessary, to observe component and system installations.
   1. Coordinate schedule for inspections with master project schedule.
   2. Report out schedule progress and updates at every biweekly construction job conference once installations have begun and until final acceptance of commissioned systems.
   3. Attend selected planning and job-site meetings to obtain information on construction progress.
   4. Review construction meeting minutes for revisions/substitutions relating to the commissioning process. Assist in resolving any discrepancies.
   5. Identify work status in Commissioning Matrix and include in monthly reports.

K. With necessary assistance and review from installing contractors, write the functional performance test procedures for equipment and systems. This may include the need to perform stand-alone data logger monitoring, data trending, or manual functional testing. Submit to DGS and Design Professional for review and approval prior to execution.

L. Analyze any functional performance trend logs and monitoring data to verify performance.
   1. Require re-test of any systems that show discontinuous or erroneous data.
   2. Require remediation of any system malfunction.

M. Coordinate, witness, and approve manual functional performance tests performed by installing contractors. Coordinate retesting as necessary until satisfactory performance is achieved.

N. Witness and document static tests of systems performed by Contractors during the course of construction. These include NETA, testing, hydrostatic testing, pneumatic testing, TAB process, duct leakage testing, etc. Tests will be performed by the installing contractors. Document test results and upload information to eBuilder for record.

O. Maintain a master deficiency and resolution log and a separate testing record. Provide DGS with written progress reports and test results with recommended actions clearly identifying responsible Prime Contractor.

P. Review equipment warranties to ensure that DGS's responsibilities for O&M to comply with warranty requirements are clearly defined. Provide written statement of same.

Q. Review the O&M manual information provided by the prime contractors and approved by the Design Professional.

R. Review and approve training plans and materials prior to scheduling training. Oversee and approve the training of the DGS's operating and maintenance personnel. Provide documentation of review.

S. Compile and maintain systems manual and final system report.

T. Provide a final commissioning report.

U. Coordinate and supervise required seasonal or deferred testing and deficiency corrections.

V. Conduct Warranty Inspection
   1. Return to the site at 10 months into the 12-month warranty period and review with facility staff the current building operation and the condition of outstanding issues related to the original and seasonal commissioning.
   2. Interview facility staff and identify problems or concerns they have operating the building as originally intended.
   3. If available, review the trend data for each system and analyze the information to verify compliance with the final design.
   4. Make suggestions for improvements and for recording these changes in the O&M manuals.
   5. Identify areas that may come under product warranty or under the original construction contract warranty.
   6. Assist facility staff in developing reports and document request process for services to remedy outstanding problems.
   7. Document complete findings in a Warranty Inspection Report and publish as an addendum to the Final Cx Report.

W. The Commissioning Agent is referred to as an independent contractor in this Section and shall work under a separate contract directly for the Department. The Commissioning Agent shall not be financially associated with any of the Work of the Contractors or subcontractors on this project to avoid potential conflicts of interest

1.13 SYSTEMS TO BE COMMISSIONED

A. The following systems will be commissioned in this project:
   1. Building Protective Systems, including
      - Fire Suppression
      - Fire Alarm Systems
   2. Plumbing
      - Domestic Hot Water System
   3. HVAC
      - Air Handling Units
      - Rooftop Unit
      - Chiller Unit, including pumps
      - Boiler Unit, including pumps
      - Variable Air Volume Boxes
      - Exhaust Fans
      - Fin Tube and Duct Hot Water Heaters
   4. Electrical
      - Power Distribution Systems
      - Emergency Generators
        Interface with all other systems to be verified
      - Lighting and Controls.
      - Fire Alarm Systems.

1.14 COMMISSIONING DOCUMENTATION AND REPORTS

A. All reports and field documentation shall be uploaded by the Commissioning Agent to eBuilder to the appropriate folder in the "40 Commissioning" folder structure.

B. The Commissioning Agent will regularly communicate with all members of the commissioning team, keeping them apprised of commissioning progress and scheduling changes through memos, progress reports, etc.

C. Monthly Report: The Commissioning Agent will provide monthly reports to DGS. Reports to include at a minimum the following information:
   1. Commissioning Matrix with updated information.
   2. Issue and Resolution Log
   3. General project status

D. Commissioning Plan: A document, prepared by Commissioning Agent, that outlines the purpose, schedule, resources, and documentation requirements of the commissioning process, and shall include, but is not limited to the following:
   1. The Commissioning Process
      a. Identification of installed systems, sub-systems, and equipment through the Commissioning Matrix, including design changes that occurred during the construction phase.
      b. Identification of the process and schedule for documenting changes on a continuous basis.
      c. Identification of the process and schedule for completing prestart and start-up checklists for systems, sub-systems, and equipment to be verified and tested.
      d. Identification of the step-by-step procedures for testing systems, sub-systems, and equipment with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.
   2. Team Structure: A document prepared by the Commissioning Agent to be distributed to all team members identifying the following:
      a. Responsibilities of the team members
      b. Communication channels
   3. Project Documentation Review and Organization
      a. Plan for review of submittals, systems manuals, and other documents and reports, identification of the relationship of these documents to other functions, and a detailed description of submittals that are required to support the commissioning processes.
      b. Description of the organization, layout, and content of commissioning documentation (including systems manual) and a detailed description of documents to be provided along with identification of responsible parties.
      c. Identification of systems and equipment to be commissioned (Commissioning Matrix).
      d. Description of expected performance for systems, sub-systems, equipment, and controls.
   4. Project Schedule
      a. Description of schedules for testing procedures along with identification of parties involved in performing and verifying tests.
      b. Schedule for commissioning activities with specific dates coordinated with overall construction schedule.
      c. Identification of items that must be completed before the next operation can proceed.
   5. Reporting Samples

a. Sample of the Issue and Resolution Log to be utilized during Construction showing all deficiencies, dates they were discovered, responsible party to address the issue, date the issue was resolved, and a narrative describing what work was done to correct the issue.
b. Monthly reports identifying status of system installation and testing (Commissioning Matrix), a copy of the Issue and Resolution Log, and a narrative of what work is completed and tested.

6. Training Expectations
   a. Description of requirements for operation and maintenance training, including required training materials.

E. Commissioning Matrix
1. The Commissioning Matrix is a complete listing of products to be commissioned by the Cx Team.
2. The Commissioning Matrix includes unique tag naming for all system components that will be used in all communication reference and documentation preparation.
3. The Commissioning Matrix includes review, approval, attributes, and installation and testing status for all system components in a tabular format for quick referencing.
4. The Commissioning Matrix is to be included in the Commissioning Plan as well as an attachment to all progress reports.

F. Pre-functional Inspection Checklists
1. The Commissioning Agent will prepare Pre-functional Inspection Checklists that describe the minimum conditions necessary prior to testing.
2. The Contractor will provide an Equipment Start-Up data sheet prior to any pre-functional or functional testing is completed.

G. Functional Performance Test Procedures
1. The Commissioning Agent will develop Functional Performance Test Procedures for each system to be commissioned, including sub-systems, equipment, and interfaces or interlocks with other systems.
2. Functional Performance Test Procedures will include a separate entry, with space for comments, for each item to be tested.
3. Preliminary Functional Performance Test Procedures will be provided to DGS, Design Professional, and Contractor for review and comment.
4. The Functional Performance Test Procedure will include test procedures for each mode of operation and provide space to indicate whether the mode under test responded as required.
5. Each Functional Performance Test procedure, regardless of system, sub-system, or equipment being tested, shall include, but not be limited to, the following:
   a. Name and identification code of tested item.
   b. Test number.
   c. Time and date of test.
   d. Indication of whether the record is for a first test or retest following correction of a problem or issue.
   e. Dated signatures of the person performing test and of the witness, if applicable.
   f. Individuals present for test.
   g. Observations and Issues.
   h. Issue and Resolution Log number, if any, generated as the result of test.
6. The Commissioning Agent will record test data, observations, and measurements on Systems Functional Performance Test Procedure forms. Photographs, forms, and other means appropriate for the application shall be included with data.

7. Commissioning Agent shall compile test and inspection reports and certificates and include them in Systems Manual and Commissioning Report

H. Issue and Resolution Log: The Commissioning Agent will prepare and maintain an Issue and Resolution Log that describes Issues and Observations that are identified during the commissioning process. The Issue and Resolution Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and how the issue was resolved. The Issue and Resolution Log will track both unresolved and resolved issues and ultimately report in a single document all issues and resolutions through construction relating to the commissioning process.

I. Preliminary Commissioning Report:
   1. A Preliminary Commissioning Report shall be prepared that shows the commissioning progress and equipment performance to date at the time the Certificate of Occupancy is issued. All remaining items to be tested, inspected, or deferred must be identified in the Preliminary Commissioning Report.
   2. The Commissioning Agent will document results of the commissioning process, including unresolved issues, and performance of systems, sub-systems, and equipment.
   3. This report will be used by DGS when determining that systems will be accepted.
   4. This report will be used to evaluate systems, sub-systems, and equipment and will serve as a future reference document during Client Agency occupancy and operation. It shall describe components and performance that exceed requirements of the Contract Documents and those that do not meet requirements of the Contract Documents. It may also include a recommendation for accepting or rejecting systems, sub-systems, and equipment.
   5. The Preliminary Commissioning Report will indicate whether systems, sub-systems, and equipment have been completed and are performing according to the Contract Documents. The commissioning report will include, but is not limited to, the following:
      a. List of any explanations of substitutions, compromises, or variances with the Contract Documents, record of conditions, and, if appropriate, recommendations for resolution.
      b. Owner's Project Requirements prepared by the Design Professional.
      c. Design Narrative documentation prepared and maintained by the Design Professional.
      d. A copy of the Commissioning plan.
      e. System Readiness Checklists and Start-up Data Sheets completed by the Contractor, with annotation of the Commissioning Agent review and spot-check.
      f. Systems Functional Performance Test Procedures, with annotation of test results.
      g. Commissioning Issue and Resolution Log.
      h. Listing of deferred test(s) not performed, including the schedule for their completion.

J. Addendum to Final Commissioning Report: The Commissioning Agent will prepare an Addendum to the Final Commissioning Report near the end of the Warranty Period.
   1. The Addendum will indicate whether systems, sub-systems, and equipment are complete and continue to perform according to the Contract Documents.
   2. The Addendum to the Final Commissioning Report shall include, but is not limited to, the following:
      a. Documentation of deferred test(s) results.
      b. Completed Systems Functional Test Procedures for deferred test(s).
      c. Updated status of unresolved issues.
      d. Documentation of resolution for system performance issues.
      e. Updated Commissioning Issues Log.
      f. Identification of potential Warranty Claims to be corrected by the Contractor.

1.15 COMMISSIONING SUBMITTALS

A. Commissioning Agent will download copies of Contract Documents including Addenda, Change Orders, requests for interpretation and meeting minutes from eBuilder (eB).

B. Submission and Review Process:
   1. It is necessary for the Commissioning Agent to attend the IJC and identify to the Project Team, and the Design Professional in particular, which submittals are required to be routed to the Commissioning Agent for the commissioning process. Contractors will create submittals for each piece of equipment or system indicated to be commissioned.
   2. Identify each component with the unique name tag name as identified in Drawings or Specifications. Notify Design Professional of any components that do not have tag name.
   3. The Contractor will make submittals to the Design Professional via eB.
   4. Commissioning Agent will review submittals concurrent with Architect/Engineer.
   5. Commissioning Agent will review submittals for conformance to Project Design Criteria and the Contract Documents as related to commissioning process.
   6. Commissioning Agent will post submittal comments to Design Professional via eB.
   7. Commissioning Agent will iterate review cycle until submittal is approved and either all comments are addressed, or exception to requirements has been granted by DGS.
   8. Design Professional will incorporate Commissioning Agent review comments into submittal comments for return to contractors.
   9. Commissioning Agent will incorporate submittal information into pre-functional checklists and functional testing procedures.

C. Contractor shall furnish one copy of manufacturer's installation and operation manuals to Commissioning Agent for each piece of equipment or system indicated to be commissioned.
   1. Submit required manuals with submittals for each piece of equipment once systems are approved.

D. Contractor shall make additional submittals requested by Commissioning Agent for each piece of equipment or system indicated to be commissioned. Incorporate requested submittal information into related operation and maintenance manuals.

E. Contractor shall provide via e-Builder copies of verification check and start-up plan to Commissioning Agent for review and approval. Supplemental procedures and checklists will be prepared by the Commissioning Agent as required by the project for the Contractor to complete to document their installation and readiness for the installation verification inspection by Commissioning Agent. Include the following at minimum:
   1. Manufacturer's standard start-up procedures copied from installation manuals.
   2. Manufacturer's standard field checkout sheets.
   3. Sensor and actuator calibration procedures.
   4. Completed factory and field calibration results.
   5. Include boxes or lines for recording and documenting checking and inspections of each procedure and summary statement with signature block.

F. Contractor shall submit via e-Builder a written training plan to Commissioning Agent for review and approval prior to conducting training including the following:
   1. Equipment included in training session.
   2. Provide both operator and maintenance level training for all equipment for all shift personnel.
   3. Location of training.

4. Objectives.
5. Subjects covered.
6. Duration of training on each subject.
7. Instructor for each subject and a list of their current qualifications.
8. Instructional methods to be used.

1.16 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Contractor shall submit operation and maintenance manuals as specified in individual equipment and system specifications. Include the following:
   1. Manufacturer's printed, detailed installation and start-up, operating, troubleshooting, and maintenance procedures.
   2. Equipment performance curves.
   3. Wiring diagrams.
   4. Factory test reports.
   5. Full sequence of operation and control diagrams.
   6. Proposed testing, adjusting, and balancing procedures.
   7. Complete warranty information, identifying DGS responsibilities to keep warranty in force.
   8. A warranty certification if available from manufacturer, naming DGS as the warrantee.
   9. Lists of installation and checkout materials shipped with equipment.
   10. Manufacturer's field checkout forms to be used by factory or field technicians. Other documentation necessary for commissioning process.
   11. Identify equipment tag names on all submitted information as applicable.
   12. The Contractor will post all O&M submittal information to eBuilder.
   13. The Design Professional will review, and once approved, identify status to the Commissioning Agent for their use in downloading approved submittals for preparation of the System Manual.

B. Final Commissioning Report: Commissioning Agent will submit one copy of final commissioning report upon completion of all deferred testing and resolution of all outstanding issues and acceptance of the systems by the Design Professional and DGS including the following:
   1. Executive summary with list and roles of participants, brief Project description, overview of commissioning and testing scope, and general description of testing and verification methods.
   2. For Each Piece of Commissioned Equipment: Include statement regarding compliance with Contract Documents in the following areas:
      a. Equipment specifications.
      b. Equipment installation.
      c. Functional performance.
      d. Equipment documentation and design intent.
      e. Operator and maintenance training.
   3. Include brief description of verification method used as well as observations and conclusions from testing for each commissioned piece of equipment and system.
   4. Final Commissioning Report will include 10-month warranty inspection results as conducted post-construction.
      a. Provide positive documentation of correct functioning of all commissioned system components as evaluated by trend analysis, inspection, or repeated functional testing as required.

C. Systems Manual: The Commissioning Agent will gather required information and compile the Systems Manual. The Systems Manual will include, but is not limited to, the following:
   1. Owner's Project Requirements
   2. Design Narrative, including system narratives, schematics, single-line diagrams, flow diagrams, equipment schedules, and changes made throughout the Project.
   3. Construction record documents, approved submittals, completed startup data sheets, verification checklists, functional and performance checklists, verified sequence of operation, and training records.
   4. Reference to the Final Commissioning Report.
   5. Operation and maintenance data as specified in Division 01 Section "Operation and Maintenance Data."

D. Final Retrospective Report
   1. The Commissioning Agent will provide to DGS a Final Retrospective Report, focusing on evaluating commissioning process issues and identifying areas where the process could be improved.

1.17 SEQUENCING

A. Contractor and Commissioning Agent must work together to sequence the work to complete commissioning, except for functional testing and DGS's personnel training, before Final Inspection.

B. Perform commissioning services to expedite the testing process and minimize unnecessary delays, while not compromising the integrity of the procedures.

C. The Commissioning Agent shall coordinate directly with the Lead Contractor, other Prime Contractors, and subcontractor on the project specific to their responsibilities and contractual obligations. If the responsible party is a subcontractor, the Commissioning Agent shall disseminate written information to all parties relative to the nature and extent of the communication including the Prime Contractor and other Subcontractors.

D. The Commissioning Agent shall coordinate the schedule of commissioning activities with the construction schedule.

E. Contractor and Commissioning Agent must work together to sequence the work to achieve functional completion before Final Inspection. Complete the following for each piece of equipment and system indicated to be commissioned to achieve functional completion:
   1. Complete and sign start-up data sheets or verification checklist documentation.
   2. Submit trend log data (if required).
   3. Submit final approved inspection, test and balance, or other field issued reports for the equipment or system being commissioned.
   4. Complete functional testing.
   5. Complete training of DGS personnel.
   6. Submit approved operation and maintenance manuals.
   7. Correct identified deficiencies or obtain approval by DGS to exclude deficiencies from functional completion.

F. For equipment or systems requiring seasonal operation, perform commissioning for other season within six months of Final Inspection.

1.18 SCHEDULING

A. Contractor and Commissioning Agent must work together to schedule the work to allow adequate time for commissioning activities. Prime Contractor must add all work activities to the Critical Path Schedule used during construction and must obtain all necessary activity descriptions, durations, and logic from the Commissioning Agent prior to finalizing the overall construction schedule.

B. Contractor schedules and scheduling is the responsibility of the Prime Contractor. The Commissioning Agent shall provide commissioning scheduling information to the Department's Representative, Project Manager and Prime Contractor for review and planning activities.

C. Identify commissioning milestones, activities, and durations on Progress Schedule.
   1. Identify the following for each piece of equipment and system including:
      a. Operation and maintenance manual submittal.
      b. Verification check and start-up.
      c. Functional performance test.
      d. Functional completion.
      e. Demonstration and training sessions.
      f. Commissioning completion.

D. Testing of systems may proceed prior to completion of systems to expedite progress. However, the Commissioning Agent shall not schedule testing and checkout services that are the primary responsibility of the contractor/vendor in advance of their testing and checkout.

E. Open issues observed shall be addressed immediately, responsible parties notified, and corrective actions coordinated in a timely manner.

F. For Installation and Performance checkouts which occur in the acceptance procedures, the Commissioning Agent shall be available for up to two site visits to try and accomplish each checkout as part of the contract. Should additional work/site visits be required because systems are not ready or because they do not successfully pass test procedures after they have been indicated as ready, additional fees may be required. These additional fees shall be paid to the Commissioning Agent by the Department and shall be reimbursed by the Prime Contractor. These situations shall be carefully documented and reported to the Bureau of Construction team for authorization to proceed.

1.19 DELIVERABLES BY CONTRACTOR

A. Start-up Data Sheets: This information will include:
   1. The unique tag number for the equipment being started.
   2. Photographs of the installed equipment showing maintenance clearance and equipment name plate.
   3. The serial number for each specific piece of equipment.
   4. Full details of any required field testing
   5. Full factory testing reports

B. Detailed Manufacturer Installation and Start-up Procedure Manual.

C. Operation and Maintenance Manual including fan and pump curves.

D. Warranty information, including all responsibilities of DGS to keep the warranty in force clearly identified.

E. The installation and checkout materials that are actually shipped with the equipment.

F. The actual field Start-up Data Sheets used by the factory or field technicians completed and submitted to the Commissioning Agent.

G. The actual field Pre-functional Inspection Checklists used by the factory or field technicians completed and submitted to the Commissioning Agent

1.20 DELIVERABLES BY COMMISSIONING AGENT

A. Preliminary Construction Commissioning Plan Submittal: The Commissioning Agent will submit the Preliminary Construction Commissioning Plan by uploading a draft to eBuilder. Present submittal in sufficient detail to evaluate data collection and arrangement process. The submission will be reviewed and returned to the Commissioning Agent via eBuilder for the preparation of the final construction-phase commissioning plan.

B. Final Construction Commissioning Plan Submittal: The Commissioning Agent will submit, via eBuilder, the final commissioning plan. The final submittal must address previous review comments. The final submittal shall include a copy of the preliminary submittal review comments along with a response to each item.

C. Functional Test Procedures and Report Forms

D. System Readiness Checklists

E. Test and Inspection Reports

F. Issue and Resolution Log

G. Preliminary Commissioning Report Submittal

H. Addendums to the Final Commissioning Report

I. Final Commissioning Report Submittal: The Commissioning Agent will submit the final commissioning report via eBuilder. The final submittal must address previous review comments and shall include a copy of the preliminary commissioning report review comments along with a response to each item.

J. Systems Manual: The systems manual includes the project final OPR, BOD, construction record documents, submittals, completed startup, verification checklists, functional and performance checklists, verified sequence of operation, facility guide, training records, and commissioning report

K. Final Retrospective Report
   1. The Commissioning Agent will provide to DGS a Final Retrospective Report, focusing on evaluating commissioning process issues and identifying areas where the process could be improved.

PART 2 PRODUCTS

2.1 TEST EQUIPMENT

A. All industry standard test equipment required for performing the specified tests shall be provided by the appropriate party responsible for the testing and shall be approved by the Commissioning Agent. Any proprietary vendor specific test equipment shall be provided by that vendor or manufacturer.

B. Special equipment, tools, and instruments (only available from vendor, specific to a piece of equipment) required for testing equipment, according to these Contract Documents, shall be included in the base bid price to the Prime Contractor and left on site, except for stand-alone data logging equipment that may be used by the Commissioning Agent.

C. Temporary Data logging equipment and software required to test equipment shall be provided by the Commissioning Agent but shall not become the property of DGS.

D. The test equipment and instrumentation used in the commissioning process shall comply with the following:
   1. Be of sufficient quality and accuracy to test and/or measure system performance within the tolerances required.
   2. Be calibrated at the manufacturer's recommended intervals with calibration tags permanently affixed to the instrument. All test equipment must be calibrated within the past 12 months of the test date. Certificates of calibration shall be submitted prior to scheduling any testing.
   3. Be maintained in good repair and operating condition throughout the duration of use on this project.
   4. Be immediately re-calibrated or repaired if dropped and/or damaged in any way during use on this project.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify equipment and systems are installed according to individual Specification Sections, manufacturers recommendations, and installation instructions.

B. Verify utility and power connections are complete and services operational.

3.2 COMMISSIONING MEETINGS

A. Plan and conduct commissioning meetings.
   1. Commissioning Agent will schedule meetings, prepare agenda and meeting minutes with copies for participants, and preside at meetings.
      a. Initial Commissioning Meeting
      b. Progress Commissioning Meetings:

B. Attend all job construction meetings

1. Commissioning Agent shall attend regular job construction meetings to ensure proper coordination of efforts and verification that the systems are properly installed, operated, and tested, and are functioning correctly to meet the design intent.

3.3 START-UP PROCEDURES

A. The Contractor is to perform start-up and record all information on the approved start-up data sheets for each piece of equipment or system indicated to be commissioned.

B. The Contractor is to record completion of each procedure. Indicate results of start-up where required. Sign and date by individual performing procedure.

C. The Contractor is to identify items not completed successfully.

D. The Contractor is to submit executed start-up data sheet to Commissioning Agent within two days of completion.

E. Allow Commissioning Agent to witness verification check and start-up.
   1. Commissioning Agent will witness procedures for each piece of equipment. For multiple units, Commissioning Agent will witness procedures on 20 percent, but not less than four of each type unit. If these four units do not pass the verification process, 50% of the units will be verified. If there are deficiencies found during the review of 50% of the units, all units will be verified.

3.4 PRE-FUNCTIONAL INSPECTION CHECKLISTS

A. Pre-functional Inspection Checklists shall be completed and signed by the Contractor, verifying that systems, sub-systems, equipment, and associated controls are ready for testing.

B. The Commissioning Agent will spot check Pre-functional Inspection Checklists to verify accuracy and readiness for testing. Inaccurate Pre-functional Inspection Checklists shall be returned to the Contractor for correction and resubmission.

C. Deficiencies and Approvals:
   1. Commissioning Agent will review Start-up Data Sheets and issue deficiency report or approval.
   2. Contractor shall correct deficiencies and resubmit updated Start-up Data Sheet with statement indicating corrections made for Commissioning Agent approval.
   3. Repeat process until Start-up Data Sheets are approved.
   4. Costs for incomplete Start-up Data Sheet items that later cause deficiencies or delays during functional tests may be charged to party responsible for incomplete item.

3.5 FUNCTIONAL PERFORMANCE TEST PROCEDURES

A. Complete the following before performing functional tests:
   1. Pre-functional Inspection Checklist including Start-up Data Sheets
   2. Control system testing with approval by Commissioning Agent for use during test and balance operations.
   3. Air system balancing and water system balancing.

4. System cleaning, duct cleaning, coil cleaning, and any other remedial cleaning required by the specifications.
5. Pressure test, duct leak test, and any other component testing required by the specifications.

B. Notify Commissioning Agent of completion of start-up activities.

C. Commissioning Agent will direct, witness, and document results of functional performance tests.

D. Conduct functional performance tests as identified in the Commissioning Plan and associated commissioning documents.

E. Demonstrate that each piece of equipment and system is operating according to documented design intent and Contract Documents.
1. Conduct testing proceeding from components to sub-systems to systems.
2. Verify performance of individual components and systems.
3. Verify performance of interactions between systems.
4. Identify and correct areas of deficient performance.

F. Operate each piece of equipment and system through each specified mode of operation including seasonal, occupied, unoccupied, warm-up, cool-down, partial load, and full load conditions.
1. Verify each sequence in sequences of operation.
2. Test for proper responses to power failure, freezing, overheating, low oil pressure, no flow, equipment failure, fire alarm activation, alarms, trouble alerts, shutdown procedures, restarts, and other abnormal conditions.

3.6 FUNCTIONAL PERFORMANCE TEST METHODS

A. Perform testing and verification by using manual testing or by monitoring performance and analyzing results using control system trend log capabilities or by standalone data loggers as specified for each piece of equipment or system.
1. Commissioning Agent may require alternate or additional method other than specified method.
2. Commissioning Agent will determine test method when method is not specified.

B. Simulated Conditions: Simulating conditions, not by overwritten values, is permitted. Timing tests to use real conditions is encouraged wherever practical.

C. Overwritten Values: Overwriting sensor values to simulate conditions may be used with caution and avoided when possible.

D. Simulated Signals: Using signal generator to create simulated signals to test and calibrate transducers in automatic temperature controls is generally recommended instead of using sensors as signal generators with simulated conditions or overwritten values.

E. Altering Setpoints: Rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints to test specific sequence is acceptable. Reset setpoint after completing test.

F. Indirect Indicators: Using indirect indicators for responses or performance is permitted only after visually and directly verifying and documenting indirect readings through control system representing actual conditions and responses over tested parameter range.

G. Perform each function and test under conditions simulating actual conditions as close as is practically possible.
   1. Provide materials, system modifications, and other items or steps necessary to produce flows, pressures, temperatures, and other responses to execute test according to specified conditions.
   2. At completion of test, return modified equipment and systems to pretest condition.

H. Sampling: Multiple identical pieces of equipment or equipment with only small size or capacity differences may be functionally tested using sampling strategy when permitted by other Section according to following rules:
   1. Do not use sampling strategy for equipment with significant differences in application or sequence of operation differences.
   2. Refer to the technical commissioning specification sections for equipment sampling and failure rates.
   3. When frequent failures occur, Commissioning Agent may stop testing and require responsible party to perform and document checkout of remaining units, prior to continuing with functional performance testing.

3.7 DEFICIENCIES AND TEST APPROVALS

A. Issue and Resolution Log: The Commissioning Agent will prepare and maintain an Issue and Resolution Log that describes Issues and Observations that are identified during the commissioning process. The Issues Log will identify and track issues as they are encountered, the party responsible for resolution, progress toward resolution, and how the issue was resolved.
   1. Creating an Issues Log Entry:
      a. Identify the issue with unique numeric identifier by which the issue may be tracked.
      b. Identify the piece of equipment or system using the unique tag number.
      c. Assign a descriptive title of the issue.
      d. Identify date and time of the issue.
      e. Identify test number of test being performed at the time of the observation, if applicable, for cross-reference.
      f. Identify system, sub-system, and equipment to which the issue applies.
      g. Identify location of system, sub-system, and equipment.
      h. Include information that may be helpful in diagnosing or evaluating the issue.
      i. Identify commissioning team member responsible for corrective action.
      j. Identify expected date of correction.
      k. Identify person documenting the issue.
   2. Documenting Issue Resolution:
      a. Log date correction is completed or the issue is resolved.
      b. Describe corrective action or resolution taken. Include description of diagnostic steps taken to determine root cause of the issue, if any.
      c. Identify changes to the Contract Documents that may require action.
      d. State that correction was completed and system, sub-system, and equipment are ready for retest, if applicable.
      e. Identify person(s) who corrected or resolved the issue.
      f. Identify person(s) documenting the issue resolution.

B. Contractor is to provide written report to Commissioning Agent before each scheduled commissioning meeting concerning status of each issue. Include explanations of disagreements with resolution proposals for each issue.
   1. Commissioning Agent will retain original Issue and Observation Log until end of Project.

C. Test Approval: Commissioning Agent notes each satisfactorily demonstrated function on functional performance test form.
   1. Commissioning Agent recommends acceptance of each test to DGS using standard form.

D. Manufacturing Defects: When ten percent but not less than three identical pieces of equipment or equipment with only small size or capacity differences fail to perform to Contract Document requirements due to manufacturing defect, all identical units may be considered defective by DGS.
   1. Within one week of notice from DGS, examine all other identical units and record findings. Submit findings to DGS within two weeks of original notice.
   2. Within two weeks of original notification, provide signed and dated written explanation of problem, cause of defect, and proposed solutions meeting Contract Document requirements. Include equipment submittals supporting solution.
   3. DGS will determine whether replacement or repair of all identical units is required.
   4. Install two examples of proposed solution. DGS will test installations for up to one week before deciding solution is acceptable.
   5. Upon acceptance, replace or repair all identical items, at Prime Contractor's expense. Extend warranty accordingly when original equipment warranty had begun.
   6. Complete repairs or replacements with reasonable speed beginning within one week from when parts can be obtained.

3.8 RETESTING AND ADDITIONAL TESTS REQUIRED

A. Where testing indicates that performance requirements are not met, the Prime Contractor shall repair or replace the failed section(s) and a re-test shall be conducted. Any repairs should be conducted with inspection and documentation by the Prime Contractor and provided to the Commissioning Agent. The Commissioning Agent must witness all reinspection of failed tests.

3.9 DEMONSTRATION

A. Instructor Qualifications: Factory-authorized service representatives, experienced in training, operation, and maintenance procedures for installed systems, sub-systems, and equipment.

B. The Contractor shall provide training and demonstration as required by other Division 22, Division 23, Division 26, or other specification sections.
   1. The Training and Demonstration shall include, but is not limited to, the following:
      a. Review the Contract Documents.
      b. Review installed systems, sub-systems, and equipment.
      c. Review instructor qualifications.
      d. Review instructional methods and procedures.
      e. Review training module outlines and contents.
      f. Review course materials (including O & M Manuals and Systems Manual).
      g. Review and discuss locations and other facilities required for instruction.
   2. Review and finalize training schedule and verify availability of educational materials, instructors, audiovisual equipment, and facilities needed to avoid delays.

3. For instruction that must occur outside, review weather and forecasted weather conditions and procedures to follow if conditions are unfavorable.
4. All training and demonstrations must be recorded by the Contractor with both audio and video and delivered to DGS for future use.

C. Training Module Submittals: The Contractor shall submit the following information to DGS and the Commissioning Agent:
1. Instruction Program: Submit outline of instructional program for demonstration and training, including a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module. Once approved and prior to actual training, submit training manuals for Department's use.
2. Qualification Data: Submit qualifications for facilitator and/or instructor.
3. Attendance Record: For each training module, submit list of participants and length of instruction time.
4. Demonstration and Training Videotapes: Submit copies within seven days of end of each training module.
    a. Identification: On each copy, provide an applied label with the following information:
        1) Name of Project.
        2) Name and address of photographer
        3) Name of Contractor.
        4) Date videotape was recorded.
        5) Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

D. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participants are expected to master. For each module, include instruction for the following:
1. Basis of System Design, Operational Requirements, and Criteria: Include the following:
    a. System, sub-system, and equipment descriptions.
    b. Performance and design criteria if Contractor has delegated design responsibility.
    c. Operating standards.
    d. Regulatory requirements.
    e. Equipment function.
    f. Operating characteristics.
    g. Limiting conditions.
    h. Performance curves.
2. Documentation: Review the following items in detail:
    a. Emergency manuals.
    b. Operations manuals.
    c. Maintenance manuals.
    d. Project Record Documents.
    e. Identification systems.
    f. Warranties and bonds.
    g. Maintenance service agreements and similar continuing commitments.
3. Emergencies: Include the following, as applicable:
    a. Instructions on meaning of warnings, trouble indications, and error messages.
    b. Shutdown instructions for each type of emergency.
    c. Operating instructions for conditions outside of normal operating limits.

d. Sequences for electric or electronic systems.
e. Special operating instructions and procedures.

4. Operations: Include the following, as applicable:
   a. Start-up procedures.
   b. Equipment or system break-in procedures.
   c. Routine and normal operating instructions.
   d. Regulation and control procedures.
   e. Control sequences.
   f. Safety procedures.
   g. Normal shutdown instructions.
   h. Operating procedures for emergencies.
   i. Operating procedures for system, sub-system, or equipment failure.
   j. Seasonal and weekend operating instructions.
   k. Required sequences for electric or electronic systems.
   l. Special operating instructions and procedures.
5. Adjustments: Include the following:
   a. Alignments.
   b. Checking adjustments.
   c. Noise and vibration adjustments.
   d. Economy and efficiency adjustments.
6. Troubleshooting: Include the following:
   a. Diagnostic instructions.
   b. Test and inspection procedures.
7. Maintenance: Include the following:
   a. Inspection procedures.
   b. Types of cleaning agents to be used and methods of cleaning.
   c. List of cleaning agents and methods of cleaning detrimental to product.
   d. Procedures for routine cleaning
   e. Procedures for preventive maintenance.
   f. Procedures for routine maintenance.
   g. Instruction on use of special tools.
   h. All requirements necessary to maintain the warranty and keep it in force until the expiration date.
8. Repairs: Include the following:
   a. Diagnosis instructions.
   b. Repair instructions.
   c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
   d. Instructions for identifying parts and components.
   e. Review of spare parts needed for operation and maintenance.

E. Training Execution:
1. Preparation: Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a combined training manual. Set up instructional equipment at instruction location.
2. Instruction:
   a. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and DGS for number of participants, instruction times, and location.

b. Instructor: Engage qualified instructors to instruct Department's personnel to adjust, operate, and maintain systems, sub-systems, and equipment not part of a system.
    1) The Department will furnish the Contractor with names and positions of participants.
3. Scheduling: Provide instruction at mutually agreed times. For equipment that requires seasonal operation, provide similar instruction at start of each season. Schedule training with the Department and the Commissioning Agent with at least seven days' advance notice.
4. Evaluation: At conclusion of each training module, assess and document each participant's mastery of module by use of an oral, or a written, performance-based test.
5. Cleanup: Collect used and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

F. Demonstration and Training Recording:
1. General: Engage a qualified commercial videographer to record demonstration and training. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice. At beginning of each training module, record each chart containing learning objective and lesson outline.
2. Digital Format: Provide high-quality Thumb Drive.
3. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
4. Narration: Describe scenes on recording by audio narration by microphone while demonstration and training are recorded. Include description of items being viewed. Describe vantage point, indicating location, direction (by compass point), and elevation or story of construction.

END OF SECTION

SECTION 02 4113

SELECTIVE SITE CLEARING AND DEMOLITION

PART 1- GENERAL

1.01 STIPULATION

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. This Section includes the following:

1. Demolition and removal of utilities and fixtures.
2. Demolition of concrete curbs, sidewalks, asphalt pavement and aggregate base courses, trees, signs, and other structures shown to be removed on the drawings.
3. Abandoning in place or removing below-grade construction as identified on the drawings.
4. Disconnecting, capping or sealing, and abandoning in place or removing site utilities as identified on the drawings.
5. Saw-cutting pavement.
6. Disposal and/or recycling of demolished materials.
7. Tree and plant protection.

B. This section does not include demolition of buildings or other above-grade structures.

1.03 REFERENCES

A. The most current version of the publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by basic designation only.

B. The Contractor is required to have one copy of the latest edition of each of the following publications available for review in the job-site construction office at all times while performing the work described in this Section. The Contractor is to comply with each of the following unless more stringent requirements are indicated on the Drawings or within these specifications.

C. AMERICAN NATIONAL STANDARDS INSTITUTE

1. ANSI A10.6: Safety Requirements for Demolition Operations.

D. NATIONAL FIRE PROTECTION ASSOCIATION

1. NFPA 241: Standard for Safeguarding Construction, Alteration, and Demolition Operations.

1.04 SUBMITTALS

A. Pre-demolition digital Photographs (in JPG format, taken with a 4 mega-pixel digital camera with optical zoom) or Videotape/DVD: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by demolition operations. Submit before Work begins.

B. Schedule of Demolition Activities: Indicate the following:

1. Detailed sequence of demolition and removal work, with starting and ending dates for each activity.
2. Coordination for shutoff and capping of utility services.

C. Evidence of disposal and recycling contracts (for information only).

D. Record drawings of removed and abandoned utilities, indicating locations, sizes, materials, and elevations. Drawings shall be legible, drawn to scale, and contain sufficient information to locate abandoned utilities after excavations are backfilled.

1.05 QUALITY CONTROL

A. Regulatory Requirements: Comply with governing local, State, and Federal notification regulations before beginning demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

B. Standards: Comply with ANSI A10.6.

C. Tree Service Firm Qualifications: Engage an experienced tree service firm that has successfully completed temporary tree and plant protection work similar to that required for this Project and that will assign an experienced, qualified arborist to Project site during execution of the Work.

1.06 DEFINITIONS

A. Remove: Detach items from existing construction and legally dispose of them off-site unless indicated to be removed and salvaged or recycled.

B. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or recycled.

1.07 MATERIALS OWNERSHIP

A. Unless otherwise noted, all cleared or demolished materials shall become the General Contractor's property and shall be promptly removed from the site.

B. All salvage items identified as “To be removed & re-installed” or “TBR&R” shall be carefully removed in a manner as to maintain the condition and integrity of the item, stored and protected from damage, and reinstalled as part of the finished construction.

1.08 PROJECT CONDITIONS

A. Work on the site under other contracts may be concurrent with this contract. The Contractor shall coordinate the demolition sequence with all other contractors. The Contractor shall provide all temporary bracing, shoring, and supports that may be required to ensure the safety of personnel in areas of the site adjacent to the demolition area.

B. The Professional assumes no responsibility for site features shown to be demolished.

C. Conditions existing at time of inspection for bidding purposes will be maintained by Client Agency as far as practicable.

D. Storage or sale of removed items or materials on-site is not permitted.

1.09 COORDINATION

A. Arrange demolition schedule so as not to interfere with other contractor’s on-site operations.

B. Contact utility agency to arrange for shutoff of utilities prior to removal.

PART 2 - PRODUCTS

A. Tree Protection-Zone Fencing: Fencing fixed in position and meeting the following requirements. Previously used materials may be used when approved by University Project Manager.

1. Plastic Protection-Zone Fencing: Plastic construction fencing constructed of high-density extruded and stretched polyethylene fabric with 2-inch (50-mm) maximum opening in pattern and weighing a minimum of 0.4 lb/ft. (0.6 kg/m); remaining flexible from minus 60 to plus 200 deg F (minus 16 to plus 93 deg C); inert to most chemicals and acids; minimum tensile yield strength of 2000 psi (13.8 MPa) and ultimate tensile strength of 2680 psi (18.5 MPa); secured with plastic bands or galvanized-steel or stainless-steel wire ties; and supported by tubular or T-shape galvanized-steel posts spaced not more than 8 feet (2.4 m) apart.
2. Height: 4 feet.
3. Color: High Visibility orange.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Survey existing conditions and correlate with requirements indicated to determine extent of site demolition required.

B. Review Project Record Documents of existing construction provided by the Professional. The Contractor shall be come familiar with the Existing Conditions and Site Demolition drawings and the method of compilation of the existing base plan. The utilities shown on the project drawings are based on correspondence with Client Agency staff, field reconnaissance of visible existing structures, and project documents provided in both electronic and paper formats by both Client Agency and or the Department of General Services (DGS).

C. When unanticipated elements are encountered, investigate and measure the nature and extent of the element. Promptly notify the Professional and follow-up with a written report.

3.02 PREPARATION

A. Notify the Pennsylvania One-Call System at 1-800-242-1776 in accordance with Pennsylvania Act 287 and all amendments. Retain the services of a utility locator for identification of underground utilities on the Client Agency Campus property.

B. Pre-demolition Conference: Client Agency representative, DGS, the general contractor and all sub-contractors performing the work shall attend a conference at the Project site with the Professional to discuss the following:

1. Inspect and discuss condition of construction to be demolished.
2. Review and finalize demolition schedule and verify availability of demolition personnel, equipment, and facilities needed to make progress and avoid delays.
3. Erosion and Sediment Control Measures and inspections with the inspecting agency.
4.

C. Review and finalize protection requirements.

D. Arrange to discontinue utility service with utility companies and other agencies.

E. Obtain all required permits and post all required notifications prior to beginning the work.

F. Existing Utilities: Do not start demolition work until utility disconnection/de-energization have been completed and verified in writing.

G. Temporary Shoring: Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent unexpected movement or collapse of construction being demolished.

H. Strengthen or add new supports when required during progress of demolition.

3.03 SAW CUTTING

A. Saw-cut pavement at limits of removal where remaining pavement is to be incorporated into new work.

B. Street Pavement: Full depth saw cuts will be required where cutting utility trenches in the street and at the limits of full depth pavement removal. Full depth saw cuts shall be in accordance with PENNDOT procedures except as follows:

1. This work shall consist of saw cutting existing roadway pavement, full depth, with approved equipment at locations indicated on the drawings.

3.04 PROTECTION

A. Existing Facilities: Protect adjacent walkways, building entries, glass windows around the adjacent buildings, and other building facilities during demolition operations.

B. Temporary Protection: Erect temporary protection, such as walks, fences, railings, canopies, and covered passageways, where required by authorities having jurisdiction or as indicated.

C. Protect existing site appurtenances and landscaping which are to remain.

D. Provide temporary barricades and other protection required to prevent injury to people and damage to adjacent buildings and facilities which are to remain.

E. Provide protection to ensure safe passage of people and vehicles around demolition areas, and to and from occupied portions of adjacent buildings and structures.

3.05 GENERAL DEMOLITION

A. General: Demolish indicated site improvements completely. Use methods required to complete the Work within limitations of governing regulations.

B. Demolition work sequence to follow the drawings provided by the Professional.

C. Engineering Surveys: Perform regular engineering surveys of the entire work area as the Work progresses to detect hazards that may result from demolition activities. Maintain a written log of survey times, dates, and findings.

D. Site Access and Temporary Controls: Conduct demolition and debris-removal operations to ensure minimum interference with roads, streets, sidewalks, walkways, and other adjacent occupied and used facilities.

1. Do not close or obstruct streets, walks, walkways, or other adjacent occupied or used facilities without permission from the University and other authorities having jurisdiction. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.
2. Use water mist, dust control palliatives, and other suitable methods to limit spread of dust and dirt. Comply with governing environmental-protection regulations. Do not use water when it may damage adjacent construction or create hazardous or objectionable conditions, such as ice, flooding, contaminated runoff, and pollution.

3.06 EXPLOSIVE DEMOLITION

A. Explosives: Use of explosives is not permitted.

3.07 TREE REMOVAL

A. No trees shall be removed except as specifically directed by the Professional and indicated on the plans. Stumps are to be removed to a depth of 12 inches below finish grade and backfilled with clean earth fill. All debris is to be left in a clean and safe condition at the end of each working day.

3.08 TREE AND PLANT PROTECTION

A. Protection-Zone Fencing: Install protection-zone fencing along edges of protection zones before materials or equipment are brought on the site and construction operations begin in a manner that will prevent people and animals from easily entering protected area except by entrance gates. Construct fencing so as not to obstruct safe passage or visibility at vehicle intersections where fencing is located adjacent to pedestrian walkways or in close proximity to street intersections, drives, or other vehicular circulation.

1. Posts: Set or drive posts into ground one-third the total height of the fence without concrete footings. Where a post is located on existing paving or concrete to remain, provide appropriate means of post support acceptable to Client Agency and Consultant.
2. Post to be set in vertical plumb position with top of posts aligning with adjacent post where grades allow. Fence to be kept tight and neat.

B. Maintain protection zones free of weeds and trash.

C. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Consultant.

D. Maintain protection-zone fencing in good condition as acceptable to Consultant and remove when construction operations are complete and equipment has been removed from the site.

1. Do not remove protection-zone fencing, even temporarily, to allow deliveries or equipment access through the protection zone.

E. Root Pruning: Prune roots that are affected by temporary and permanent construction. Prune roots by hand and as directed by Contractor's Tree Service Firm as follows:

1. Cut roots manually by digging a trench and cutting exposed roots with sharp pruning instruments; do not break, tear, chop, or slant the cuts. Do not use a backhoe or other equipment that rips, tears, or pulls roots.
2. Cut Ends: Paint root ends as directed by Tree Service Firm. Coat cut ends of roots with an emulsified asphalt or other coating formulated for use on damaged plant tissues and that is acceptable to Tree Service Firm.

3. Temporarily support and protect roots from damage until they are permanently redirected and covered with soil.
4. Cover exposed roots with burlap and water regularly.
5. Backfill as soon as possible according to requirements in Section 312000 "Earth Moving."

F. Root Pruning at Edge of Protection Zone: Prune roots 12 inches outside of the protection zone, by cleanly cutting all roots to the depth of the required excavation.

G. Root Pruning within Protection Zone: Clear and excavate by hand to the depth of the required excavation to minimize damage to root systems. Use narrow-tine spading forks, comb soil to expose roots, and cleanly cut roots as close to excavation as possible.
1. Contractor's Tree Service Firm shall evaluate impacts of proposed construction on existing trees, identify root protection required, and supervise the pruning of tree roots. Where the Tree Service Firm determines that the stability of a tree would be compromised by proposed construction, the Contractor shall remove the tree and replace it with a 2.5" caliper trees of species approved by the Professional and at location approved by the Professional.

3.09 RESTORATION

A. Below-Grade Areas: Fill below-grade areas and voids resulting from utility demolition operations with satisfactory soil materials. Refer to section 31 2000 Earthwork for soil materials and compaction requirements.

3.10 REPAIRS

A. General: Promptly repair damage to adjacent construction.

B. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.

C. Restore exposed finishes of patched areas and extend restoration into adjoining construction in a manner that eliminates evidence of patching and refinishing.

3.11 RECYCLING DEMOLISHED MATERIALS

A. General: Separate recyclable demolished materials from other demolished materials to the maximum extent possible. Separate recyclable materials by type.

1. Provide containers or other storage method approved by the Professional for controlling recyclable materials until such materials are removed from Project site.
2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
3. Stockpile materials away from demolition area.
4. Store components off the ground and protect from the weather.
5. Transport recyclable materials off Client Agency's property to the recycling process facility.

B. Recycling Incentives: Revenues for recycling demolition materials shall accrue to the contractor unless otherwise noted in the Project Documents.

3.12 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials planned to be recycled, reused, or otherwise indicated to remain Client Agency's property, remove demolished materials from Project site and legally dispose of them in a permitted, regulated disposal facility.

1. Do not allow demolished materials to accumulate on-site.
2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
3.

B. Burning or burial: Do not burn or bury demolished materials unless otherwise specified.

C. Disposal: Transport demolished materials off Client Agency's property and legally dispose of them.

3.13 CLEANING

A. Clean adjacent structures, streets, sidewalks, and other pavement surfaces to remain free of dust, dirt, and debris caused by demolition operations. Return adjacent areas to condition existing before demolition operations began.

END OF SECTION

SECTION 02 4119

SELECTIVE DEMOLITION

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. This Section includes the following:

1. Demolition and removal of selected portions of the building (including HVAC, plumbing and electrical items).
2. Demolition and removal of selected site elements.

1.03 RELATED DOCUMENTS

A. Refer to Plumbing documents and Electrical documents for specific equipment to be removed and/or re-installed in the new work by other Prime Contractors.

1.04 DEFINITIONS

A. Remove: Remove and legally dispose of items except those indicated to be reinstalled, salvaged, or to remain the User's property.

B. Salvage, or Remove and Salvage: Items indicated to be removed and salvaged remain the Client Agency’s property. Remove, clean, and pack or crate items to protect against damage. Identify contents of containers and deliver to Client agency's designated storage area.

C. Remove and Reinstall: Remove items indicated; clean, service, and otherwise prepare them for reuse; store and protect against damage. Reinstall items in the same locations or in locations indicated.

D. Existing to Remain: Protect construction indicated to remain against damage and soiling during selective demolition. When permitted by the Professional, items may be removed to a suitable, protected storage location during selective demolition and then cleaned and reinstalled in their original locations.

1.05 MATERIALS OWNERSHIP

A. Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain the Client agency's property, demolished materials shall become the Contractor's property and shall be removed from the site with further disposition at the Contractor's option.

B. Carefully remove and salvage each item indicated to be re-used or salvaged in a manner to prevent damage and deliver promptly to the Client agency.

1.06 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections, for information only, unless otherwise indicated.

B. Schedule of selective demolition activities indicating the following:

1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity.
2. Interruption of utility services.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Use of elevator and stairs.
5. Detailed sequence of selective demolition and removal work to ensure uninterrupted progress of Client agency's on-site operations.
6. Coordination of Client agency's continuing occupancy of portions of existing building and of Client agency's partial occupancy of completed Work.
7. Locations of temporary partitions and means of egress.

C. Inventory of items to be removed and salvaged.

1.07 QUALITY CONTROL

A. Demolition Firm Qualifications: Engage an experienced firm that has successfully completed selective demolition Work similar to that indicated for this Project.

B. Regulatory Requirements: Comply with governing EPA notification regulations before starting selective demolition. Comply with hauling and disposal regulations of authorities having jurisdiction.

1.08 PROJECT CONDITIONS

A. Client agency assumes no responsibility for actual condition of buildings to be selectively demolished.

1. Conditions existing at time of inspection for bidding purpose will be maintained by Client agency as far as practical.

B. Hazardous Materials: Hazardous materials will be encountered in the Work; refer to the drawings for locations.

1. If materials suspected of containing hazardous materials are encountered, where not shown on the documents, do not disturb; immediately notify the Department. The Department will remove hazardous materials under a separate contract.

C. Storage or sale of removed items or materials on-site will not be permitted.

D. Utility Service: Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

E. Maintain fire-protection facilities in service during selective demolition operations.

1.09 WARRANTY

A. Existing Warranties: Remove, replace, patch, and repair materials and surfaces cut or damaged during selective demolition, by methods and with materials so as not to void existing warranties.

1.10 SCHEDULING

A. Arrange selective demolition schedule so as not to interfere with Client agency's on-site operations.

PART 2 - PRODUCTS

2.01 SCHEDULE OF ITEMS TO BE REMOVED AND REINSTALLED

A. NA

2.02 SCHEDULE OF ITEMS TO BE SALVAGED

A. Also refer to mechanical and electrical drawings and specifications.
   i. Chiller
   ii. Boilers
   iii. Disconnect Switches
   iv. MDF Breakers
   v. Refrigerator Condensing Units

2.03 SCHEDULE OF ITEMS TO REMAIN

A. Refer to selective demolition drawings.

2.04 MATERIALS

A. Fire Extinguishers: Portable, UL rated; with class and extinguishing agent as required by locations and classes of fire exposures.

B. Temporary Partitions: See 3.03.

2.05 REPAIR MATERIALS

A. Use repair materials identical to existing materials.

   1. Where identical materials are unavailable or cannot be used for exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.
   2. Use materials whose installed performance equals or surpasses that of existing materials.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Verify that utilities have been disconnected and capped.

B. Survey existing conditions and correlate with requirements indicated to determine extent of selective demolition required.

C. Inventory and record the condition of items to be removed and reinstalled and items to be removed and salvaged.

D. When unanticipated HVAC, electrical, or structural elements that conflict with the intended function or design are encountered, investigate and measure the nature and extent of the conflict. Promptly submit a written report to the Professional.

E. Survey the condition of the building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of the structure or adjacent structures during selective demolition.

F. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

3.02 UTILITY SERVICES

A. Maintain existing utilities indicated to remain in service and protect them against damage during selective demolition operations.

1. Do not interrupt existing utilities serving on-site occupied or operating facilities, except when authorized in writing by Client agency and authorities having jurisdiction. Provide temporary services during interruptions to existing utilities, as acceptable to Client agency and to governing authorities.

    a. Provide not less than 72 hours' notice to Client agency if shutdown of service is required during changeover.

B. Utility Requirements: Locate, identify, disconnect, and seal or cap off indicated utility services serving building to be selectively demolished.

1. Client agency will arrange to shut off indicated utilities when requested by Contractor.
2. Arrange to shut off indicated utilities with utility companies.
3. Where utility services are required to be removed, relocated, or abandoned, provide bypass connections to maintain continuity of service to other parts of the building before proceeding with selective demolition.
4. Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit after bypassing.

C. Utility Requirements: Refer to Division 22 and 26 Sections for shutting off, disconnecting, removing, and sealing or capping utility services. Do not start selective demolition work until utility disconnecting and sealing have been completed and verified in writing.

3.03 PREPARATION

A. Drain, purge, or otherwise remove, collect, and dispose of chemicals, gases, explosives, acids, flammables, or other dangerous materials before proceeding with selective demolition operations.

B. Employ a certified, licensed exterminator to treat building and to control rodents and vermin before and during selective demolition operations.

C. Conduct demolition operations to prevent injury to people and damage to existing spaces indicated to remain. Ensure safe passage of people around selective demolition area.

D. Erect and maintain dustproof partitions and temporary enclosures to limit dust and dirt migration and to separate areas from fumes and noise.

1. Construct dustproof partitions of not less than nominal 4-inch studs at 24" oc, 5/8-inch gypsum wallboard with joints taped on occupied side, and 1/2-inch fire-retardant plywood on the demolition side. R-13 batt insulation when building is not enclosed.
2. Seal joints and perimeter. Equip partitions with dustproof doors and security locks.
3. Protect air-handling equipment.
4. Weatherstrip openings.

E. Provide and maintain interior and exterior shoring, bracing, or structural support to preserve stability and prevent movement, settlement, or collapse of building to be selectively demolished.

1. Strengthen or add new supports when required during progress of selective demolition.

3.04 SELECTIVE DEMOLITION

A. Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete Work within limitations of governing regulations and as follows:

1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition work above each floor or tier before disturbing supporting members on lower levels.
2. Neatly cut openings and holes plumb, square, and true to dimensions required. Use cutting methods least likely to damage construction to remain or adjoining construction. To minimize disturbance of adjacent surfaces, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Temporarily cover openings to remain.
3. Cut or drill from the exposed or finished side into concealed surfaces to avoid marring existing finished surfaces.
4. Do not use cutting torches until work area is cleared of flammable materials. At concealed spaces, such as duct and pipe interiors, verify condition and contents of hidden space before starting flame-cutting operations. Maintain portable fire-suppression devices during flame-cutting operations.
5. Maintain adequate ventilation when using cutting torches.
6. Remove decayed, vermin-infested, or otherwise dangerous or unsuitable materials and promptly dispose of off-site.
7. Remove structural framing members and lower to ground by method suitable to avoid free fall and to prevent ground impact or dust generation.
8. Locate selective demolition equipment throughout the structure and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.
9. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level. Dispose of demolished items and materials promptly. On-site storage or sale of removed items is prohibited.
10. Return elements of construction and surfaces to remain to condition existing before start of selective demolition operations.

B. Remove resilient floor coverings and adhesive according to recommendations of the Resilient Floor Covering Institute's (RFCI) "Recommended Work Practices for the Removal of Resilient Floor Coverings" and Addendum.

1. Remove residual adhesive and prepare substrate for new floor coverings by one of the methods recommended by RFCI.

C. Remove roofing where noted on the drawings and provide temporary weather protection of the building as required. Existing roofing is under warranty; this warranty must be maintained during demo work as well as new construction work. See applicable Division 7 Section for new roofing requirements.

3.05 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in small sections. Cut concrete to a depth of at least 3/4 inch at junctures with construction to remain, using power-driven saw. Dislodge concrete from reinforcement at perimeter of areas being demolished, cut reinforcement, and then remove remainder of concrete indicated for selective demolition. Neatly trim openings to dimensions indicated.

B. Masonry: Demolish in small sections. Cut masonry at junctures with construction to remain, using power-driven saw, then remove masonry between saw cuts.

C. Concrete Slabs-on-Grade: Saw-cut perimeter of area to be demolished, then break up and remove.

D. Resilient Floor Coverings: Remove floor coverings and adhesive according to recommendations in RFCI-WP and its Addendum.

E. Roofing: Remove where required for new openings; work should be performed so as to not void the current warranty.

3.06 SECURITY AND PROTECTION FACILITIES INSTALLATION

A. Protection of Existing Facilities: Protect existing vegetation, equipment, structures, utilities, and other improvements at Project site and on adjacent properties, except those indicated to be removed or altered. Repair damage to existing facilities.

B. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction as required to comply with environmental regulations and that minimize possible air, mold, waterway, and subsoil contamination or pollution or other undesirable effects.

C. Tree and Plant Protection: Install temporary fencing located as indicated or outside the drip line of trees to protect vegetation from damage from construction operations. Protect tree root systems from damage, flooding, and erosion.

D. Pest Control: Engage pest-control service to recommend practices to minimize attraction and harboring of rodents, roaches, and other pests and to perform extermination and control procedures at regular intervals so Project will be free of pests and their residues at Substantial Completion. Perform control operations lawfully, using environmentally safe materials.

E. Site Enclosure Fence: Before construction operations begin, furnish and install site enclosure fence in a manner that will prevent people and animals from easily entering site except by entrance gates. Maintain security by limiting number of keys and restricting distribution to authorized personnel.

F. Security Enclosure and Lockup: Install temporary enclosure around partially completed areas of construction. Provide lockable entrances to prevent unauthorized entrance, vandalism, theft, and similar violations of security. Lock entrances at end of each work day.

G. Temporary Enclosures: Provide temporary enclosures for protection of existing construction to remain, from exposure, foul weather, other demolition/construction operations, and similar activities. Provide temporary weathertight enclosure for exterior of existing spaces to remain.

1. Where heating or cooling is needed and permanent enclosure is incomplete, insulate temporary enclosures.
2. Prevent dust, fumes, and odors from entering existing spaces to remain.

3.07 MOISTURE AND MOLD CONTROL

A. Contractor's Moisture-Protection Plan: Avoid trapping water in finished work. Document visible signs of mold that may appear during construction.

B. Exposed Construction Phase: Before installation of weather barriers, when materials are subject to wetting and exposure and to airborne mold spores, protect as follows:

1. Protect porous materials from water damage.
2. Protect stored and installed material from flowing or standing water.
3. Keep porous and organic materials from coming into prolonged contact with concrete.
4. Remove standing water from decks.
5. Keep deck openings covered or dammed

C. Partially Enclosed Construction Phase: After installation of weather barriers but before full enclosure and conditioning of building, when installed materials are still subject to infiltration of moisture and ambient mold spores, protect as follows:

1. Do not load or install drywall or other porous materials or components, or items with high organic content, into partially enclosed building.
2. Keep interior spaces reasonably clean and protected from water damage.
3. Periodically collect and remove waste containing cellulose or other organic matter.
4. Discard or replace water-damaged material.
5. Do not install material that is wet.
6. Discard, replace, or clean stored or installed material that begins to grow mold.
7. Perform work in a sequence that allows any wet materials adequate time to dry before enclosing the material in drywall or other interior finishes

D. Controlled Construction Phase of Construction: After completing and sealing of the building enclosure but prior to the full operation of permanent HVAC systems, using temporary equipment, control moisture and humidity inside building by maintaining effective dry-in conditions.

3.08 PATCHING AND REPAIRS

A. Promptly patch and repair holes and damaged surfaces caused to adjacent construction by selective demolition operations. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

B. Temporary Support: Provide temporary support of work to be cut.

C. Protection: Protect in-place construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

D. Cutting: Cut in-place construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. Prior to cutting openings through existing structural floor slabs, contractor shall x-ray and GPR scan the slab to confirm locations of existing reinforcing at all locations of proposed floor penetrations. All new conduit, floor boxes, plumbing lines, drains, ducts, etc being cut through the floor must be located between existing reinforcing. Openings that require cutting of reinforcing must be structurally reinforced as indicated on structural drawings or as directed by structural engineer.

E. Where repairs to existing surfaces are required, patch to produce surfaces suitable for new materials.
1. Completely fill holes and depressions in existing masonry walls to remain with an approved masonry patching material, applied according to manufacturer's printed recommendations.

F. Restore exposed finishes of patched areas and extend finish restoration into adjoining construction to remain in a manner that eliminates evidence of patching and refinishing.

G. Patch and repair floor and wall surfaces in the new space where demolished walls or partitions extend one finished area into another and at all openings and penetrations through walls or floors. Large and known openings through floors and walls are indicated on drawings. Not all miscellaneous openings are indicated. All opeings into and through walls and floors shall be patched.

1. Provide a flush and even surface of uniform color and appearance.
2. Closely match texture and finish of existing adjacent surface.
3. Patch with durable seams that are as invisible as possible. Comply with specified tolerances.
4. Where patching smooth painted surfaces, extend final paint coat over entire unbroken surface containing the patch after the surface has received primer and second coat.
5. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
6. Inspect and test patched areas to demonstrate integrity of the installation, where feasible.

H. Patch, repair, or rehang existing ceilings as necessary to provide an even-plane surface of uniform appearance.

3.07 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Promptly dispose of demolished materials. Do not allow demolished materials to accumulate on-site.

B. Burning: Do not burn demolished materials.

C. Disposal: Transport demolished materials off Client agency's property and legally dispose of them.

3.08 CLEANING

A. Sweep the building broom clean on completion of selective demolition operation.

B. Change filters on air-handling equipment on completion of selective demolition operations.

END OF SECTION

SECTION 028211

REMOVAL OF ASBESTOS CONTAINING MATERIALS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

B. The procedures specified herein are guidelines for minimum performance. The Contractor is responsible for his own methods of operations and conformance to regulatory codes, rules and guidelines. The Contractor is required to obtain all permits, licenses and approvals to perform the work, including any rights to use patented systems.

1.02 SCOPE OF WORK

A. The scope of work for this project covers the supplying of all labor, tools, materials, equipment, services and appurtenances to accomplish the work specified and indicated on the contract drawing. The work shall be performed to the complete satisfaction of the Department in accordance with the current EPA and OSHA regulations, State Labor and Industry and Department of Environment Protection regulations and any other applicable State and Local Government regulations.

B. Contractor shall submit an Action Plan which describes specifically how abatement work is to be completed for each abatement phase. At a minimum the work Plan shall address work area preparation, work practices, decon location, estimated completion dates, respiratory protection, and disposal. Approval of the Action Plan must be obtained through the Professional prior to the start of work. Procedures outlined in the Action Plan must be followed throughout the abatement phase. Any changes in Action Plan must obtain prior approval from Professional.

C. Work under this project includes but is not limited to the following:

Location	Floor	Material Description	Quantity	Condition	Recommendations
Passage 104	1/2	Light Brown with Gray 1' x 1' Floor Tile Mastic	300 S.F.	Good	Remove prior to renovation if impacted
Stair ST-1	1/2	Light Brown with Gray 1' x 1' Floor Tile Mastic	300 S.F.	Good	Remove prior to renovation if impacted
Lobby 101E	1	White with Blue Specks 1' x 1' Floor Tile Mastic	1,930 S.F.	Good	Remove prior to renovation if impacted
Coat Room 106	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic	340 S.F.	Good	Remove prior to renovation if impacted
Lobby 101	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic	1,980 S.F.	Good	Remove prior to renovation if impacted
Coat Room 105	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic	340 S.F.	Good	Remove prior to renovation if impacted
Lobby 101W	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic	880 S.F.	Good	Remove prior to renovation if impacted
President's Dining Room 101W	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic (Under Carpet)	870 S.F.	Good	Remove prior to renovation if impacted
Vestibule 203	2	Dark Brown 1' x 1' Floor Tile Mastic	365 S.F.	Good	Remove prior to renovation if impacted
Dining Room 200/202	2	Dark Brown 1' x 1' Floor Tile Mastic	6,120 S.F.	Good	Remove prior to renovation if impacted
Storage Room 204	2	Dark Brown 1' x 1' Floor Tile Mastic	320 S.F.	Good	Remove prior to renovation if impacted
Faculty Dining 205	2	Laminate Flooring Mastic	360 S.F.	Good	Remove prior to renovation if impacted
Linen 205	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	45 S.F.	Good	Remove prior to renovation if impacted
Serving 207	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	830 S.F.	Good	Remove prior to renovation if impacted
Hallway outside Vestibule 203	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	610 S.F.	Good	Remove prior to renovation if impacted
Serving 216	2	Gray and White 1' x 1' Floor Tile Mastic	850 S.F.	Good	Remove prior to renovation if impacted
Kitchen Office 220/221	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	280 S.F.	Good	Remove prior to renovation if impacted
Linen 215	2	Light Blue Sheet Vinyl Flooring Mastic	45 S.F.	Good	Remove prior to renovation if impacted
Dining Room 213/214	2	Gray and White 1' x 1' Floor Tile Mastic	7,200 S.F.	Good	Remove prior to renovation if impacted
Faculty Dining 212	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	360 S.F.	Good	Remove prior to renovation if impacted
Storage Room 211	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	370 S.F.	Good	Remove prior to renovation if impacted
Faculty Dining 210	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	360 S.F.	Good	Remove prior to renovation if impacted

D. The quantities shown are approximate and no guarantee is expressed or implied that the quantities are correct or that the asbestos-containing materials are easily removable from the substrate, surfaces or components. See demolition drawings for additional information.

E. In addition, Contractor shall remove and dispose of non-asbestos-containing materials, as

specified in the Contract Documents including:

1. Mastic and residual mastic, in accordance with the Resilient Floor Covering Institute (RFCI) “Recommended Work Practices for Removal of Resilient floor Coverings” and per the Commonwealth of Pennsylvania.

F. Refer to the Contract Drawings for the approximate location of all asbestos-containing materials to be removed, within the scope of this Contract. Note that resilient floor tile is under carpet.

1.03 CONTROL OF WORK

A. All work which does not conform to the requirements of the contract, plans and specifications will be considered unacceptable.

B. Unacceptable work, whether the result of poor workmanship, use of defective materials, damage through carelessness, or any other cause found to exist prior to the final acceptance of the work, shall be corrected immediately and replaced in an acceptable manner.

C. All bidders should inspect job site prior to bidding to determine job conditions.

D. If the Department finds the materials furnished, work performed, or the finished product not within reasonably close conformity with the plans and specifications and have resulted in an unacceptable finished product, the affected work or material shall be removed and replaced or otherwise corrected by and at the expense of the Contractor.

E. The term "reasonably close conformity" shall not be construed as waiving the Contractor's responsibility to complete the work in accordance with the plans, contract and specifications. The term shall not be construed as waiving the Department's right to insist on strict compliance with the requirements of the contract, plans and specifications during the Contractor's prosecution of the work, when in the Department's opinion and judgement such compliance is essential to provide an acceptable finished work.

1.04 QUALITY ASSURANCE

A. Consultant:

1) The Professional shall contract for a Quality Assurance Consultant Project Monitor hereafter referred to as ‘Consulting Firm’ which specializes in performing air sampling, project monitoring and inspections on asbestos abatement projects. The testing laboratory shall as a minimum be accredited by the NIOSH PAT Program (Proficiency Analytical Testing) for PCM asbestos air analysis, and NVLAP for asbestos bulk analysis.

2) The Consulting Firm will be responsible for certifying the project was completed in accordance with all federal, state, and local asbestos standards and regulations.

3) The Consulting Firm and Asbestos Abatement Contractor must complete the Certification of Visual Inspection form found at the end of this section for each work area completed.

4) The Consulting Firm shall review the Contractors Action Plan which describes specifically how work is to be completed for each abatement phase. Approval of the Action Plan must be obtained through the Professional prior to the start of work.

B. Contractor Experience:

1) The Asbestos Abatement Contractor shall have a minimum of three (3) years experience in the asbestos abatement business. He shall have successfully completed three (3) projects of similar or larger size and dollar value to this project and shall not have defaulted on an asbestos abatement project within the last three (3)

years. The Contractor shall be certified by Pennsylvania Department of Labor and Industry.

C. Worker Certification:

1) The Contractor shall furnish proof that his employees have had instruction on the dangers of asbestos exposure, on respirator use, decontamination and current OSHA and EPA regulations.

2) Documentation of workers medical exams, consist of x-rays and pulmonary function shall be submitted and as may be required by current OSHA and EPA regulations and any applicable State and Local Government regulations.

3) There must be on site at all times, an EPA Certified Asbestos Abatement Supervisor. The Asbestos Abatement Supervisor shall have successfully completed a 5-day EPA Certified Practices and Procedures Course as per 40 CFR, Part 763, Subpart E, Appendix C-EPA Model Accreditation Plan (must provide a copy of certificate from EPA approved course). All asbestos workers shall have successfully completed a 4-day EPA Certified Practices and Procedures Course as per 40 CFR, Part 763, Subpart E, Appendix C-EPA Model Accreditation Plan. The Contractor must provide copies of certificates from Pennsylvania Department of Labor and Industry for all workers, and supervisors as required by regulation.

4) When required by the Pennsylvania Department of Labor and Industry (PDL&I) the Contractor, Abatement Supervisor, and Abatement Workers shall be licensed by (PDL&I). Each worker/supervisor shall have a current photo identification issued by PDL&I available on request by the Department when required.

1.05 POSTING OF REGULATIONS

A. The Contractor will have at all times in his possession at his office one (1) copy and in view at the job site one (1) copy, current OSHA Regulations 29 CFR 1926.1101, Asbestos and current Environmental Protection Agency 40 CFR Part 61, Subpart M: National Emission Standard for Hazardous Air Pollutants as related to asbestos stripping, emissions, notification, work practices and disposal of asbestos waste.

1.06 REGULATORY SUBMITTALS (CONTRACTOR'S RESPONSIBILITY)

The Contractor is required to notify the building occupants and the following agencies in writing ten (10) days prior to starting work for notification and instructions concerning proper disposal of asbestos waste material.

1) United States Environmental Protection Agency - Region III
Asbestos - NESHAP Coordinator (3AT33)
841 Chestnut Building
Philadelphia, PA 19106

2) Pennsylvania Department of Environmental Protection
Bureau of Air Quality Control
Regional Manager

3) Pennsylvania Department of Labor and Industry
Asbestos Occupation Accreditations & Certification
Bureau of Occupational and Industrial Safety
Room 155E Labor and Industry Building
Seventh & Forster Streets
Harrisburg, Pennsylvania 17120

4) Where work is performed in Allegheny County or City of Philadelphia, appropriate notification must also be made. Obtain permits as required by local regulations.

5) EPA, DEP approved asbestos landfill proposed to be used by the Contractor for RACM. Submit completed WSR for RACM at projects end (see 3.07, F).

1.07 AIR TESTING AND MONITORING

A. Air sampling of the work areas and surrounding environment will be conducted during the performance of this contract by the Consulting Firm so as to ensure abatement procedures are in compliance with all codes, regulations, ordinances and this specification.

B. The Contractor shall fully cooperate with the Consulting Firm and all others responsible for testing and inspecting the work.

C. Air testing and analyses shall be in accordance with current EPA and requirements of Section 29 CFR 1926.1101 of the current OSHA Regulations, as a minimum. Analysis shall be performed by Phase Contrast Microscopy per NIOSH 7400 Method and/or Transmission Electron Microscopy (TEM) per EPA Level II (AHERA) analytical procedures.

D. Air tests taken prior to start of work (background) and at completion (pre-clearance) will be analyzed by PCM-Phase Contrast Microscopy. Final (clearance) testing shall be by TEM-Transmission Electron Microscopy.

E. The Consulting Firm shall give verbal notification to the Department of the results of each test within twenty-four (24) hours of the time the samples were delivered to the laboratory. The Consulting Firm shall confirm the results in writing within three (3) days thereafter. A microscope on site for PCM analyses is acceptable to facilitate a faster turn-around time.

F. Prompt reports are necessary so that, if required, modifications to work methods and/or practices may be implemented as soon as possible.

G. Representatives of the Consulting Firm shall have access to the work area at all times. The Contractor shall provide facilities for such access in order that the Consulting Firm may properly perform its function.

H. Sampling equipment and personnel will be provided by the Consulting Firm.

I. Air sampling shall be performed in each work area prior to commencement of the work at that location. The highest fiber count reading during pre-clearance clean-up monitoring shall be lower than the background readings established by pre-job monitoring or 0.01 f/cc, whichever is lower. When the criteria is met, perform final clearance testing by Transmission Electron Microscopy (TEM) using EPA Level II methodology. Clearance criteria is 70 s/mm^2 for fibers greater than .5 microns in length with an aspect ratio 5:1.

J. Air samples shall be taken in accordance with, but not necessarily limited to, the following schedule:

AREA	WHEN	NUMBER	MINIMUM VOLUME (liters)	FLOW RATE (liters/min.)
Work Area(PCM)	Prior to job start	2	1500	2-10
Work Area(PCM)	During area isolation	Daily[1]	480-960	1-2
Work Area-Inside (PCM)	During abatement work	Daily[1]	480-960	1-2
Work area Exterior (PCM	During abatement work	Daily[1]	1000	2-10
Work Area(PCM)[4]	Upon work(pre-clearance)completion	2(minimum)	1500	2-10
Work Area (TEM)[4]	At completion (final)	1[3]	1200	2-10

SCHEDULE NOTES:

1 Consecutive daily air samples will be collected during abatement to yield a minimum of eight (8) hours of sampling time for each active work area.

2 Exterior work area(s) samples shall be collected daily at decon clean room entrance, load out exit, discharge of HEPA exhaust units, and area(s) adjacent to work area(s) that are occupied or will be re-occupied.

3 One sample collected and analyzed per work area; archive remaining filter for one year.

4. Aggressive air sampling must be conducted when work area is prepared as a negative pressure enclosure.

K. Work area clearance testing shall be completed before work site protective barriers are removed.

L. The Contractor is responsible for performing the thirty (30) minute excursion air sampling per OSHA regulations.

M. The Contractor is responsible for performing 8 hour TWA personal air samples in the employees breathing zone per OSHA regulations.

1.08 AIR FILTERING - (FOR GUIDELINE PURPOSES ONLY)

A. An approved negative pressure machine may be used in the active work area using HEPA equipped air movement units.

B. Air may be drawn from clean areas through the decontamination and active work areas, HEPA filtered and exhausted through air movement units to the containment exterior. Replace filters in accordance with manufacturer's instructions and to meet the needs of this specification.

C. Air movement should be sufficient quantity to ensure a minimum of four (4) air changes per hour.

Example: Active work area = 50' x 50' x 20' H = 50,000 cu. ft.

For four air changes per hour = 4 AC/HR x 50,000 CF/AC = 200,000 cu.ft./hr.

In cubic feet per minute = 200,000 CF/HR : 60 min/hr = 3,333 cu. ft./minute

This active work area would require a combination of air movement/HEPA units, i.e., 2,500 CFM and 1,500 CFM

D. The exhaust system must be sufficient to maintain a minimum pressure differential of -0.02 inches of water relative to unsealed, adjacent area. Provide continuous, twenty-four (24) hours per day monitoring of the pressure differential with an automatic recording instrument.

E. The exhaust system(s) will run twenty-four (24) hours/day until final clearance is obtained and will be maintained in accordance with ANSI Z9.2 and the manufacturers directions.

F. To ensure continuous operation, the Contractor shall have a spare negative exhaust unit available.

1.09 ALTERNATIVE AIR FILTERING METHODS

A. Other approved air filtering methods may be utilized at the Contractor's discretion, with the stipulation that designated regulatory agencies provide documented approval to the Department. It shall be the responsibility of the Contractor to submit all documentation required to the appropriate regulatory agency for their review and approval.

1.10 PLACEMENT OF WARNING SIGNS AND LABELS

A. The Contractor shall furnish and place warning signs at all approaches to asbestos control areas containing concentrations of airborne asbestos fibers. Locate warning signs at such a distance that personnel may read the warning sign and take the necessary protective action required before entering the area. Warning signs shall be in place for the duration of the work. The Contractor shall furnish and attach caution labels to all disposal containers holding asbestos materials, scrap waste, debris and other products contaminated with asbestos.

B. Warning Signs: Provide warning signs conforming to 29 CFR 1926.1101 with the following legend:

DANGER
ASBESTOS
CANCER AND LUNG DISEASE HAZARD
AUTHORIZED PERSONNEL ONLY
RESPIRATORS AND PROTECTIVE CLOTHING ARE
REQUIRED IN THIS AREA

C. Caution Labels: Attach label to the outside of all disposal bags and containers which hold asbestos contaminated materials and are to be removed from the site. Caution labels shall be printed in letters of sufficient size and contrast so as to be readily visible and legible and shall display the following legend:

DANGER
CONTAINS ASBESTOS FIBERS
AVOID CREATING DUST
CANCER AND LUNG DISEASE HAZARD

D. Identification Labels: Attach label to the outside of all disposal bags and containers which hold asbestos contaminated materials and are to be transported off facility site. Identification labels shall display the following legend:

Waste Generator Name: _____Fill Out_____

Generator Location: _____Fill Out_____

E. Transportation marking shall conform to 49 CFR 171 and 172 and shall be provided on all containers with more than one pound of friable asbestos. Transportation marking shall display the following legend:

R Q HAZARDOUS SUBSTANCE
SOLID, NOS
ORM-E, NA 9188
(ASBESTOS)

PART 2 - PRODUCTS

2.01 EQUIPMENT AND MATERIALS

A. The list of required materials will include, but is not necessarily limited to the following:

1) Respirators: Provide respiratory protection in accordance with OSHA Regulation 29 CFR 1926.1101 and appendices ANSI Z88.2-1980. Respiratory protection regardless of negative exposure assessments. There shall be NO EXCEPTION to this requirement. As minimum protection, negative pressure air purifying respirators shall be worn. Contractor shall select the appropriate respirator based on an initial exposure assessment or exposure monitoring results. No employee or visitor shall enter any area without this protection until clearance has been obtained. Employees or visitors shall wear a respirator. Respirators shall be NIOSH approved. Ensure proper filters are worn using a HEPA as a minimum.

2) Protective Clothing:

a) Disposable Clothing – such as "Tyvek" by DuPont or equal as approved by Professional. Clothing shall consist of coverall, head cover and foot cover. Gloves will be worn for hand cover as needed.

3) Wetting Agents - The asbestos material will be sprayed with water containing an additive to enhance penetration. The additive, or wetting agent, will be polyoxyethylene at a concentration of one (1) ounce per five (5) gallons of water or as otherwise specified by manufacturer. A fine spray of this solution must be applied to prevent fiber disturbance proceeding the removal of the asbestos material. The asbestos will be sufficiently saturated to prevent emission of airborne fibers in excess of the exposure limits prescribed in the current OSHA standards referenced in these specifications. DRY REMOVAL WILL NOT BE ALLOWED EXCEPT WITH WRITTEN APPROVAL FROM EPA or BECAUSE OF FREEZING WORK AREA TEMPERATURES.

4) Polyethylene sheeting: Six (6) mils, for protection of floors, walls, doors, windows, fixed equipment, HVAC supply and return openings, and critical barriers.

5) Polyethylene bags (with warning labels) six (6) mils minimum for disposal. All asbestos that is removed shall be double bagged.

6) Tape: High quality vinyl or fabric duct tape. Paper masking tape will not be permitted.

7) Negative Pressure Filtration Equipment: Air movement and filtering equipment equipped with HEPA filters rated at 99.97% removal down to 0.3 microns, and of sufficient capacity to provide a minimum of four (4) air changes per hour for each active work area.

8) Airless Spray Equipment: Electric airless spray equipment for saturating and mist fiber control. Low pressure (500 psi) equipment must be available on-site and utilized as required.

9) Vacuum: HEPA rated for surface cleaning and house-keeping. Hand operated and power tools such as, but not limited to, saws, corers, abrasive wheels and drills should be provided with local exhaust ventilation systems with HEPA filters.

10) Hand Tools: Brooms, plastic shovels, scrapers, brushes, etc., in sufficient quantity to ensure the appropriate level of housekeeping.

11) Water Filtration System: Shower and contaminated water filtration system.

12) GFI Equipment: All electrical connections in the work area must be through "ground fault" protected outlets/circuits.

13) Penetrating Encapsulant: Penetrating encapsulants to be used on this project are International Cellulose Corporation SK-13 Asbestos Encapsulant, International Protective Coatings Corporation Serpiflex Shield, Fiberlock Technology ABC Asbestos Binding Compound Concentrate, and others listed as acceptable in the Environmental Protection Agency - Battelle Laboratory Encapsulant Study, or approved equal.

14) Bridging Encapsulant: Bridging encapsulants to be used on this project are American Coatings Corporation Cable Coating 2B, Decadex Laboratories Firecheck, Fiberlock Technology ABC Asbestos Binding Compound Concentrate, or approved equal.

B. The Contractor will have at all times in his possession at the job site Material Safety Data Sheets (MSDS) for wetting agents, encapsulants, solvents, strippers, and any other potentially hazardous materials.

2.02 PERSONNEL PROTECTIONS

A. Personnel protection is required for laborers, mechanics, supervision and visitors at the work site during the set-up and abatement operations.

B. Each worker shall be supplied with a minimum of two (2) complete protective work clothes and respirator filter changes per day for the complete duration of the project. Hard hats should be available as appropriate which meet ANSI Z-89.1 standards. Safety toe footwear is to be worn underneath the disposable shoe covers and must meet the requirements and specifications in ANSI Z-41.1. Eye wear and face protection must meet the standards and specifications of ANSI Z-87.1.

C. In addition to sets of protective work clothes for workers, the Contractor shall have on hand two (2) additional sets of disposable work clothes, per day and respirators for personnel who are authorized to inspect the work site. Hard hats should be available as appropriate which meet ANSI Z-41.1. Eye wear and face protection must meet the standards and specifications of ANSI Z-87.1.

D. Respirators approved for asbestos use and protective work clothes will be worn by laborers and mechanics as a minimum during set-up operations (plastic draping, light-fixture dropping or removal, etc.).

E. Appropriate respirators will be worn by all personnel in the active work area.

F. Upon leaving the active work area, filters will be discarded, cartridges removed and respirators cleaned in disinfectant solution and clean water rinse.

G. Clean respirators will be stored in plastic bags when not in use.

H. Respirators will be inspected daily for broken, missing, or deteriorated parts.

PART 3 - EXECUTION

3.01 AREA PREPARATION

A. Movable furniture, blinds and equipment will be removed from area of work by the Using Agency.

B. Heating and ventilating system servicing the areas of work must be shut down prior to starting any work. Notify the Institution prior to starting any work in order that they may arrange to have the heating and ventilating system shut down.

C. The Contractor shall isolate the work area for the duration of the work by installing critical barriers completely sealing off all openings in the work area, including, but not limited to, heating, ventilation ducts, doorways, corridors, windows, roof ventilator openings, and wall vents, with plastic sheeting taped securely in place with six (6) mils plastic sheeting.

D. The Contractor shall build decontamination chamber(s) to be connected to each active work area for entrance to or exit from the active work area. When required a separate material load out unit shall be constructed.

E. All floor and wall surfaces in the work areas shall be covered with plastic sheeting taped securely in place to protect them from water damage and asbestos contamination.

F. The Contractor shall cover all fixtures, fixed demountable partitions, lighting, fixed items and equipment in the work area with plastic sheeting taped securely in place.

G. Duct tape, staples, wood strips and other methods will be used appropriately to attach vertical plastic barriers to walls and to floors. All edges of plastic material shall overlap the adjoining sheet a minimum of twelve inches. All joints (vertical and horizontal) to be continuously sealed with duct tape.

H. Upon completion of area isolation, the Contractor shall remove, where practical, all detachable electrical heating and ventilation equipment, wipe and vacuum, clean and remove from active work area.

3.02 DECONTAMINATION UNIT (USAGE AND ACTIVITIES)

A. Outside room (clean room). In this room the worker leaves all street clothes and dresses in clean working clothes (usually disposable coveralls). Respiratory protection equipment is also stored in this area. No asbestos contaminated items should enter this room. Workers enter this room either from outside the structure dressed in street clothes, or naked from the showers, after showering.

B. Shower Room: This is a separate room used for transit by cleanly dressed workers entering the job from the outside room or by workers headed for the showers after undressing in the equipment room.

C. Equipment Room (contaminated area): Work equipment, footwear, additional contaminated work clothing are left here. This is a change and transit area for workers.

D. Decontamination chambers require temporary services. Verify during bidding period the availability for temporary hook up. Mobilization, hook-up and demobilization, disconnection costs will be the responsibility of the Contractor. Installation of temporary services during demolition shall be per current EPA and OSHA regulations.

E. Work Area: The work area should be separated by polyethylene barriers from the equipment room. If the airborne asbestos level in the work area is expected to be high, as in dry removal an additional intermediate cleaning space may be added between the equipment room and the work area. Isolation of the work areas, as required, is necessary to prevent contamination and fiber dispersal to other areas of the building during work and clean-up operation. Air movement will flow uninterrupted from outside the work area through the change and equipment rooms and into the active work area. It is then HEPA filtered and exhausted to the building exterior.

3.03 WORK AREA ENTRANCE/EXIT

A. All workers involved in the removal of asbestos will utilize the following procedure for work area entrance and exit.

B. The worker enters the outside room and removes clothing, puts on clean coveralls, gloves and respirator. Protective clothing sleeves will be taped to gloves and protective clothing legs will be taped to foot covers. The neck collar, zipper seam, wrists and ankles of protective clothing will be taped closed.

C. Worker proceeds via shower room to equipment room. Any additional clothing and equipment left in equipment room and required by worker is put on. This includes additional warm garments workers usually provide themselves when the work area is too cold for coveralls only. These must be treated as contaminated clothing and left in the decontamination area.

D. Worker proceeds to work area.

E. Before leaving the work area, the worker should remove all gross contamination and debris from the protective clothing, by vacuuming down the clothes with a vacuum cleaner with a HEPA filter. In practice, this is carried out by one worker assisting another.

F. The worker proceeds to equipment room and removes all clothing except respiratory protection equipment. Extra work clothing may be stored in contaminated end of the area.

G. Disposable protective clothing is placed in a bag for disposal. The worker then proceeds into the shower room. Respiratory protection equipment should only be removed after wetting in shower to prevent inhalation of fibers. Ensure that employees shower every time upon exiting the work area and before entering the clean room.

H. After showering, the worker moves to the clean room and dresses in either new protective clothes for another entry, or street clothes if leaving. Respirator filters are sealed with tape or thrown away if spent, and respirator body is thoroughly cleaned and brought to the clean room.

I. Workers shall not eat, drink, smoke, chew gum, or chew tobacco in the work area. To eat, drink or smoke, workers shall exit the work area following the decontamination procedure outlined above.

J. All footwear shall be left inside work area until completion of the job, then cleaned or discarded.

3.04 METHOD OF REMOVAL

A. Remove and dispose of all asbestos-containing materials (ACM) in accordance with the methods and procedures outlined in the United States Department of Labor, Occupational Safety and Health Administration (OSHA) Asbestos Regulations, Codes of Federal Regulations Title 29, Part 1926, Section 1926.1101.

B. Dry removal will not be allowed except when wet removal will create a safety hazard. Dry removal process will require written authorization by EPA and the Department except when work area has freezing conditions.

C. Work of this section shall be performed in the following manner:

1) Eliminate air flow into containment area by isolating all supply and return air ducts from mechanical system. Turn off electrical power.

2) Install six (6) mil polyethylene critical barriers over all doors, wall openings, ceiling openings, electrical outlets, etc. Secure with duct tape on all sides.

3) ix (6) mil polyethylene protecting ceiling surface from wall to wall.

4) Six (6) mil polyethylene protecting wall surface from floor to ceiling.

5) Isolation barriers separating occupied areas and work areas shall be framed and covered with 1/2 inch plywood and two (2) layers of six (6) mil polyethylene.

6) Duct HEPA filter unit through door. Locate unit to prevent dead air pockets.

7) Install triple air curtain, six (6) mil polyethylene (typical), over door opening into decontamination unit or load out unit.

3.05 GLOVEBAG REMOVAL PROCEDURES

A. All applicable OSHA and NIOSH requirements and glovebag manufacturer's recommendations shall be met during glove bagging operations.

B. Glovebags shall only be used to remove 3 feet or less of material.

3.05 HOUSEKEEPING

A. Throughout the work period, the Contractor shall maintain the building and site in a standard of cleanliness as specified throughout these specifications.

B. Contaminated disposable clothing, respirator filters and other debris will be bagged, properly labeled and sealed at the end of each work day.

C. All asbestos generated by either removal, encapsulation or repair will be bagged, properly labeled, and sealed at the end of each work day.

D. Respirators will be thoroughly cleaned at the end of each work day and stored for the next day's use.

E. Retain all stored items in an orderly arrangement allowing maximum access, not impeding traffic, and providing the required protection of materials.

F. Do not allow the accumulation of scrap, debris, waste material, and other items not required for completion of this work.

G. At least weekly, and more often if necessary, completely remove all scrap, debris and waste material from the job site.

H. Unless otherwise noted or directed, materials resulting from demolition operations shall be the property of the Contractor, shall not be used in the work and shall be promptly removed from the site.

I. Daily and more often if necessary, inspect the work areas and adjoining spaces, and pick up all scrap, debris and waste material. Remove all such items to the place designated for their storage.

J. Provide adequate storage for all items awaiting removal from the job site, observing all requirements for fire protection and protection of the ecology.

K. Maintain the site in a neat and orderly condition at all times.

L. Compressed air is not to be used for cleaning purposes.

3.06 FINAL DECONTAMINATION OF WORK AREA

A. Following careful double bagging of all removed asbestos material by the Contractor, he shall label bags as required.

B. Bags shall be wiped with clean damp cloths prior to transportation to approved disposal site.

C. With critical barriers in place, sheet plastic on walls, floors, and ceiling, the negative pressure system operating, the Contract shall carry out the first cleaning. If there are two layers of wall, floor, and ceiling plastic, clean outer layer as described below and remove carefully. With one

layer of wall, floor, and ceiling plastic in place, use damp cleaning cloth to wipe surfaces of plastic. Use each surface of a cleaning cloth one time and then dispose of as contaminated waste.

D. Continue this cleaning until there is no visible debris from removed material or residue on plastic sheeting. This first cleaning shall extend to include the Equipment Room (Dirty Room) in the decontamination unit.

E. Pressure washing techniques of any kind are strictly prohibited.

F. Pre-Encapsulation Inspection of substrate is performed by Consulting Firm to ensure removal and cleaning of the substrate is adequate. The Contractor may accompany this inspection. If during the inspection, the substrate or plastic sheeting isn't cleaned to the satisfaction of the Consulting Firm, additional re-cleaning will be required to meet the satisfaction of the Consulting Firm.

G. Encapsulate substrate and all remaining plastic sheeting within the work area. A colored encapsulant may be used on non-finished surfaces.

H. After encapsulant has dried, remove floor, wall, and ceiling plastic carefully by folding inwards into bundles and bagged for disposal. **NOTE**: Final barriers are not to be removed until work is completed.

I. With critical barriers in place, negative pressure system operating, and immovable objects covered with plastic sheeting, perform a second cleaning as was done in the first cleaning. Wet mop any hard floor surfaces. HEPA vacuum carpeted area surfaces. Hard surfaced flooring such as concrete, terrazzo, VAT and ceramic tile, shall be wet mopped, allowed to dry, and damp mopped a second time with clean mop heads. All mop heads and cleaning cloths are to be discarded in the same manner as asbestos waste.

J. All surfaces are to be left visually clean.

K. Perform visual inspection of work area Consulting Firm and Contractor shall complete Certification Of Visual Inspection form found at the end of this section.

L. The Consulting Firm shall take pre-clearance samples as specified in Air Sample Schedule, Section 1.07 as soon as feasible but no longer than eight (24) hours after completion of all cleaning work, or as may be specified by the Department. If pre-clearance criteria are met, proceed with air testing for final clearance by Transmission Electron Microscopy (TEM).

M. If pre-clearance criteria is not met, repeat final cleaning until additional tests indicate acceptable levels have been achieved before proceeding with final clearance testing by TEM. Costs associated with additional cleaning and testing shall be borne by the Contractor.

N. After air testing clearance criteria has been met, critical barriers and negative air pressure system can be removed.

3.07 DISPOSAL OF ASBESTOS WASTE

A. All RACM and miscellaneous ACM debris will be transported to the predesignated disposal site in accordance with the guidelines of the U.S. Environmental Protection Agency, Title 40, Part 61, Subpart M, and all local agencies' regulations. Ensure all waste bags/leaktight container have facilities name, address, and contact person as required by NESHAP. Drums are to be used to transport bagged ACM's as required by regulation(s).

B. EPA NESHAP Category I &II nonfriable ACM may be disposed of as C&D waste as allowed by regulation. If nonfriable materials become friable they must then be disposed of as regulated ACM waste in an approved landfill.

C. Workers loading/unloading the asbestos materials and machinery operators will wear respirators and disposable work clothing when handling material at the project and disposal site. Asbestos warning signs shall be posted on vehicle as required by regulation.

D. The bags may be dumped from the drums into the burial site. If drums are used to transport the ACM bags, the bags may be dumped from the drums into the burial site. The drums may be reused. However, if a bag is broken or damaged, the entire drum should be buried.

E. The landfill area used for dumping shall be certified to receive and buy materials contaminated by asbestos.

F. Obtain completed Waste Shipment Record (WSR) for all RACM. WSR must also indicate amount of waste in cubic yards. Submit signed WSR with final report/Project Close-out.

3.08 INSPECTIONS

A. All work procedures detailed in this specification will be strictly adhered to and meet or exceed all current EPA, OSHA, DEP, ASTM and PDL&I regulations.

B. All work shall meet with the approval of the Department. Work which does not meet with the approval shall be determined to be unsatisfactory.

ASBESTOS CERTIFICATION OF VISUAL INSPECTION

Project Name:_____

Project Number:_____

Building Name:_____

Work Area Location:_____

ABATEMENT CONTRACTOR CERTIFICATION

In accordance with Project Specifications and scope of work, the abatement contractor hereby certifies that the Abatement Contractor has visually inspected the work area (all surfaces including pipes, beams, ledges, walls, ceiling and floor, decontamination unit, sheet plastic, etc.) and has found no asbestos dust, debris or residue.

Abatement Contractor Name:_____

Signature:_____ Print Name:_____

Print Title:_____ Date:_____

QUALITY ASSURANCE CONSULTANT

The Quality Assurance Consultant hereby certifies that he/she has accompanied the Abatement Contractor on the visual inspection and verifies that this inspection has been thorough and to the best of his/her knowledge and belief, the Abatement Contractor's certification above is a true and honest one.

Quality Assurance Consultant Name:_____

Inspector Signature:_____ Date:_____

Print Inspector Name:_____

END OF SECTION

SECTION 028700

REMOVAL AND DISPOSAL OF UNIVERSAL WASTE

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION OF THE WORK

A. Certain building/mechanical components have been identified as requiring proper removal and disposal before any general demolition/renovation activities occur. This section specifies requirements for removing, handling, storing, transporting, and ultimate disposal of light fixture ballasts, fluorescent lamps/tubes, lead building components, mercury containing thermostats/gauges, refrigeration lubricants, ozone depleting substances, white good items and smoke detectors. Some of these materials are found within mechanical equipment scheduled for demolition and others are self-contain.

B. Quantities - The quantities shown are approximate.

Material	Quantity
Suspected Mercury Containing Fluorescent Light Tubes –	448
Light Ballasts (No PCBs found) - Throughout	164
Suspected Mercury Containing Thermometers – Mech 117	17
Suspected PCB or Mercury Containing Transformers – Electrical 116	Undetermine

C. The contractor is responsible to remove and dispose or recycle all materials impacted by the work as part of this project in accordance with all Federal, State and Local Waste Stream Requirements. The Contractor shall be required to carefully remove and properly recycle or dispose of these items in accordance with all applicable waste disposal requirements. Waste manifests associated with the final disposition of these materials shall be presented to Client Agency prior to payment.

D. The Contractor shall provide labor, materials, equipment and insurance to complete the work specified in this Section including, but not limited to, the removal and lawful disposal of hazardous materials, hazardous wastes, and special wastes. Work shall be performed in accordance with this specification, all referenced documents included as part of this specification, and with all Federal, State and local regulations. Wherever there is a conflict or overlap of requirements, the most stringent provisions will apply. Generally, the management of miscellaneous hazardous materials shall include, but not be limited to:

1. Characterization (any testing that may be required by the off-site materials management facility), removal, and disposal of hazardous materials or potentially hazardous materials.

2. Characterization (any testing that may be required by the off-site materials

management facility), removal, and disposal of contained gear oils, hydraulic oils and refrigeration liquids, etc. from various pieces of machinery and equipment, as part of the work.

3. Characterization (any testing that may be required by the off-site materials management facility), removal, and disposal of all containers, drums, and unknown materials generated as part of the work.

4. Characterization (any testing that may be required by the off-site materials management facility), removal, and disposal of loose paint chips and flaking and peeling paint from walls and floors throughout generated as part of the Contractors work.

5. File all necessary notices, obtain all permits and licenses, and pay all governmental taxes, fees, and other costs in connection with the work. Obtain all necessary approvals of all governmental departments having jurisdiction. The Contractor shall deliver a copy of all permits, approvals and notifications to the Client Agency before beginning any work.

6. Perform all sampling and testing required to properly profile the material for waste reuse, recycling or disposal. This shall also include all testing required by the recycling or disposal facility.

7. All costs for the testing shall be borne by the Contractor.

8. Comply with the Contractor's submitted Health and Safety Plan.

1.3 RELATED WORK

A. Division 02 Section – Removal & Disposal of Asbestos-Containing Materials.

1.4 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referenced in text by basic designation only. The list provided below is not intended to be all inclusive of each regulation prevailing over the work. The latest version of the document listed shall govern the work performed.

A. Code of Federal Regulations (CFR)

1. 29 CFR 1910, "Occupational Safety and Health Standards" (General Industry Standards)

2. 29 CFR 1926, "Safety and Health Regulations for Construction" (Construction Industry Standards)

3. 40 CFR 50, "National Primary and Secondary Ambient Air Quality Standards"

4. 40 CFR 60, "Standards of Performance for New Stationary Sources," Appendix B, "Test Methods"

5. 40 CFR 117, "Determination of Reportable Quantities for Hazardous Substances"

6. 40 CFR 122, "USEPA Administered Permit Program: The National Pollutant

Discharge Elimination System"

7. 40 CFR 172, "Hazardous Waste Transportation"

8. 40 CFR 261, "Identification and Listing of Hazardous Waste"

9. 40 CFR 262, "Standards Applicable to Generators of Hazardous Waste"

10. 40 CFR 263, "Standards Applicable to Transporters of Hazardous Waste"

11. 40 CFR 268, "Land Disposal Restrictions"

12. 40 CFR 273, "Universal Waste Rule"

13. 40 CFR 300, "National Oil and Hazardous Substances Pollution Contingency Plan"

14. 40 CFR 302, "Designation, Reportable Quantities, and Notification"

B. Occupational Safety and Health Administration (OSHA) Booklet 3126 "Working with Lead in the Construction Industry"

C. National Institute for Occupational Health and Safety (NIOSH)

1. NIOSH Method 7082, "Lead"

D. American Society for Testing and Materials (ASTM)

1. ASTM D3335, "Test Method for Low Concentration for Lead, Cadmium, and Cobalt in Paint by Atomic Absorption Spectroscopy"

E. USEPA Publications

1. SW-846, "Test Methods for Evaluating Solid Waste – Physical/Chemical Methods"

2. USEPA Method 3050, "Acid Digestion of Sediments, Sludges, and Soils"

1.5 QUALITY ASSURANCE

A. Examination of Existing Conditions: The Contractor shall examine the Contract Drawings, Contract Specifications and the equipment and materials to either be demolished or disposed of as part of this contract for hazardous waste identification, handling, removal, and disposal requirements and provisions for new work. There shall be no additional fees paid to the contractor for his/her failure to account for the provisions of this Section.

B. Hazardous Waste Removal and Transportation Firm Qualifications: An experienced firm that has specialized in hazardous waste work similar in material and extent to that indicated for this Project. The Contractor shall provide for the proper transportation and disposition of all materials generated as part of the work.

C. Regulatory Requirements: Comply with governing USEPA notification regulations before beginning removal of any hazardous waste materials. Comply with hauling and disposal regulations of authorities having jurisdiction. The Contractor shall provide for the proper

transportation and disposition of all materials generated as part of the work.

1.6 PERMITTING

A. The use and disposal of hazardous materials (broken fluorescent lamps, leaking or damaged batteries, mercury thermostats, and PCB ballasts) is highly regulated and compliance with all requirements set forth by authorities having jurisdiction is an essential condition of the Work. The Contractor shall be fully aware of all such requirements and ensure that all regulatory conditions are met, including those required of any Sub-contractors.

B. The Contractor is responsible for ensuring that all personnel performing work under this section shall be properly trained in accordance with all Federal, state and local regulations. The Contractor is required to provide proof of training and licensing of any and all employees completing the work of this section at least 5 days prior to the start of Work.

1.7 LOCATION OF WORK

A. Certain building/mechanical components have been identified as requiring proper removal and disposal before any general demolition/renovation activities occur. This section specifies requirements for removing, handling, storing, transporting, and ultimate disposal of all hazardous materials that may be discovered as part of this undertaking including but not limited to light fixture ballasts, fluorescent lamps, lead building components, mercury containing thermostats/gauges, ozone depleting substances, machine/liberating oils, radiological devices, hydraulic oils, transformer oils, conditioning chemicals, refrigeration lubricants, and smoke detectors. Some of these materials are found within mechanical equipment scheduled for demolition and others are self-contained.

B. The contractor is responsible to remove and dispose or recycle all materials impacted by the work as part if this project in accordance with all Federal, State and Local Waste Stream Requirements. The Contractor shall be required to carefully remove and properly recycle or dispose of these items in accordance with all applicable waste disposal requirements. Waste manifests associated with the final disposition of these materials shall be presented to Site Project Manager and the Client Agency prior payment. The materials list is provided for general guidance and may not correspond exactly to the materials to be removed. The Contractor is responsible to investigate all items for the presence of all hazardous materials.

C. Handling, containerizing, packaging, re-handling, hauling and disposal of all items identified above are to be included in the lump sum bid item of the Contract.

1.8 SUBMITTALS

A. The Contractor shall submit each item in this Article according to the Conditions of the Contract unless otherwise indicated.

B. The Contractor shall provide copies of all worker certifications associated with OSHA 40-Hour Hazardous Waste Site Health and Safety Training in accordance with 29 CFR 1910.120.

C. Submit a work plan and schedule for waste removal, containment, storage, transportation, disposal and or recycling. Wastes shall be cleaned up and containerize daily.

D. After completion of the hazardous materials removal, the Contractor shall provide a final report documenting removal, transportation and recycling, treatment, disposal, or incineration activities. The document shall include copies of manifests, shipping slips, permits, and licenses for this Project.

PART 2 – PRODUCTS

2.1 PROTECTIVE EQUIPMENT

A. Provide health and safety equipment required to protect workers and to comply with the Health and Safety Plan and OSHA requirements.

2.2 DISPOSAL BAGS

A. Disposal Bags: Provide 6 mil (0.15 mm) thick leak-tight polyethylene bags.

2.3 DRUMS

A. DOT Hazardous Waste Disposal Drums: Provide DOT 17-H Open -Top Drums *(55* gallon) in accordance with DOT regulations title 49 CFR Parts 173, 178, and 179.

2.4 LABELS

A. DOT Hazardous Waste Labels: in accordance with DOT regulations, Title 49 CFR parts173, 178, and 179.

B. Universal Waste Labeling. USEPA 40 CFR 273.14

PART 3 – EXECUTION

3.1 GENERAL WORK AREA SET UP

A. Signage: Prior to the preparation for work that will disturb hazardous materials; the Contractor shall place warning signs immediately outside all entrances and exits to the area.

B. Access to Work Areas: The Contractor shall allow only authorized personnel into the work area. Barrier tape shall be used to limit access to the exterior work area.

3.2 GENERAL HAZARDOUS MATERIALS/HAZARDOUS WASTE MANAGEMENT

A. Do not mix potentially hazardous waste streams. Where feasible, separate each type of hazardous waste from other types of hazardous wastes, from asbestos waste and from construction debris.

B. Segregate, package, label, transport and dispose of Hazardous Materials/Hazardous Waste in accordance with DOT, USEPA, State and local regulations.

C. The Engineer shall identify materials considered to be a listed or characteristic hazardous waste prior to initiating this project. A schedule of materials that must be managed as hazardous waste is attached as an Appendix to this specification.

D. The following wastes are designated as Hazardous Wastes and are non-salvageable. This is not a comprehensive listing of hazardous wastes.

1. Waste Type A: PCB waste to include PCB-containing ballasts from fluorescent light fixtures.

2. Waste Type B: HVAC and refrigerator refrigerant.

3.3 HAZARDOUS MATERIALS/HAZARDOUS WASTE PACKAGING AND LABELING

A. Package each segregated Hazardous Waste Type A, B, and C, in separate specified containers as follows. IMPORTANT: Do Not Mix Waste Streams

1. Waste Type A to be packaged in DOT 17-H open-top drums. Fill to capacity only with Waste Type A. Install gasket on lid, apply lock ring, and seal. Apply Hazardous Waste Label to drum side. Enter DOT Shipping Data as follows: RQ Waste Polychlorinated Biphenyls, 9, UN-2315, PG-II, (M00l). Adjacent to each label, enter the date indicating when waste was first placed in each drum.

2. Waste Type B to be packaged in DOT 17-H open-top drums. Fill to capacity only with Waste Type C. Install gasket on lid, apply lock ring, and seal. Apply Hazardous Waste Label to drum side. Enter DOT Shipping Data as follows: RQ Hazardous Waste Solid, NOS, 9, NA3077, PG-III, (D009). Adjacent to each label, enter the date indicating when waste was first placed in each drum.

B. Maintain all containers in a continuously sealed condition after they have been filled. Do not reopen sealed containers or place additional waste in previously sealed containers. Storage of containers must be in a secure location.

3.4 HANDLING AND DISPOSAL OF BATTERIES, LEAD COMPONENTS, FLUORESCENT LAMPS & MERCURY THERMOSTATS

A. The Contractor is responsible for removing all fluorescent lamps from fixtures, intact, prior to demolition. Fluorescent lamps shall be recycled and managed in accordance with the Universal Waste Management Standards (310 CMR 30.1034). If fluorescent lamps become broken or damaged during removal and/or handling, broken lamps shall be managed as hazardous waste as specified below.

B. The Contractor is responsible for recycling and managing intact, non-leaking batteries (lead-acid, nickel cadmium, and lithium) in accordance with the Universal Waste Management Standards (310 CMR 30.1034). If batteries are, or become damaged or are leaking during removal and/or handling, such batteries shall be managed as hazardous waste as specified below.

C. The Contractor shall manage intact fluorescent lamps and intact batteries in the following manner:

1. Do not break or crush spent lamps or batteries or damage them in any way.

2. Store intact lamps and batteries in a secure area(s) protected from physical damage. Storage area(s) should be identified within an easily read sign stating, “Universal Waste Area - Spent Fluorescent Lamps” or “Universal Waste Area – Batteries” as appropriate.

3. Store lamps and batteries in packaging or containers that are designed to minimize breakage/damage during both storage and shipping. Label containers

as “Universal Waste – Spent Fluorescent Lamps” or “Universal Waste – Batteries” as appropriate and mark each container with the date on which you first began storing the waste.

4. Use a Bill of Lading that contains the following information when shipping to the recycler: name and address of generator, transporter, and recycler; number of lamps shipped; date of shipment and date of receipt by recycler; and, dated signature of recycler. Deliver a copy of the Bill of Lading to the Site Project Manager within 5 days of shipment of the materials.

D. Broken fluorescent lamps shall be placed in sealed, vapor-tight containers/drums that are compatible with the waste being stored for disposal as mercury-containing hazardous waste. The waste shall be classified as RCRA characteristic hazardous waste and shall be labeled and stored in accordance with all applicable regulations.

E. Leaking or damaged batteries shall be placed in appropriate non-metal containers/drums that are compatible with the waste being stored for disposal as hazardous waste and shall be labeled and stored in accordance with all applicable regulations.

F. Mercury thermostats shall be placed in sealed, vapor-tight drums (55-gallons or less) for disposal as mercury-containing hazardous waste and shall be classified as RCRA characteristic hazardous waste (note, thermostats can be co-mingled with broken fluorescent lamps as appropriate).

G. Lead Components (sink traps) shall be placed in a sealed drum (55-gallons or less) for disposal and/or recycling in accordance with Federal, State and local waste stream requirements.

H. The Contractor shall deliver to the Site Project Manager information relating to the transportation and recycling or disposal of batteries, lead components, fluorescent lamps, and mercury thermostats before the start of the Work. This information shall include:

1. Name and address of fluorescent lamp recycler or dismantler that will accept fluorescent lamps, intact;

2. Name and address of the battery recycler that will accept batteries, intact;

3. Name and address of the RCRA TSDF that will accept leaking batteries, broken fluorescent lamps and mercury thermostats as hazardous waste;

4. Copies of all authorization letters, licenses, and permits to operate for the facilities, to confirm that they are permitted to accept the batteries and fluorescent lamps; and,

5. Name and address of hazardous waste transporter that will transport leaking batteries and/or broken fluorescent lamps to RCRA TSDF including USEPA Identification Number and proof of permit, license, or authorization to transport hazardous waste in all affected areas.

3.5 HANDLING AND DISPOSAL OF BALLASTS

A. Prior to removal of any ballasts, the Contractor shall uncover and inspect the label on the ballast. All ballasts designated as 'No PCBs' shall be marked with green paint; all other ballasts shall be assumed to contain PCBs and shall be marked with red paint. Similar color-coding shall be used for the receiving drums.

B. Removal shall be performed using approved methods and tools that will minimize damage to the fluorescent lamp and ensure a quick, neat removal with the ballast intact and undamaged.

C. Once removed, the ballasts shall be placed in a corresponding color-coded 55-gallon drum.

D. Once filled, the 55-gallon drums shall be closed and properly labeled for temporary storage, transport, and disposal in accordance with all applicable regulations.

E. Drums containing PCB ballasts that are marked red, and other PCB contaminated materials shall be incinerated at a TSCA/RCRA and approved utilized incineration facility in accordance with Federal, State and local waste stream requirements.

F. Drums containing “no PCB” fluids, ballasts and capacities that are marked green shall be disposed of at a legally permitted disposal facility.

G. Upon completion of the destruction of PCB ballasts, the Contractor shall deliver to the Project Manager:

1. Written certification from the incineration facility that the items were delivered to, accepted, and destroyed by the facility. Certificate shall be signed by the person authorized by the facility to accept PCB items for disposal.

2. Copies of all manifests.

3. Certificates of Destruction of Materials.

3.6 HAZARDOUS MATERIALS/CONTAINERIZED WASTE

A. All hazardous materials shall be characterized and disposed of in accordance with applicable federal, state, and local regulations. Hazardous waste manifests shall be completed for all off-site waste management.

B. Workers who handle hazardous materials shall be licensed and trained in safe and proper hazardous materials handling procedures. At a minimum, this shall include OSHA 40- Hour Hazardous Waste Site Health and Safety Training in accordance with 29 CFR 1910.120.

C. Any hazardous materials containers in poor condition shall be removed as soon as possible.

D. Handling Hazardous Waste

1. The Contractor shall place waste in DOT approved containers and label the containers for transport to a licensed disposal site.

2. The Contractor shall use an authorized hazardous waste transporter to haul waste to an approved hazardous waste facility.

3. The Contractor is responsible to prepare, maintain and track all record keeping, chain-of-custody and reporting requirements including a copy of the hazardous waste manifest.

4. The Contractor shall accurately measure and weigh the volume of each container or load of waste removed from the site. Submit records of waste volumes in Final

Report.

5. The Contractor shall not place paint debris on the unprotected ground and paint debris shall be shielded to prevent dispersion of the debris by wind or precipitation.

6. The Contractor shall provide legal transportation of the waste to the recycling, disposal, treatment, or incineration facility, and complete or obtain all required licenses, manifests, receiving facility waste profiles, or other forms. Copies of all forms or licenses, and the signed original of the Waste Manifest for each waste load, shall be given to the Engineer and Site Project Manager.

E. The Contractors Project Manager shall provide appropriate notifications to regulatory agencies if there is a release to the environment exceeding the CERCLA/NJ DEP reporting requirements (e.g. lead - 1 pound).

F. Any evidence of improper storage shall be cause for immediate shutdown of the project until corrective action is taken.

3.7 TEMPORARY STORAGE

A. Partially filled containers of hazardous waste may be stored at the work site for intermittent packaging provided that:

1. Each container is properly labeled when it is first placed in service;

2. Each container remains closed at all times except when compatible waste types are added; and

3. When moved from site to site, each container remains within the geographic boundaries of the facility without moving or crossing public access highways.

B. All items classes of waste identified as part of this section, once removed, shall be stored on-site in accordance with all applicable regulations for no more than 30 Days. At the conclusion of each day's work, drums containing hazardous waste (broken fluorescent lamps, leaking or damaged batteries, mercury thermostats, and PCB ballasts) shall be securely stored in regulatory-compliant locations (i.e., properly marked/signed, proper secondary containment, etc.) under lock and key.

C. Hazardous waste shall be stored and loaded from secure areas that are impervious and contained. At a minimum, the area shall be lined with 6-mil HDPE overlaid with absorbent paper.

3.8 TRANSPORTATION OF HAZARDOUS WASTES

A. The Contractor shall continuously maintain custody of all hazardous waste materials generated at the work site. Provide security, short-term storage, transportation and disposition until custody is transferred to an approved properly permitted treatment, storage, disposal or site or recycling center. Document continuous chain-of custody of all wastes generated.

B. Do not remove, or cause to be removed, hazardous waste from Client's property without a legally executed Uniform Hazardous Waste manifest

1. All haulers shall be properly licensed to transport hazardous waste (broken

fluorescent lamps, leaking or damaged batteries, mercury thermostats, and PCB ballasts) in Pennsylvania and all other states traversed in transporting the ballasts to approved disposal sites. Haulers shall be under the direct control of the Contractor at all times. Any spills during transport shall remain the responsibility of the Contractor. Any damage of costs incurred as a result of a spill and the required cleanup process shall be borne by the Contractor. Vehicles used for the transportation of PCB items and asbestos shall be plainly marked as required by DOT and state regulations.

2. All drums and equipment carcasses shall be secured to the transport vehicle to prevent movement during transport.

C. The Contractor shall be responsible for preparing all manifests and other required shipping documents and for acquiring the necessary signatures for transport. At completion of hauling and disposal of each load submit copy of waste manifest, chain of custody form, and landfill/incineration receipt in Final Report.

3.9 DISPOSAL OF HAZARDOUS WASTE

A. The Contractor is responsible for completing all disposal documents, which may include, but are not limited to, waste profiles, hazardous waste manifests and land ban restriction forms. The Client Agency shall be designated as the Generator on all documents and shall sign the documents as such. Note that the Client Agency may or may not possess USEPA ID numbers; the Contractor shall complete and apply for Generator ID Numbers or the appropriate USEPA # and Generator Status as may be required for this undertaking. Copies of all disposal documents shall be delivered to the Site Project Manager for review at least 5 days prior to shipment. Coordination for the Site Project Manager/Generator's signature on hazardous waste disposal documents shall be made through the Site Project Manager.

B. For hazardous waste which is shipped off-site using a hazardous waste manifest, the Contractor shall provide the bottom three copies of the manifest to the Site Project Manager at the time of shipment for distribution to the appropriate agencies.

3.10 DISCOVERY OF HAZARDOUS MATERIALS

A. If hazardous materials, such as chemicals, or other hazardous materials are discovered during the course of the work other than those identified in the Plans and Specifications, the Contractor shall cease work in affected area only and immediately notify the Engineer and Site Project Manager of such discovery. Do not proceed with work in such areas until instructions are issued by the Engineer. Continue work in other area

B. If unmarked containers are discovered during the course of the work other than those identified in the plans and Specifications cease work in the affected area only and immediately notify the Engineer and the Site Project Manager of such discovery. The Contractor shall not proceed with work in such areas until instructions are issued by the Engineer. Take immediate precautions to prohibit endangering the containers integrity. Work can continue in other areas.

END OF SECTION

SECTION 031000
CONCRETE FORMING AND ACCESSORIES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Form-facing materials.
2. Waterstops.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for formwork related to concrete pavement and walks.

1.3 DEFINITIONS

A. Form-Facing Material: The temporary form materials that come in direct contact with the concrete as part of the formwork components in supporting the concrete while the concrete is setting and gaining sufficient strength to be self-supporting. The most common materials are steel, aluminum, and wood.

B. Formwork: The total system of support of freshly placed concrete, including the mold or sheathing that contacts the concrete, as well as supporting members, hardware, and necessary bracing.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction, movement, contraction, and isolation joints
c. Forms and form-removal limitations.
d. Shoring and reshoring procedures.
e. Anchor rod and anchorage device installation tolerances.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Prepared by, and signed and sealed by, a qualified professional registered in the state, responsible for their preparation, detailing fabrication, assembly, and support of forms.

1. For exposed vertical concrete walls, indicate dimensions and form tie locations.
2. Indicate dimension and locations of construction and movement joints required to construct the structure in accordance with ACI 301.

a. Location of construction joints is subject to approval of The Professional.

3. Indicate location of waterstops.
4. Indicate proposed schedule and sequence of stripping of forms, shoring removal, and reshoring installation and removal.
5. Indicate layout of insulating concrete forms, dimensions, course heights, form types, and details.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Minutes of preinstallation conference.

C. Qualification Statements: For testing and inspection agency.

1.7 QUALITY ASSURANCE

A. Testing and Inspection Agency Qualifications: An independent agency, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

B. Mockups: Formed surfaces to demonstrate typical joints, surface finish, texture, tolerances, and standard of workmanship.

1. Build panel approximately 100 sq. ft. in the location indicated or, if not indicated, as directed by The Professional.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Concrete Formwork: Design and analyze, erect, shore, brace, and maintain formwork, shores, and reshores in accordance with ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads, so that

resulting concrete conforms to the required shapes, lines, and dimensions.

1. Design formwork to limit deflection of form-facing material to 1/240 of center-to-center spacing of supports.

    a. For architectural concrete specified in Section 033300 "Architectural Concrete," limit deflection of form-facing material, studs, and walers to 0.0025 times their respective clear spans (L/400).

2.2 FORM-FACING MATERIALS

A. As-Cast Surface Form-Facing Material:

1. Provide continuous, true, and smooth concrete surfaces.
2. Furnish in largest practicable sizes to minimize number of joints.
3. Acceptable Materials: As required to comply with Surface Finish designations specified in Section 033000 "Cast-in-Place Concrete, and as follows:

    a. Plywood, metal, or other approved panel materials.
    b. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:

        1) APA HDO (high-density overlay).
        2) APA MDO (medium-density overlay); mill-release agent treated and edge sealed.

B. Concealed Surface Form-Facing Material: Lumber, plywood, metal, plastic, or another approved material.

1. Provide lumber dressed on at least two edges and one side for tight fit.

C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces without spiral or vertical seams not exceeding specified formwork surface class.

1. Provide forms with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

2.3 WATERSTOPS

A. Flexible PVC Waterstops: U.S. Army Corps of Engineers' CE CRD-C 572, with factory-installed metal eyelets, for embedding in concrete to prevent passage of fluids through joints, with factory-fabricated corners, intersections, and directional changes.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

    a. BoMetals, Inc.
    b. Sika Corporation
    c. Vinylex Waterstop & Accessories
    d. Or equal as approved by Professional.

2. Profile: Flat dumbbell with center bulb.

3. Dimensions: 6 by 3/8 inch thick; nontapered.

B. Self-Expanding Butyl Strip Waterstops: Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete, 3/4 by 1 inch.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Carlisle Coatings & Waterproofing Inc
b. CETCO is a subsidiary of Minerals Technologies Inc.
c. Concrete Sealants Inc.
d. Henry, a Carlisle Company (formerly Henry Company and Carlisle Coatings & Waterproofing Inc. brands)
e. Sika Corporation

2.4 RELATED MATERIALS

A. Reglets: Fabricate reglets of not less than 0.022-inch- thick, galvanized-steel sheet. Temporarily fill or cover face opening of reglet to prevent intrusion of concrete or debris.

B. Dovetail Anchor Slots: Hot-dip galvanized-steel sheet, not less than 0.034 inch thick, with bent tab anchors. Temporarily fill or cover face opening of slots to prevent intrusion of concrete or debris.

C. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch, minimum.

D. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
2. Form release agent for form liners to be acceptable to form liner manufacturer.

E. Form Ties: Factory-fabricated, removable or snap-off, glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

F. Sealant: One-part moisture cure silicone sealant used with form liners.

PART 3 - EXECUTION

3.1 INSTALLATION OF FORMWORK

A. Comply with ACI 301.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 and to comply with the Surface Finish designations specified in Section 033000 "Cast-in-Place Concrete" for as-cast finishes.

C. Limit concrete surface irregularities as follows:

1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch.

D. Construct forms tight enough to prevent loss of concrete mortar.

1. Minimize joints.
2. Exposed Concrete: Symmetrically align joints in forms.

E. Construct removable forms for easy removal without hammering or prying against concrete surfaces.

1. Provide crush or wrecking plates where stripping may damage cast-concrete surfaces.
2. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
3. Install keyways, reglets, recesses, and other accessories, for easy removal.

F. Do not use rust-stained, steel, form-facing material.

G. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces.

1. Provide and secure units to support screed strips
2. Use strike-off templates or compacting-type screeds.

H. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible.

1. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar.
2. Locate temporary openings in forms at inconspicuous locations.

I. Chamfer exterior corners and edges of permanently exposed concrete.

J. At construction joints, overlap forms onto previously placed concrete not less than 12 inches.

K. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work.

1. Determine sizes and locations from trades providing such items.

L. Construction and Movement Joints:

1. Construct joints true to line with faces perpendicular to surface plane of concrete.

2. Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by The Professional.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, and girders in the middle third of spans.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings.

    a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

M. Provide temporary ports or openings in formwork where required to facilitate cleaning and inspection.

1. Locate ports and openings in bottom of vertical forms, in inconspicuous location, to allow flushing water to drain.
2. Close temporary ports and openings with tight-fitting panels, flush with inside face of form, and neatly fitted, so joints will not be apparent in exposed concrete surfaces.

N. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

O. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

P. Coat contact surfaces of forms with form-release agent, in accordance with manufacturer's written instructions, before placing reinforcement.

3.2 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC 303.
3. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
4. Install dovetail anchor slots in concrete structures, as indicated on Drawings.
5. Clean embedded items immediately prior to concrete placement.

3.3 INSTALLATION OF WATERSTOPS

A. Flexible Waterstops: Install in construction joints and at other joints indicated to form a continuous diaphragm.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Allow clearance between waterstop and reinforcing steel of not less than 2 times the largest concrete aggregate size specified in Section 033000 "Cast-in-Place Concrete."
4. Secure waterstops in correct position at 12 inches o.c.

5. Field fabricate joints in accordance with manufacturer's written instructions using heat welding.

    a. Miter corners, intersections, and directional changes in waterstops.
    b. Align center bulbs.

6. Clean waterstops immediately prior to placement of concrete.
7. Support and protect exposed waterstops during progress of the Work.

B. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, in accordance with manufacturer's written instructions, by adhesive bonding, mechanically fastening, and firmly pressing into place.

1. Install in longest lengths practicable.
2. Locate waterstops in center of joint unless otherwise indicated on Drawings.
3. Protect exposed waterstops during progress of the Work.

3.4 REMOVING AND REUSING FORMS

A. Formwork for sides of piers, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F for 24 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 70 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work.

1. Split, frayed, delaminated, or otherwise damaged form-facing material are unacceptable for exposed surfaces.
2. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints.

1. Align and secure joints to avoid offsets.
2. Do not use patched forms for exposed concrete surfaces unless approved by The Professional.

3.5 INSTALLATION OF SHORING AND RESHORING

A. Comply with ACI 318 and ACI 301 for design, installation, and removal of shoring and reshoring.

1. Do not remove shoring or reshoring until measurement of slab tolerances is complete.

B. Plan sequence of removal of shores and reshore to avoid damage to concrete. Locate and provide adequate reshoring to support construction without excessive stress or deflection.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: (.1) General Construction Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: (.1) General Construction Contractor will engage a qualified testing agency to perform tests and inspections.

C. Inspections:

1. Inspect formwork for shape, location, and dimensions of the concrete member being formed.
2. Inspect insulating concrete forms for shape, location, and dimensions of the concrete member being formed.

D. Prepare test and inspection reports.

END OF SECTION 031000

SECTION 032000
CONCRETE REINFORCING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Steel reinforcement bars.
2. Welded-wire reinforcement.

B. Related Requirements:

1. Section 321313 "Concrete Paving" for reinforcing related to concrete pavement and walks.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review the following:

a. Special inspection and testing and inspecting agency procedures for field quality control.
b. Construction contraction and isolation joints.
c. Steel-reinforcement installation.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Each type of steel reinforcement.
2. Epoxy repair coating.
3. Bar supports.

B. Shop Drawings: Comply with ACI SP-066:

1. Include placing drawings that detail fabrication, bending, and placement.
2. Include bar sizes, lengths, materials, grades, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, location of splices, lengths of lap splices, details of mechanical splice couplers, details of welding splices, tie spacing, hoop spacing, and supports for concrete reinforcement.

C. Construction Joint Layout: Indicate proposed construction joints required to build the structure.

1. Location of construction joints is subject to approval of The Professional.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For testing and inspection agency.

B. Welding certificates.

1. Reinforcement To Be Welded: Welding procedure specification in accordance with AWS D1.4/D1.4M.

C. Material Certificates: For each of the following, signed by manufacturers:

1. Epoxy-Coated Reinforcement: CRSI's "Epoxy Coating Plant Certification."

D. Material Test Reports: For the following, from a qualified testing agency:

1. Steel Reinforcement:

a. For reinforcement to be welded, mill test analysis for chemical composition and carbon equivalent of the steel in accordance with ASTM A706/A706M.

E. Field quality-control reports.

F. Minutes of preinstallation conference.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, hired by the (.1) General Construction Contractor, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.4/D 1.4M.

C. Mockups: Reinforcing for cast-concrete formed surfaces, to demonstrate tolerances and standard of workmanship.

1. Build panel approximately 100 sq. ft. for formed surface in the location indicated on Drawings or, if not indicated, as directed by The Professional.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage and to avoid damaging coatings on steel reinforcement.

1. Store reinforcement to avoid contact with earth.
2. Do not allow epoxy-coated reinforcement to be stored outdoors for more than 60 days without being stored under an opaque covering.

PART 2 - PRODUCTS

2.1 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, Grade 60, deformed.

B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Epoxy-Coated Reinforcing Bars:

1. Steel Bars: ASTM A615/A615M, Grade 60, deformed bars.
2. Epoxy Coating: ASTM A775/A775M or ASTM A934/A934M with less than 2 percent damaged coating in each 12-inch bar length.

D. Steel Bar Mats: ASTM A184/A184M, fabricated from ASTM A615/A615M, Grade 60, deformed bars, assembled with clips.

E. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

F. Galvanized-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from galvanized-steel wire into flat sheets.

2.2 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. Epoxy-Coated Joint Dowel Bars: ASTM A615/A615M, Grade 60, plain-steel bars, ASTM A775/A775M epoxy coated.

C. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded-wire reinforcement in place.

1. Manufacture bar supports from steel wire, plastic, or precast concrete in accordance with CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:

a. For concrete surfaces exposed to view, where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire, all-plastic bar supports, or CRSI Class 2 stainless steel bar supports.
b. For epoxy-coated reinforcement, use CRSI Class 1A epoxy-coated or other dielectric-polymer-coated wire bar supports.

D. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch in diameter.

1. Finish: Plain.

E. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating; compatible with epoxy coating on reinforcement and complying with ASTM A775/A775M.

2.3 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

PART 3 - EXECUTION

3.1 PREPARATION

A. Protection of In-Place Conditions:

1. Do not cut or puncture vapor retarder.
2. Repair damage and reseal vapor retarder before placing concrete.

B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that reduce bond to concrete.

3.2 INSTALLATION OF STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for placing and supporting reinforcement.

B. Accurately position, support, and secure reinforcement against displacement.

1. Locate and support reinforcement with bar supports to maintain minimum concrete cover.
2. Do not tack weld crossing reinforcing bars.

C. Preserve clearance between bars of not less than 1 inch, not less than one bar diameter, or not less than 1-1/3 times size of large aggregate, whichever is greater.

D. Provide concrete coverage in accordance with ACI 318.

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.

1. Bars indicated to be continuous, and all vertical bars to be lapped not less than 36 bar diameters at splices, or 24 inches, whichever is greater.
2. Stagger splices in accordance with ACI 318.

G. Install welded-wire reinforcement in longest practicable lengths.

1. Support welded-wire reinforcement in accordance with CRSI "Manual of Standard Practice."

a. For reinforcement less than W4.0 or D4.0, continuous support spacing to not exceed 12 inches.

2. Lap edges and ends of adjoining sheets at least one wire spacing plus 6 inches for plain wire and 8 inches for deformed wire.
3. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.

H. Epoxy-Coated Reinforcement: Repair cut and damaged epoxy coatings with epoxy repair coating in accordance with ASTM D3963/D3963M.

3.3 JOINTS

A. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by The Professional.

1. Place joints perpendicular to main reinforcement.
2. Continue reinforcement across construction joints unless otherwise indicated.
3. Do not continue reinforcement through sides of strip placements of floors and slabs.

B. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length, to prevent concrete bonding to one side of joint.

3.4 INSTALLATION TOLERANCES

A. Comply with ACI 117.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: (.1) General Construction Contractor will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Agency: (.1) General Construction will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel-reinforcement placement.

END OF SECTION 032000

SECTION 033000
CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Concrete standards.
2. Concrete materials.
3. Fiber reinforcement.
4. Vapor retarders.
5. Curing materials.
6. Accessories.
7. Repair materials.
8. Concrete mixture materials.
9. Concrete mixture class types.
10. Concrete mixing.

B. Related Requirements:

1. Section 031000 "Concrete Forming and Accessories" for form-facing materials, form liners, insulating concrete forms, and waterstops.
2. Section 032000 "Concrete Reinforcing" for steel reinforcing bars and welded-wire reinforcement.
3. Section 312000 "Earth Moving" for drainage fill under slabs-on-ground.
4. Section 321313 "Concrete Paving" for concrete pavement and walks.

1.3 DEFINITIONS

A. Cementitious Materials: Portland cement or blended hydraulic cement alone or in combination with one or more of the following:

1. Fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cementitious Materials (w/cm) Ratio: The ratio by weight of mixing water to cementitious materials.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:

    a. (.1C) Concrete Construction Contractor's superintendent and (.1) General Construction Contractor’s superintendent.
    b. Independent testing agency responsible for inspections and acceptance testing of concrete at Project site.
    c. Ready-mix concrete manufacturer.
    d. Concrete Subcontractor.
    e. Special concrete finish Subcontractor.

2. Review the following:

    a. Special inspection and testing and inspecting agency procedures for field quality control.
    b. Construction joints, control joints, isolation joints, and joint-filler strips.
    c. Semirigid joint fillers.
    d. Vapor-retarder installation.
    e. Anchor rod and anchorage device installation tolerances.
    f. Cold- and hot-weather concreting procedures.
    g. Concrete finishes and finishing.
    h. Curing procedures.
    i. Forms and form-removal limitations.
    j. Shoring and reshoring procedures.
    k. Methods for achieving specified floor and slab flatness and levelness.
    l. Floor and slab flatness and levelness measurements.
    m. Concrete repair procedures.
    n. Concrete protection.
    o. Initial curing of standard-cured and field curing of field-cured test cylinders (ASTM C31/C31M.)
    p. Protection of field cured field test cylinders.
    q. Distribution of test reports.

1.5 ACTION SUBMITTALS

A. Product Data:

1. Portland cement.
2. Blended hydraulic cement.
3. Performance-based hydraulic cement.
4. Fly ash.
5. Slag cement.
6. Silica fume.
7. Natural or other pozzolans.
8. Aggregates.
9. Admixtures:

    a. Include limitations of use. Admixtures that do not comply with reference ASTM International requirements must be submitted with test data for approval.

10. Fiber reinforcement.
11. Vapor retarders.
12. Floor and slab treatments.
13. Liquid floor treatments.
14. Curing materials.

15. Joint fillers.
16. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:

1. Mixture identification.
2. Compressive strength at 28 days or other age as specified.
3. Compressive strength required at stages of construction.
4. Durability exposure classes for Exposure Categories F, S, W, and C.
5. Maximum w/cm ratio.
6. Calculated equilibrium and fresh density for lightweight concrete.
7. Slump or slump flow limit.
8. Air content.
9. Nominal maximum aggregate size.
10. Synthetic microfiber content.
11. Intended placement method.
12. Submit adjustments to design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant changes.

C. Shop Drawings:

1. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.

a. Location of construction joints is subject to approval of The Professional.

D. Samples: For vapor retarder.

E. Concrete Schedule: For each location of each class of concrete indicated in "Concrete Mixture Class Types" Article, including the following:

1. Concrete class designation.
2. Location within Project.
3. Exposure class designation.
4. Formed surface finish designation and final finish.
5. Final finish for floors.
6. Floor treatment, if any.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:

1. Installer: Include copies of applicable ACI certificates.
2. Testing Agency: Include documentation indicating compliance with ASTM E329 or ASTM C1077 and copies of applicable ACI certificates for testing technicians or ACI Concrete Construction Special Inspector - MH, ASCC.

B. Material Certificates: For each of the following:

1. Cementitious materials.
2. Admixtures.
3. Fiber reinforcement.
4. Curing compounds.
5. Floor and slab treatments.

6. Bonding agents.
7. Adhesives.
8. Vapor retarders.
9. Semirigid joint filler.
10. Joint-filler strips.
11. Repair materials.

C. Material Test Reports: For the following:

1. Portland cement.
2. Blended hydraulic cement.
3. Performance-based hydraulic cement.
4. Fly ash.
5. Slag cement.
6. Silica fume.
7. Natural or other pozzolans.
8. Aggregates.
9. Admixtures.

D. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances in accordance with ACI 117 and in compliance with ASTM E1155.

E. Research Reports:

1. For concrete admixtures in accordance with ICC's Acceptance Criteria AC198.
2. For sheet vapor retarder/termite barrier, showing compliance with ICC's Acceptance Criteria AC380.

F. Preconstruction Test Reports: For each mix design.

G. Field quality-control reports.

H. Minutes of preinstallation conference.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified Installer who employs Project personnel qualified as an ACI-certified Concrete Flatwork Associate and Concrete Flatwork Finisher and a supervisor who is a certified ACI Advanced Concrete Flatwork Finisher/Technician or an ACI Concrete Flatwork Finisher with experience installing and finishing concrete.

1. Post-Installed Concrete Anchors Installers: ACI-certified Adhesive Anchor Installer.

B. Ready-Mixed Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94/C94M requirements for production facilities and equipment.

C. Laboratory Testing Agency Qualifications: A testing agency qualified in accordance with ASTM C1077 and ASTM E329 for testing that performs duties on behalf of the Professional.

1. Personnel performing laboratory tests to be an ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician, Level 1. Testing agency laboratory supervisor tests to be an ACI-certified Concrete Laboratory Testing Technician, Level 2.

D. Field Quality-Control Testing Agency Qualifications: An independent agency, hired by the (.1) General Construction Contractor, qualified in accordance with ASTM C1077 and ASTM E329 for testing indicated.

1. Personnel conducting field tests on plastic concrete properties are to be qualified as an ACI Concrete Field Testing Technician, Grade 1, in accordance with policies from ACI CPP 610.1 or an equivalent certification program.

E. Mockups: Cast concrete slab-on-ground and formed-surface panels to demonstrate typical joints, surface finish, texture, tolerances, floor treatments, and standard of workmanship. Provide up to two batches of concrete to demonstrate the number of required mockups.

1. Slab-on-Ground: Build panel in the location indicated or, if not indicated, as directed by The Professional.

a. Divide panel into four equal panels to demonstrate saw joint cutting.

2. Formed Surfaces: Build panel in the location indicated or, if not indicated, as directed by The Professional.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on each concrete mixture.

1. Include the following information in each test report:

a. Admixture dosage rates.
b. Slump.
c. Air content.
d. Seven-day compressive strength.
e. 28-day compressive strength.
f. Evaluation of permeability-reducing admixtures.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301.

1.10 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 as follows:

1. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
2. When air temperature has fallen to, or is expected to fall below 40 deg F during the protection period, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
3. Do not use frozen materials or materials containing ice or snow.
4. Do not place concrete in contact with surfaces less than 35 deg F, other than reinforcing steel.

B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:

1. Maintain concrete temperature at time of discharge to not exceed 95 deg F.
2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

1.11 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to furnish replacement sheet vapor retarder/termite barrier material and accessories for sheet vapor retarder/ termite barrier and accessories that do not comply with requirements or that fail to resist penetration by termites within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 CONCRETE STANDARDS

A. ACI Publications: Comply with ACI 301 unless modified by requirements in the Contract Documents.

2.2 CONCRETE MATERIALS

A. Source Limitations:

1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
2. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:

1. Portland Cement: ASTM C150/C150M, Type I, gray.
2. Blended Hydraulic Cement: ASTM C595/C595M, Type IP, Portland-pozzolan cement.
3. Performance-Based Hydraulic Cement: ASTM C1157/C1157M: Type GU, general use.
4. Pozzolans: ASTM C618, Class C, F, or N.
5. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
6. Silica Fume: ASTM C1240.

C. Normal-Weight Aggregates:

1. Coarse Aggregate: ASTM C33/C33M, Class 1N , Exterior concrete to have Class 3M.
2. Maximum Coarse-Aggregate Size: 1 inch nominal.
3. Fine Aggregate: ASTM C33/C33M.
4. Recycled Aggregate: Provide documentation of characteristics of recycled aggregate and mechanical properties and durability of proposed concrete, which incorporates recycled aggregate to conform to appliable requirements for the class of concrete.

D. Lightweight Aggregate: ASTM C330/C330M, 1-inch nominal maximum aggregate size.

1. Limit lightweight aggregate for internal curing to prewetted lightweight fine aggregate in accordance with ASTM C1761/C1761M.

2.3 ADMIXTURES

A. Air-Entraining Admixture: ASTM C260/C260M.

B. Chemical Admixtures: Do not use calcium chloride or admixtures containing calcium chloride in steel-reinforced concrete.

1. Water-Reducing Admixture: ASTM C494/C494M, Type A.
2. Retarding Admixture: ASTM C494/C494M, Type B.
3. Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C494/C494M, Type F.
5. High-Range, Water-Reducing and -Retarding Admixture: ASTM C494/C494M, Type G.

C. Mixing Water for Concrete Mixtures and Water Used to Make Ice: ASTM C1602/C1602M. Include documentation of compliance with limits for alkalis, sulfates, chlorides, or solids content of mixing water from Table 2 in ASTM C1602/C1602M.

2.4 FIBER REINFORCEMENT

A. Synthetic Fibrillated Microfiber: Fibrillated polypropylene microfibers complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
b. FullForce by ABC Polymer Industries, LLC
c. Master Builders Solutions
d. Sika Corporation
e. Or equal as approved by the Professional.

2.5 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A. Include manufacturer's recommended thickness and adhesive or pressure-sensitive tape.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Barrier-Bac; Inteplast Group
b. ISI Building Products
c. Poly-America, L.P.
d. Reef Industries, Inc.
e. Stego Industries, LLC
f. W. R. Meadows, Inc
g. Or equal as approved by the Professional.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film burlap-polyethylene sheet.

1. Color:

a. Ambient Temperature Below 50 deg F (10 deg C): Black.
b. Ambient Temperature between 50 and 85 deg F (10 and 29 deg C): Any color.
c. Ambient Temperature Above 85 deg F (29 deg C): White.

C. Water: Potable water that does not cause staining of the surface.

D. Clear, Waterborne, Membrane-Forming, Dissipating Curing Compound: ASTM C309, Type 1, Class B.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ChemMasters, Inc
b. Dayton Superior Corporation
c. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
d. Kaufman Products, Inc
e. MAPEI Corporation
f. SpecChem, LLC
g. Vexcon Chemicals Inc.
h. W. R. Meadows, Inc
i. Or equal as approved by the Professional.

E. Clear, Waterborne, Membrane-Forming, Curing and Sealing Compound: ASTM C1315, Type 1, Class A.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ChemMasters, Inc
b. Dayton Superior Corporation
c. Euclid Chemical Company (The); a subsidiary of RPM International, Inc.
d. Kaufman Products, Inc
e. MAPEI Corporation
f. SpecChem, LLC
g. Vexcon Chemicals Inc.
h. W. R. Meadows, Inc
i. Or equal as approved by the Professional.

2.7 ACCESSORIES

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber for exterior concrete, and ASTM D1752, cork or self-expanding cork for interior concrete.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, epoxy resin with a Type A shore durometer hardness of 80 in accordance with ASTM D2240.

C. Bonding Agent: ASTM C1059/C1059M, Type II, nonredispersible, acrylic emulsion or styrene butadiene.

D. Epoxy Bonding Adhesive: ASTM C881/C881M, two-component epoxy resin, capable of humid

curing and bonding to damp surfaces, of class suitable for application temperature and of grade and class to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.8 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi at 28 days when tested in accordance with ASTM C109/C109M.

B. Repair Overlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/4 inch and that can be filled in over a scarified surface to match adjacent floor elevations.

1. Cement Binder: ASTM C150/C150M portland cement or hydraulic or blended hydraulic cement, as defined in ASTM C219.
2. Primer: Product of topping manufacturer recommended for substrate, conditions, and application.
3. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch or coarse sand as recommended by topping manufacturer.
4. Compressive Strength: Not less than 5000 psi at 28 days when tested in accordance with ASTM C109/C109M.

2.9 CONCRETE MIXTURE MATERIALS

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, in accordance with ACI 301.

1. Use a qualified testing agency for preparing and reporting proposed mixture designs, based on laboratory trial mixtures.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland or hydraulic cement in concrete assigned to Exposure Class F3 as follows:

1. Fly Ash or Other Pozzolans: 25 percent by mass.
2. Slag Cement: 50 percent by mass.
3. Silica Fume: 10 percent by mass.
4. Total of Fly Ash or Other Pozzolans and Silica Fume: 35 percent by mass with fly ash or pozzolans not exceeding 25 percent by mass and silica fume not exceeding 10 percent by mass.

C. Admixtures: Use admixtures in accordance with manufacturer's written instructions.

2.10 CONCRETE MIXTURE CLASS TYPES

A. Class A: Normal-weight concrete used for footings, foundation walls, piers.

1. Exposure Class: ACI 318 Class F1.
2. Minimum Compressive Strength: 4000 psi at 28 days.
3. Maximum w/cm Ratio: 0.50.
4. Slump Limit: 5 inches, plus or minus 1-1/2 inches for concrete.
5. Air Content:

    a. Exposure Class F1: 4.5 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.

6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cementitious materials.

B. Class B: Normal-weight concrete used for exterior foundations, exterior retaining walls, exterior slabs on grade.

1. Exposure Class: ACI 318 Class F2.
2. Minimum Compressive Strength: 4500 psi at 28 days.
3. Maximum w/cm Ratio: 0.45.
4. Slump Limit: 5 inches, plus or minus 1.5 inches for concrete.
5. Air Content:

    a. Exposure Classes F2: 6.0 percent, plus or minus 1.5 percent at point of delivery for concrete containing 1-inch nominal maximum aggregate size.

6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

C. Class C: Normal-weight concrete used for interior slabs-on-ground .

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Maximum w/cm Ratio : 0.55.
3. Slump Limit: 5 inches, plus or minus 1.5 inches for concrete.
4. Air Content:

    a. Do not use an air-entraining admixture or allow total air content to exceed 3 percent for concrete used in trowel-finished floors.

5. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
6. Synthetic Microfiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than a rate of 1.5 lb/cu. yd..

D. Class F:Structural Normal-weight concrete used interior slabs on metal deck.

1. Minimum Compressive Strength: 3500 psi at 28 days.
2. Maximum w/cm Ratio: 0.55.
3. Slump Limit: 5 inches, plus or minus 1.5 inches for concrete.
4. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.
5. Total air content must not to exceed 3 percent for concrete used in trowel-finished floors.

E. Class I: Normal-weight concrete used for interior metal pan stairs and landings:

1. Minimum Compressive Strength: 3000 psi at 28 days.
2. Maximum w/cm Ratio: 0.53.
3. Maximum Size Aggregate: 1/2 inch.
4. Slump Limit: 3 inches, plus 1 inch or minus 2 inches.
5. Air Content: 0 percent, plus or minus 1.5 percent at point of delivery.
6. Limit water-soluble, chloride-ion content in hardened concrete to 1.00 percent by weight of cement.

2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and furnish delivery ticket.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete in accordance with ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.

1. For mixer capacity of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
2. For mixer capacity larger than 1 cu. yd., increase mixing time by 15 seconds for each additional 1 cu. yd..
3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mixture type, mixture time, quantity, and amount of water added. Record approximate location of final deposit in structure.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:

1. Before placing concrete, verify that installation of concrete forms, accessories, reinforcement, and embedded items is complete and that required inspections have been performed.
2. Do not proceed until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide reasonable auxiliary services to accommodate field testing and inspections, acceptable to testing agency, including the following:

1. Daily access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Secure space for storage, initial curing, and field curing of test samples, including source of water and continuous electrical power at Project site during site curing period for test samples.
4. Security and protection for test samples and for testing and inspection equipment at Project site.

3.3 TOLERANCES

A. Comply with ACI 117.

3.4 INSTALLATION OF EMBEDDED ITEMS

A. Place and secure anchorage devices and other embedded items required for adjoining Work that is attached to or supported by cast-in-place concrete.

1. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
2. Install reglets to receive waterproofing and through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.

3.5 INSTALLATION OF VAPOR RETARDERS

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder in accordance with ASTM E1643 and manufacturer's written instructions.

1. Install vapor retarder with longest dimension parallel with direction of concrete pour.
2. Face laps away from exposed direction of concrete pour.
3. Lap vapor retarder over footings and grade beams not less than 6 inches, sealing vapor retarder to concrete.
4. Lap joints 6 inches and seal with manufacturer's recommended tape.
5. Terminate vapor retarder at the top of floor slabs, grade beams, and pile caps, sealing entire perimeter to floor slabs, grade beams, foundation walls, or pile caps.
6. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
7. Protect vapor retarder during placement of reinforcement and concrete.

    a. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches on all sides and sealing to vapor retarder.

3.6 INSTALLATION OF CAST-IN-PLACE CONCRETE

A. Before placing concrete, verify that installation of formwork, reinforcement, embedded items, and vapor retarder is complete and that required inspections are completed.

1. Immediately prior to concrete placement, inspect vapor retarder for damage and deficient installation, and repair defective areas.
2. Provide continuous inspection of vapor retarder during concrete placement and make necessary repairs to damaged areas as Work progresses.

B. Notify The Professional and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Water addition in transit or at the Project site must be in accordance with ASTM C94/C94M and must not exceed the permitted amount indicated on the concrete delivery ticket.

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness.

1. If a section cannot be placed continuously, provide construction joints as indicated.
2. Deposit concrete to avoid segregation.
3. Deposit concrete in horizontal layers of depth not to exceed formwork design pressures and in a manner to avoid inclined construction joints.
4. Consolidate placed concrete with mechanical vibrating equipment in accordance with ACI 301.

    a. Do not use vibrators to transport concrete inside forms.
    b. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer.
    c. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity.
    d. At each insertion, limit duration of vibration to time necessary to consolidate concrete, and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Do not place concrete floors and slabs in a checkerboard sequence.
2. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
3. Maintain reinforcement in position on chairs during concrete placement.
4. Screed slab surfaces with a straightedge and strike off to correct elevations.
5. Level concrete, cut high areas, and fill low areas.
6. Slope surfaces uniformly to drains where required.
7. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface.
8. Do not further disturb slab surfaces before starting finishing operations.

3.7 INSTALLATION OF JOINTS

A. Construct joints true to line, with faces perpendicular to surface plane of concrete.

B. Construction Joints: Coordinate with floor slab pattern and concrete placement sequence.

1. Install so strength and appearance of concrete are not impaired, at locations indicated on Drawings or as approved by The Professional.
2. Place joints perpendicular to main reinforcement.

    a. Continue reinforcement across construction joints unless otherwise indicated.

3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches into concrete.
4. Locate joints for beams, slabs, joists, and girders at third points of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
5. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
6. Space vertical joints in walls as indicated on Drawings. Unless otherwise indicated on Drawings, locate vertical joints beside piers integral with walls, near corners, and in concealed locations where possible.
7. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
8. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces for exterior concrete.

C. Control Joints in Slabs-on-Ground: Form weakened-plane control joints, sectioning concrete into areas as indicated. Construct control joints for a depth equal to at least one-fourth of concrete thickness as follows:

1. Grooved Joints: Form control joints after initial floating by grooving and finishing each edge of joint to a radius of 1/8 inch. Repeat grooving of control joints after applying surface finishes. Eliminate groover tool marks on concrete surfaces.
2. Sawed Joints: Form control joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch wide joints into concrete when cutting action does not tear, abrade, or otherwise damage surface and before concrete develops random cracks.

D. Isolation Joints in Slabs-on-Ground: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.

1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated on Drawings.
2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface, where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints:

1. Install dowel bars and support assemblies at joints where indicated on Drawings.
2. Lubricate or asphalt coat one-half of dowel bar length to prevent concrete bonding to one side of joint.

3.8 APPLICATION OF FINISHING FLOORS AND SLABS

A. Scratch Finish:

1. While still plastic, texture concrete surface that has been screeded and bull-floated or darbied.
2. Use stiff brushes, brooms, or rakes to produce a profile depth of 1/4 inch in one direction.
3. Apply scratch finish to surfaces to receive mortar setting beds for bonded cementitious floor finishes.

B. Float Finish:

1. When bleedwater sheen has disappeared and concrete surface has stiffened sufficiently to permit operation of specific float apparatus, consolidate concrete surface with power-driven floats or by hand floating if area is small or inaccessible to power-driven floats.
2. Repeat float passes and restraightening until surface is left with a uniform, smooth, granular texture and complies with ACI 117 tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish and to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

C. Trowel Finish:

1. After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel.

2. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance.
3. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
4. Do not add water to concrete surface. Use of an approved finishing aid is acceptable.
5. Do not apply troweled finish to concrete, which has a total air content greater than 3 percent.
6. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
7. Finish surfaces to the following tolerances, in accordance with ASTM E1155, for a randomly trafficked floor surface:

    a. Slabs on Ground:

        1) Specified overall values of flatness, FF 35; and of levelness, FL 25; with minimum local values of flatness, FF 24; and of levelness, FL 17.

D. Trowel and Fine-Broom Finish: First apply a trowel finish to surfaces indicated on Drawings. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.

1. Coordinate required final finish with The Professional before application.
2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and locations indicated on Drawings.

1. Immediately after float finishing, slightly roughen trafficked surface by brooming with a fiber-bristle broom perpendicular to main traffic route.
2. Coordinate required final finish with The Professional before application.

3.9 APPLICATION OF FINISHING FORMED SURFACES

A. As-Cast Surface Finishes:

1. ACI 301 (ACI 301M) Surface Finish SF-2.0: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams.

    a. Patch voids larger than 3/4 inch wide or 1/2 inch deep.
    b. Remove projections larger than 1/4 inch.
    c. Patch tie holes.
    d. Surface Tolerance: ACI 117, Class B.
    e. Locations: Apply to concrete surfaces exposed to public view, to receive a rubbed finish,.

B. Rubbed Finish: Apply the following to as-cast surface finishes where indicated on Drawings:

1. Smooth-Rubbed Finish: (Exposed Retaining Walls, Loading Dock Face, and As Noted)

    a. Perform no later than one day after form removal.
    b. Moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture.

c. If sufficient cement paste cannot be drawn from the concrete by the rubbing process, use a grout made from the same cementitious materials used in the in-place concrete.
d. Maintain required patterns or variances as shown on Drawings or to match design reference sample mockups.

3.10 INSTALLATION OF MISCELLANEOUS CONCRETE ITEMS

A. Filling in:

1. Fill in holes and openings left in concrete structures after Work of other trades is in place unless otherwise indicated.
2. Mix, place, and cure concrete, as specified, to match color and texture with in-place construction exposed to view.
3. Provide other miscellaneous concrete filling indicated or required to complete the Work.

B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.

C. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches minimum in height high unless otherwise indicated on Drawings, and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated on Drawings, or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices.

    a. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
    b. Cast anchor-bolt insert into bases.
    c. Install anchor bolts to elevations required for proper attachment to supported equipment.

D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items.

1. Cast-in inserts and accessories, as shown on Drawings.
2. Screed, tamp, and trowel finish concrete surfaces.

3.11 APPLICATION OF CONCRETE CURING

A. Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

1. Comply with ACI 301 for cold weather protection during curing.
2. Comply with ACI 301 and ACI 305.1 for hot-weather protection during curing.
3. Maintain moisture loss no more than 0.2 lb/sq. ft. x h, calculated in accordance with ACI 305R, before and during finishing operations.

B. Curing Formed Surfaces: Comply with ACI 308.1 as follows:

1. Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces.
2. Cure concrete containing color pigments in accordance with color pigment manufacturer's instructions.
3. If forms remain during curing period, moist cure after loosening forms.
4. If removing forms before end of curing period, continue curing for remainder of curing period as follows:

    a. Continuous Fogging: Maintain standing water on concrete surface until final setting of concrete.
    b. Continuous Sprinkling: Maintain concrete surface continuously wet.
    c. Absorptive Cover: Pre-dampen absorptive material before application; apply additional water to absorptive material to maintain concrete surface continuously wet.
    d. Water-Retention Sheeting Materials: Cover exposed concrete surfaces with sheeting material, taping, or lapping seams.
    e. Membrane-Forming Curing Compound: Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.

        1) Recoat areas subject to heavy rainfall within three hours after initial application.
        2) Maintain continuity of coating and repair damage during curing period.

C. Curing Unformed Surfaces: Comply with ACI 308.1 as follows:

1. Begin curing after finishing concrete.
2. Interior Concrete Floors:

    a. Floors to Receive Floor Coverings Specified in Other Sections: (.1C) Concrete Construction Contractor has option of the following:

        1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

            a) Lap edges and ends of absorptive cover not less than 12 inches.
            b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

        2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

            a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
            b) Cure for not less than seven days.

        3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following not in cold weather:

            a) Water.

b) Continuous water-fog spray.

b. Floors to Receive Penetrating Liquid Floor Treatments: (.1C) Concrete Construction Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive.

a) Immediately repair any holes or tears during curing period, using cover material and waterproof tape.
b) Cure for not less than seven days.

3) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

c. Floors to Receive Polished Finish: (.1C) Concrete Construction Contractor has option of the following:

1) Absorptive Cover: As soon as concrete has sufficient set to permit application without marring concrete surface, install prewetted absorptive cover over entire area of floor.

a) Lap edges and ends of absorptive cover not less than 12 inches.
b) Maintain absorptive cover water saturated, and in place, for duration of curing period, but not less than seven days.

2) Ponding or Continuous Sprinkling of Water: Maintain concrete surfaces continuously wet for not less than seven days, utilizing one, or a combination of, the following:

a) Water.
b) Continuous water-fog spray.

d. Floors To Receive Curing Compound:

1) Apply uniformly in continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Maintain continuity of coating, and repair damage during curing period.
4) Removal: After curing period has elapsed, remove curing compound without

damaging concrete surfaces by method recommended by curing compound manufacturer.

e. Floors To Receive Curing and Sealing Compound:

1) Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller in accordance with manufacturer's written instructions.
2) Recoat areas subjected to heavy rainfall within three hours after initial application.
3) Repeat process 24 hours later, and apply a second coat. Maintain continuity of coating, and repair damage during curing period.

3.12 INSTALLATION OF JOINT FILLING

A. Prepare, clean, and install joint filler in accordance with manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least one month(s) or as agreed upon for project schedule and manufacturer installation instructions and/or warranties.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.13 INSTALLATION OF CONCRETE SURFACE REPAIRS

A. Defective Concrete:

1. Repair and patch defective areas when approved by The Professional.
2. Remove and replace concrete that cannot be repaired and patched to meet specification requirements.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks in excess of 0.01 inch spalls, air bubbles exceeding surface finish limits, honeycombs, rock pockets, fins and other projections on the surface exceeding surface finish limits, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete.

a. Limit cut depth to 3/4 inch.
b. Make edges of cuts perpendicular to concrete surface.
c. Clean, dampen with water, and brush-coat holes and voids with bonding agent.
d. Fill and compact with patching mortar before bonding agent has dried.
e. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.

2. Repair defects on surfaces exposed to view by blending white portland cement and

standard portland cement, so that, when dry, patching mortar matches surrounding color.

a. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching.
b. Compact mortar in place and match surrounding surface.

3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance, as determined by The Professional.

D. Repairing Unformed Surfaces:

1. Test unformed surfaces, such as floors and slabs, for finish, and verify surface tolerances specified for each surface.

a. Correct low and high areas.
b. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

2. Repair finished surfaces containing surface defects, including spalls, popouts, honeycombs, rock pockets, crazing, and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width.
3. After concrete has cured at least 14 days, correct high areas by grinding.
4. Correct localized low areas during, or immediately after, completing surface-finishing operations by adding patching mortar.

a. Finish repaired areas to blend into adjacent concrete.

5. Correct other low areas scheduled to receive floor coverings with a repair underlayment.

a. Prepare, mix, and apply repair underlayment and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
b. Feather edges to match adjacent floor elevations.

6. Correct other low areas scheduled to remain exposed with repair topping.

a. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor elevations.
b. Prepare, mix, and apply repair topping and primer in accordance with manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

7. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete.

a. Remove defective areas with clean, square cuts, and expose steel reinforcement with at least a 3/4-inch clearance all around.
b. Dampen concrete surfaces in contact with patching concrete and apply bonding agent.
c. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate.
d. Place, compact, and finish to blend with adjacent finished concrete.
e. Cure in same manner as adjacent concrete.

8. Repair random cracks and single holes 1 inch or less in diameter with patching mortar.

    a. Groove top of cracks and cut out holes to sound concrete, and clean off dust, dirt, and loose particles.
    b. Dampen cleaned concrete surfaces and apply bonding agent.
    c. Place patching mortar before bonding agent has dried.
    d. Compact patching mortar and finish to match adjacent concrete.
    e. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to The Professional's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to The Professional's approval.

3.14 FIELD QUALITY CONTROL

A. Special Inspections: (.1) General Construction Contractor will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

1. Testing agency to be responsible for providing curing facility for initial curing of strength test specimens on-site and verifying that test specimens are cured in accordance with standard curing requirements in ASTM C31/C31M.
2. Testing agency to immediately report to The Professional, (.1) General Construction Contractor, and concrete manufacturer any failure of Work to comply with Contract Documents.
3. Testing agency to report results of tests and inspections, in writing, to the Department, The Professional, (.1) General Construction Contractor, and concrete manufacturer within 48 hours of inspections and tests.

    a. Test reports to include reporting requirements of ASTM C31/C31M, ASTM C39/C39M, and ACI 301, including the following as applicable to each test and inspection:

        1) Project name.
        2) Name of testing agency.
        3) Names and certification numbers of field and laboratory technicians performing inspections and testing.
        4) Name of concrete manufacturer.
        5) Date and time of inspection, sampling, and field testing.
        6) Date and time of concrete placement.
        7) Location in Work of concrete represented by samples.
        8) Date and time sample was obtained.
        9) Truck and batch ticket numbers.
        10) Design compressive strength at 28 days.
        11) Concrete mixture designation, proportions, and materials.
        12) Field test results of fresh concrete, including slump or slump flow, air content, temperature and density.
        13) Information on storage and curing of samples at the Project site, including curing method and maximum and minimum temperatures during initial curing period.

14) Type of fracture and compressive break strengths at seven days and 28 days.

4. Provide a space and source of power or other resources for curing and access to test specimens by the testing agency.

C. Delivery Tickets: comply with ASTM C94/C94M.

D. Inspections:

1. Headed bolts and studs.
2. Verification of use of required design mixture.
3. Concrete placement, including conveying and depositing.
4. Curing procedures and maintenance of curing temperature.
5. Verification of concrete strength before removal of shores and forms from beams and slabs.

6. Batch Plant Inspections: On a random basis, as determined by The Professional.

E. Concrete Tests: Testing of composite samples of fresh concrete obtained in accordance with ASTM C 172/C 172M to be performed in accordance with the following requirements:

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 150 cu. yd. or fraction thereof.

a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing is to be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C143/C143M:

a. One test at point of delivery for each composite sample, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests as needed.

3. Slump Flow: ASTM C1611/C1611M:

a. One test at point of delivery for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.
b. Perform additional tests as needed.

4. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete; ASTM C173/C173M volumetric method, for structural lightweight concrete.

a. One test for each composite sample when strength test specimens are cast, but not less than one test for each day's pour of each concrete mixture.

5. Concrete Temperature: ASTM C1064/C1064M:

a. One test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample when strength test specimens are cast.

6. Concrete Density: ASTM C138/C138M:

    a. One test for each composite sample when strength test specimens are cast.

7. Unit Weight: ASTM C138/C138M density of fresh structural lightweight concrete.

    a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture. The fresh density should be consistent with that associated with the equilibrium density within a tolerance of plus or minus 4 lb/ft.3.

8. Compression Test Specimens: ASTM C31/C31M:

    a. Cast and standard cure two sets of two 6 inches by 12-inches or 4-inch by 8-inch cylindrical specimens for each composite sample.

9. Compressive-Strength Tests: ASTM C39/C39M.

    a. Test one set of two standard cured specimens at seven days and one set of two specimens at 28 days.
    b. A compressive-strength test to be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.

10. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, (.1) General Construction Contractor to evaluate operations and provide corrective procedures for protecting and curing in-place concrete.

11. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests of standard cured cylinders equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi if specified compressive strength is 5000 psi, or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi.

12. If compressive strength of in situ concrete is accepted, either without additional testing or on the basis of testing other than original cylinder compressive strength tests, the Contractor shall compensate the Department for the Contractor's failure to meet the specified strength requirements by paying to the Department one hundred dollars ($100) per cubic yard for each one hundred pounds per square inch (100psi) below the specified compressive strength. The original laboratory cured 28-day cylinder compressive strength test results only shall be used to determine the difference between specified and furnished strengths.

13. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by The Professional but will not be used as sole basis for approval or rejection of concrete.

14. Additional Tests:

    a. Testing and inspecting agency to make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by The Professional.
    b. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42/C42M or by other methods as directed by The Professional.

1) Acceptance criteria for concrete strength to be in accordance with ACI 301, Section 1.7.6.3.

15. Additional testing and inspecting, at (.1) General Construction Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

16. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

F. Measure floor and slab flatness and levelness in accordance with ASTM E1155 within 24 hours of completion of floor finishing and promptly report test results to The Professional.

3.15 PROTECTION

A. Protect concrete surfaces as follows:

1. Protect from petroleum stains.
2. Diaper hydraulic equipment used over concrete surfaces.
3. Prohibit vehicles from interior concrete slabs.
4. Prohibit use of pipe-cutting machinery over concrete surfaces.
5. Prohibit placement of steel items directly on concrete surfaces. Place on wood blocks or other means to elevate off of concrete during storage or staging.
6. Prohibit use of acids or acidic detergents over concrete surfaces.
7. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.
8. Protect concrete surfaces scheduled to receive surface hardener or polished concrete finish using floor slab protective covering.

END OF SECTION 033000

SECTION 03 5400

CAST UNDERLAYMENT

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Polymer-modified, self-leveling, hydraulic cement underlayment for application below interior floor coverings.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site .

1.4 ACTION SUBMITTALS

A. Product Data: For the following:

1. Hydraulic cement underlayment.
2. Reinforcement.
3. Primer.
4. Corrosion-resistant coating.
5. Surface sealer.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Installer who is approved by manufacturer for application of underlayment products required for this Project.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Comply with manufacturer's written instructions for substrate temperature, ventilation, ambient temperature and humidity, and other conditions affecting underlayment performance.

1. Place hydraulic cement underlayments only when ambient temperature and temperature of substrates are between 50 and 80 deg F.

PART 2 - PRODUCTS

2.1 HYDRAULIC CEMENT UNDERLAYMENTS

A. Hydraulic Cement Underlayment: Polymer-modified, self-leveling, hydraulic cement product that can be applied in minimum uniform thickness of 1/4 inch and that can be feathered at edges to match adjacent floor elevations.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or equal as approved by Professional:
   a. ARDEX Americas.
   b. Custom Building Products.
   c. MAPEI Corporation.
   d. Maxxon Corporation.
   e. USG Corporation.
2. Cement Binder: ASTM C150/C150M, portland cement, or hydraulic or blended hydraulic cement as defined by ASTM C219.
3. Compressive Strength: Not less than 5000 psi at 28 days when tested according to ASTM C109/C109M.
4. Underlayment Additive: Resilient-emulsion product of underlayment manufacturer, formulated for use with underlayment when applied to substrate and conditions indicated.

B. Aggregate: Well-graded, washed gravel, 1/8 to 1/4 inch; or coarse sand as recommended by underlayment manufacturer.

1. Provide aggregate when recommended in writing by underlayment manufacturer for underlayment thickness required.

C. Water: Potable and at a temperature of not more than 70 deg F.

D. Reinforcement: For underlayment applied to wood substrates, provide galvanized metal lath or other corrosion-resistant reinforcement recommended in writing by underlayment manufacturer.

E. Primer: Product of underlayment manufacturer recommended in writing for substrate, conditions, and application indicated.

F. Corrosion-Resistant Coating: Recommended in writing by underlayment manufacturer for metal substrates.

G. Surface Sealer: Designed to reduce porosity as recommended by manufacturer for type of floor covering to be applied to underlayment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for conditions affecting performance of the Work.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare and clean substrate according to manufacturer's written instructions.

1. Treat nonmoving substrate cracks according to manufacturer's written instructions to prevent cracks from telegraphing (reflecting) through underlayment.
2. Fill substrate voids to prevent underlayment from leaking.

B. Concrete Substrates: Mechanically remove, according to manufacturer's written instructions, laitance, glaze, efflorescence, curing compounds, form-release agents, dust, dirt, grease, oil, and other contaminants that might impair underlayment bond.

1. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
   a. Anhydrous Calcium Chloride Test, ASTM F1869: Proceed with installation only after substrates do not exceed a maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 85 percent relative humidity level measurement, or as recommended by hydraulic cement underlayment manufacturer.

C. Wood Substrates: Mechanically fasten loose boards and panels to eliminate substrate movement and squeaks. Sand to remove coatings that might impair underlayment bond and remove sanding dust.

1. Install underlayment reinforcement recommended in writing by manufacturer.

3.3 INSTALLATION

A. Mix and install underlayment components according to manufacturer's written instructions.

1. Close areas to traffic during underlayment installation and for time period after installation recommended in writing by manufacturer.
2. Coordinate installation of components to provide optimum adhesion to substrate and between coats.
3. At substrate expansion, isolation, and other moving joints, allow joint of same width to continue through underlayment.

B. Apply primer over prepared substrate at manufacturer's recommended spreading rate.

C. Install underlayment to produce uniform, level surface.

1. Feather edges to match adjacent floor elevations.

D. Cure underlayment according to manufacturer's written instructions. Prevent contamination during installation and curing processes.

E. Do not install floor coverings over underlayment until after time period recommended in writing by underlayment manufacturer.

F. Apply surface sealer at rate recommended by manufacturer.

G. Remove and replace underlayment areas that evidence lack of bond with substrate, including areas that emit a "hollow" sound when tapped.

3.4 INSTALLATION TOLERANCES

A. Finish and measure surface, so gap at any point between gypsum cement underlayment surface and an unleveled, freestanding, 10-foot- long straightedge resting on two high spots and placed anywhere on the surface does not exceed 1/8 inch .

3.5 PROTECTION

A. Protect underlayment from concentrated and rolling loads for remainder of construction period.

END OF SECTION 03 5400

SECTION 040120.63

BRICK MASONRY REPAIR

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes repairing brick masonry, including replacing units.

1.3 DEFINITIONS

A. Rebuilding (Setting) Mortar: Mortar used to set and anchor masonry in a structure, distinct from pointing mortar installed after masonry is set in place.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Include plans, elevations, sections, and locations of replacement masonry units on the structure.
2. Show provisions for expansion joints or other sealant joints.

C. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.6 QUALITY ASSURANCE

A. Brick Masonry Repair Specialist Qualifications: Engage an experienced brick masonry repair firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repair work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials

and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of brick masonry repair to demonstrate aesthetic effects and to set quality standards for materials and execution and for fabrication and installation.

1. Masonry Repair: Prepare sample areas for each type of masonry repair work performed. If not otherwise indicated, size each mockup not smaller than two adjacent whole units or approximately 48 inches (1200 mm) in least dimension. Construct sample areas in locations in existing walls where directed by Architect unless otherwise indicated. Demonstrate quality of materials, workmanship, and blending with existing work.

PART 2 - PRODUCTS

2.1 MASONRY MATERIALS

A. Face Brick: As required to complete brick masonry repair work.

1. Brick Matching Existing: Units with colors, color variation within units, surface texture, size, and shape that match existing brickwork.

a. For existing brickwork that exhibits a range of colors or color variation within units, provide brick that proportionally matches that range and variation rather than brick that matches an individual color within that range.

2. Special Shapes:

a. Provide molded, 100 percent solid shapes for applications where core holes or "frogs" could be exposed to view or weather when in final position and where shapes produced by sawing would result in sawed surfaces being exposed to view.
b. Provide specially ground units, shaped to match patterns, for arches and where indicated.
c. Mechanical chopping or breaking brick, or bonding pieces of brick together by adhesive, are unacceptable procedures for fabricating special shapes.

B. Building Brick: ASTM C 62, Grade SW and of same vertical dimension as face brick, for masonry work concealed from view.

2.2 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Masonry Cement: ASTM C 91/C 91M.

D. Mortar Cement: ASTM C 1329/C 1329M.

E. Mortar Sand: ASTM C 144.

1. Exposed Mortar: Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Colored Mortar: Natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C 979/C 979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.3 MANUFACTURED REPAIR MATERIALS

A. Brick Patching Compound: Factory-mixed cementitious product that is custom manufactured for patching brick masonry.
1. Use formulation that is vapor and water permeable (equal to or more than the masonry unit), exhibits low shrinkage, has lower modulus of elasticity than masonry units being repaired, and develops high bond strength to all types of masonry.
2. Formulate patching compound in colors and textures to match each masonry unit being patched.

2.4 ACCESSORY MATERIALS

A. Setting Buttons and Shims: Resilient plastic, nonstaining to masonry, sized to suit joint thicknesses and bed depths of masonry units, less the required depth of pointing materials unless removed before pointing.

B. Other Products: Select materials and methods of use based on the following, subject to approval of a mockup:

1. Previous effectiveness in performing the work involved.
2. Minimal possibility of damaging exposed surfaces.
3. Consistency of each application.
4. Uniformity of the resulting overall appearance.
5. Do not use products or tools that could leave residue on surfaces.

2.5 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:
   1. Rebuilding (Setting) Mortar by Property: ASTM C 270, Property Specification, Type N unless otherwise indicated; with cementitious material limited to masonry cement or mortar cement.
   2. Pigmented, Colored Mortar: Add mortar pigments to produce exposed, setting (rebuilding) mortar of colors required.

PART 3 - EXECUTION

3.1 BRICK REMOVAL AND REPLACEMENT

A. At locations indicated, remove bricks that are damaged, spalled, or deteriorated or are to be reused. Carefully remove entire units from joint to joint, without damaging surrounding masonry, in a manner that permits replacement with full-size units.

   1. Include 200 sf of brick removal and replacement in general areas indicated on the drawings for miscellaneous damaged existing brick repair. This is in addition to the reinstallation of salvaged brick being installed at window sills and patching of areas at stair tower removal indicated on drawings.

B. Support and protect remaining masonry that surrounds removal area.

C. Maintain flashing, reinforcement, lintels, and adjoining construction in an undamaged condition.

D. Notify Architect of unforeseen detrimental conditions including voids, cracks, bulges, and loose units in existing masonry backup, rotted wood, rusted metal, and other deteriorated items.

E. Remove in an undamaged condition as many whole bricks as possible.

   1. Remove mortar, loose particles, and soil from brick by cleaning with hand chisels, brushes, and water.
   2. Remove sealants by cutting close to brick with utility knife and cleaning with solvents.

F. Clean masonry surrounding removal areas by removing mortar, dust, and loose particles in preparation for brick replacement.

G. Replace removed damaged brick with other removed brick in good condition, where possible, matching existing brick. Do not use broken units unless they can be cut to usable size.

H. Install replacement brick into bonding and coursing pattern of existing brick. If cutting is required, use a motor-driven saw designed to cut masonry with clean, sharp, unchipped edges.

   1. Maintain joint width for replacement units to match existing joints.
   2. Use setting buttons or shims to set units accurately spaced with uniform joints.

I. Lay replacement brick with rebuilding (setting) mortar and with completely filled bed, head, and collar joints. Butter ends with enough mortar to fill head joints and shove into place. Wet both replacement and surrounding bricks that have ASTM C 67 initial rates of absorption (suction) of more than 30 g/30 sq. in. per min Use wetting methods that ensure that units are nearly saturated but surface is dry when laid.

   1. Tool exposed mortar joints in repaired areas to match joints of surrounding existing brickwork.

2. Rake out mortar used for laying brick before mortar sets according to Section 040120.64 "Brick Masonry Repointing." Point at same time as repointing of surrounding area.
3. When mortar is hard enough to support units, remove shims and other devices interfering with pointing of joints.

J. Curing: Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.

1. Hairline cracking within the mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

3.2 MASONRY UNIT PATCHING

A. Patching Bricks:

1. Remove loose material from masonry surface. Carefully remove additional material so patch does not have feathered edges but has square or slightly undercut edges on area to be patched and is at least 1/4 inch (6 mm) thick, but not less than recommended in writing by patching compound manufacturer.
2. Mask adjacent mortar joint or rake out for repointing if patch extends to edge of masonry unit.
3. Mix patching compound in individual batches to match each unit being patched. Combine one or more colors of patching compound, as needed, to produce exact match.
4. Rinse surface to be patched and leave damp, but without standing water.
5. Brush-coat surfaces with slurry coat of patching compound according to manufacturer's written instructions.
6. Place patching compound in layers as recommended in writing by patching compound manufacturer, but not less than 1/4 inch (6 mm) or more than 2 inches (50 mm) thick. Roughen surface of each layer to provide a key for next layer.
7. Trowel, scrape, or carve surface of patch to match texture and surrounding surface plane or contour of masonry unit. Shape and finish surface before or after curing, as determined by testing, to best match existing masonry unit.
8. Keep each layer damp for 72 hours or until patching compound has set.

3.3 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040120.63

SECTION 040120.64

BRICK MASONRY REPPONTING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes repointing joints with mortar.

1.3 UNIT PRICES

A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.5 INFORMATIONAL SUBMITTALS

A. Quality-control program.

1.6 QUALITY ASSURANCE

A. Brick Masonry Repointing Specialist Qualifications: Engage an experienced brick masonry repointing firm to perform work of this Section. Firm shall have completed work similar in material, design, and extent to that indicated for this Project with a record of successful in-service performance. Experience in only installing masonry is insufficient experience for masonry repointing work.

B. Quality-Control Program: Prepare a written quality-control program for this Project to systematically demonstrate the ability of personnel to properly follow methods and use materials and tools without damaging masonry. Include provisions for supervising performance and preventing damage.

C. Mockups: Prepare mockups of brick masonry repointing to demonstrate aesthetic effects and to set quality standards for materials and execution.

1. Repointing: Rake out joints in two separate areas, each approximately 36 inches (900 mm) high by 48 inches (1200 mm) wide, unless otherwise indicated, for each type of repointing required, and repoint one of the areas.

PART 2 - PRODUCTS

2.1 MORTAR MATERIALS

A. Portland Cement: ASTM C 150/C 150M, Type I or Type II, except Type III may be used for cold-weather construction; white or gray, or both where required for color matching of mortar.

1. Provide cement containing not more than 0.60 percent total alkali when tested according to ASTM C 114.

B. Hydrated Lime: ASTM C 207, Type S.

C. Masonry Cement: ASTM C 91/C 91M.

D. Mortar Cement: ASTM C 1329/C 1329M.

E. Mortar Sand: ASTM C 144.

1. Match size, texture, and gradation of existing mortar sand as closely as possible. Blend several sands if necessary to achieve suitable match.
2. Color: Provide natural sand or ground marble, granite, or other sound stone of color necessary to produce required mortar color.

F. Mortar Pigments: ASTM C 979/C 979M, compounded for use in mortar mixes, and having a record of satisfactory performance in masonry mortars.

G. Water: Potable.

2.2 MORTAR MIXES

A. Measurement and Mixing: Measure cementitious materials and sand in a dry condition by volume or equivalent weight. Do not measure by shovel; use known measure. Mix materials in a clean, mechanical batch mixer.

1. Mixing Pointing Mortar: Thoroughly mix cementitious materials and sand together before adding any water. Then mix again, adding only enough water to produce a damp, unworkable mix that retains its form when pressed into a ball. Maintain mortar in this dampened condition for 15 to 30 minutes. Add remaining water in small portions until mortar reaches desired consistency. Use mortar within one hour of final mixing; do not retemper or use partially hardened material.

B. Colored Mortar: Produce mortar of color required by using specified ingredients. Do not alter specified proportions without Architect's approval.

1. Mortar Pigments: Where mortar pigments are indicated, do not add pigment exceeding 10 percent by weight of the cementitious or binder materials, except for carbon black which is limited to 2 percent.

C. Do not use admixtures in mortar unless otherwise indicated.

D. Mixes: Mix mortar materials in the following proportions:

1. Pointing Mortar by Volume: ASTM C 270, Proportion Specification, 1 part portland cement, 1 part lime, and 6 parts sand. Add mortar pigments to produce mortar colors required.
2. Pointing Mortar by Type: ASTM C 270, Proportion Specification, Type N unless otherwise indicated; with cementitious material limited to masonry cement or mortar cement. Add mortar pigments to produce mortar colors required.

PART 3 - EXECUTION

3.1 REPOINTING MASONRY

A. Include 200 square feet of brick repointing of salvaged brick reinstallation and cracked or broken existing joints in general areas indicated on the drawings. This is in addition to pointing for the reinstallation of salvaged brick being installed at window sills and patching of areas at stair tower removal indicated on drawings.

B. Rake out and repoint joints to the following extent:

1. All joints in areas indicated.
2. Joints indicated as sealant-filled joints. Seal joints according to Section 079200 "Joint Sealants."
3. Joints at locations of the following defects:

a. Holes and missing mortar.
b. Cracks that can be penetrated 1/4 inch (6 mm) or more by a knife blade 0.027 inch (0.7 mm) thick.
c. Cracks **1/16 inch (1.6 mm)** or more in width and of any depth.
d. Hollow-sounding joints when tapped by metal object.
e. Eroded surfaces 1/4 inch (6 mm) or more deep.
f. Deterioration to point that mortar can be easily removed by hand, without tools.
g. Joints filled with substances other than mortar.

C. Do not rake out and repoint joints where not required.

D. Rake out joints as follows, according to procedures demonstrated in approved mockup:

1. Remove mortar from joints to depth of joint width plus 1/8 inch (3 mm, but not less than 1/2 inch (13 mm) or not less than that required to expose sound, unweathered mortar.
2. Remove mortar from masonry surfaces within raked-out joints to provide reveals with square backs and to expose masonry for contact with pointing mortar. Brush, vacuum, or flush joints to remove dirt and loose debris.
3. Do not spall edges of masonry units or widen joints. Replace or patch damaged masonry units as directed by Architect.

E. Notify Architect of unforeseen detrimental conditions including voids in mortar joints, cracks, loose masonry units, rotted wood, rusted metal, and other deteriorated items.

F. Pointing with Mortar:

1. Rinse joint surfaces with water to remove dust and mortar particles. Time rinsing application so, at time of pointing, joint surfaces are damp but free of standing water. If rinse water dries, dampen joint surfaces before pointing.
2. Apply pointing mortar first to areas where existing mortar was removed to depths greater than surrounding areas. Apply in layers not greater than 3/8 inch until a uniform depth is formed. Fully compact each layer, and allow it to become thumbprint hard before applying next layer.
3. After deep areas have been filled to same depth as remaining joints, point joints by placing mortar in layers not greater than 3/8 inch. Fully compact each layer and allow to become thumbprint hard before applying next layer. Where existing masonry units have worn or rounded edges, slightly recess finished mortar surface below face of masonry to avoid widened joint faces. Take care not to spread mortar beyond joint edges onto exposed masonry surfaces or to featheredge the mortar.
4. When mortar is thumbprint hard, tool joints to match original appearance of joints as demonstrated in approved mockup. Remove excess mortar from edge of joint by brushing.
5. Cure mortar by maintaining in thoroughly damp condition for at least 72 consecutive hours, including weekends and holidays.
6. Hairline cracking within mortar or mortar separation at edge of a joint is unacceptable. Completely remove such mortar and repoint.

G. Where repointing work precedes cleaning of existing masonry, allow mortar to harden at least 30 days before beginning cleaning work.

3.2 FINAL CLEANING

A. After mortar has fully hardened, thoroughly clean exposed masonry surfaces of excess mortar and foreign matter; use wood scrapers, stiff-nylon or -fiber brushes, and clean water, applied by low pressure spray.

1. Do not use metal scrapers or brushes.
2. Do not use acidic or alkaline cleaners.

END OF SECTION 040120.64

SECTION 04 2000

UNIT MASONRY

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).
2. Face Brick.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for furnishing steel lintels and shelf angles for unit masonry.

1.3 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

1. Clay Masonry Unit Test: For each type of unit required, according to ASTM C 67 for compressive strength.
2. Concrete Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
3. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
4. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
5. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement.

C. Samples for Verification: For each type and color of exposed masonry unit and colored mortar.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product indicated. For masonry units include data on material properties material test reports substantiating compliance with requirements.

B. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.6 QUALITY ASSURANCE

A. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 602 unless modified by requirements in the Contract Documents.

B. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.

1. Build sample panels for typical exterior wall in sizes approximately 48 inches long by 48 inches high by full thickness.

1.7 PROJECT CONDITIONS

A. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

B. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

B. CMUs: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength as indicated on structural drawings.
2. Density Classification: Normal weight unless otherwise indicated.

3. Products: Subject to compliance with requirements, provide products by one of the following or equal approved by Professional:
   a. Church Brick
   b. McAvoy Brick
   c. Glen-Gery
   d. Redland Brick
   e. Belden Tri-State Building Materials
   f. Or Equal as approved by the Professional.

2.3 BRICK

A. Use salvaged brick to greatest extent possible for best match. Provide new matching brick as necessary if inadequate supply of salvaged brick is available.

B. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of existing adjacent units:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

C. Clay Face Brick: Facing brick complying with ASTM C 216.

1. Grade: SW.
2. Type: FBS.
3. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3350 psi.
4. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested according to ASTM C 67.
5. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated "not effloresced."
6. Surface Coating: Brick with colors or textures produced by application of coatings shall withstand 50 cycles of freezing and thawing according to ASTM C 67 with no observable difference in the applied finish when viewed from 10 feet.
7. Size: Match existing.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C 144.

1. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
2. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

E. Aggregate for Grout: ASTM C 404.

F. Water: Potable.

G. Do not use add mixtures, including air entraining agents, accelerator, retarders, salts, anti-freeze compounds, or other admixtures, unless otherwise indicated or accepted in writing by the Professional prior to use.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
1. Exterior Walls: Hot-dip galvanized, carbon steel.
2. Wire Size for Side Rods: 0.187-inch diameter.
3. Wire Size for Cross Rods**:** 0.187-inch diameter.
4. Wire Size for Veneer Ties: 0.187-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

2.6 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.

B. Adjustable Masonry-Veneer Anchors:

1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:

    a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.

2. Contractor's Option: Unless otherwise indicated, provide any of the following types of anchors:
3. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.

    a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
        1) Heckmann Building Products Inc.
        2) Hohmann & Barnard, Inc.
        3) Wire-Bond.
        4) Or equal as approved by Professional.

    b. Anchor Section: Rib-stiffened, sheet metal plate with screw holes top and bottom, having slotted holes for inserting wire tie.
    c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch- diameter, hot-dip galvanized steel wire.

C. Partition Top Anchors: 0.105-inch- (2.66-mm-) thick metal plate with a 3/8-inch- (9.5-mm-) diameter metal rod 6 inches (152 mm) long welded to plate and with closed-end plastic tube fitted over rod that allows rod to move in and out of tube. Fabricate from steel, hot-dip galvanized after fabrication.

D. Anchor Bolts: Headed or L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

2.7 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing complying with SMACNA's "Architectural Sheet Metal Manual" Section 076200 "Sheet Metal Flashing and Trim" and as follows:

1. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

    a. Manufacturers: Subject to compliance with requirements, available manufacturers with products that may be incorporated into the Work include, but are not limited to, the following, or equal approved by Professional:

        1) Heckmann Building Products Inc.
        2) Hohmann & Barnard, Inc.
        3) Wire Bond, Inc.
        4) Or equal as approved by Professional.

2. Metal Sealant Stop: Fabricate from stainless steel. Extend at least 3 inches into wall and out to exterior face of wall. At exterior face of wall, bend metal back on itself for 3/4 inch and down into joint 1/4 inch to form a stop for retaining sealant backer rod.

B. Flexible Flashing: Use one of the following unless otherwise indicated:

1. EPDM Flashing: Sheet flashing product made from ethylene-propylene-diene terpolymer, complying with ASTM D 4637, 0.040 inch thick.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following, or equal approved by Professional :

1) Carlisle Coatings & Waterproofing; Pre-Kleened EPDM Thru-Wall Flashing.
2) Firestone Specialty Products; FlashGuard.
3) Heckmann Building Products Inc.; No. 81 EPDM Thru-Wall Flashing.
4) Hohmann & Barnard, Inc.; Epra-Max EPDM Thru-Wall Flashing.
5) Or equal as approved by Professional.

C. Solder and Sealants for Sheet Metal Flashings: As specified in Section 076200 "Sheet Metal Flashing and Trim."

D. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.8 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; formulated from urethane.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Products: Use the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

a. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following, or equal approved by Professional :

1) Advanced Building Products Inc.; Mortar Maze weep vent.
2) Blok-Lok Limited; Cell-Vent.
3) Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
4) Heckmann Building Products Inc.; No. 85 Cell Vent.
5) Hohmann & Barnard, Inc.; Quadro-Vent.
6) Wire-Bond; Cell Vent.
7) Or equal as approved by Professional.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following, or equal approved by Professional:

    a. Advanced Building Products Inc.; Mortar Break.
    b. Archovations, Inc.; CavClear Masonry Mat.
    c. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
    d. Mortar Net USA, Ltd.; Mortar Net.
    e. Or equal as approved by Professional.

2. Provide one of the following configurations:

    a. Strips, full-depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep.
    b. Sheets or strips full depth of cavity and installed to full height of cavity.

2.9 CAVITY-WALL INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, Type IV, closed-cell product extruded with an integral skin.

B. Adhesive: Type recommended by insulation board manufacturer for application indicated.

2.10 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following, or equal approved by Professional:

    a. Diedrich Technologies, Inc.
    b. EaCo Chem, Inc.
    c. ProSoCo, Inc.
    d. Or equal as approved by Professional.

2.11 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.

B. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated.

1. For masonry below grade or in contact with earth, use Type M.

2. For reinforced masonry, use Type N.
3. For mortar parge coats, use Type S or Type N.

C. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

B. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

C. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.2 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2 inch total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch.
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch or minus 1/4 inch.
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch.

3.3 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

D. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

E. Fill cores in hollow CMUs with grout 24 inches under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.4 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 ANCHORED MASONRY VENEER

A. Anchor masonry veneers to concrete backup with masonry-veneer anchors to comply with the following requirements:

1. Fasten screw-attached anchors to concrete with metal fasteners of type indicated. Use two fasteners unless anchor design only uses one fastener.
2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 25 inches o.c. horizontally, with not less than one anchor for each **2.67 sq. ft.** of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Coat cavity face of backup wythe using weather barrier or waterproofing as indicated.

D. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 ANCHORING MASONRY TO STRUCTURAL STEEL AND CONCRETE

A. Anchor masonry to structural steel and concrete where masonry abuts or faces structural steel or concrete to comply with the following:

1. Provide an open space not less than **1/2 inch** wide between masonry and structural steel or concrete unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.8 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
3. Install metal drip edges beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal drip edge.
4. Install metal flashing termination beneath flexible flashing at exterior face of wall. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of metal flashing termination.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24 inches o.c. unless otherwise indicated.
3. Cover cavity side of weep holes with plastic insect screening at cavities insulated with loose-fill insulation.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

3.9 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: Engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Level 1 special inspections according to the "International Building Code."

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

G. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: General (.1) Construction Contractor shall engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.

B. Inspections: Special inspections according to Level **B** in TMS 402/ACI 530/ASCE 5.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.
2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
3. Place grout only after inspectors have verified proportions of site-prepared grout.

C. Testing Prior to Construction: One set of tests.

D. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

E. Clay Masonry Unit Test: For each type of unit provided, according to ASTM C 67 for compressive strength.

F. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C 140 for compressive strength.

G. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C 780.

H. Mortar Test (Property Specification): For each mix provided, according to ASTM C 780. Test mortar for mortar air content and compressive strength.

I. Grout Test (Compressive Strength): For each mix provided, according to ASTM C 1019.

3.12 PARGING

A. Parge exterior faces of below-grade masonry walls, where indicated, in 2 uniform coats to a total thickness of 3/4 inch.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.13 REPAIRING, POINTING, AND CLEANING

A. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

B. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes.
2. Protect surfaces from contact with cleaner.
3. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
4. Clean brick by bucket-and-brush hand-cleaning method described in BIA Technical Notes 20.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.14 MASONRY WASTE DISPOSAL

A. Waste Disposal as Fill Material: Dispose of clean masonry waste, including excess or soil-contaminated sand, waste mortar, and broken masonry units, by crushing and mixing with fill material as fill is placed.

1. Do not dispose of masonry waste as fill within 18 inches of finished grade.

B. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Client Agency's property.

END OF SECTION 042000

SECTION 051200
STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

1. Structural-steel materials.
2. Shrinkage-resistant grout.
3. Shear stud connectors.

B. Related Requirements:

1. Section 051213 "Architecturally Exposed Structural Steel Framing" for additional requirements for architecturally exposed structural steel.
2. Section 053100 "Steel Decking" for field installation of shear stud connectors through deck.
3. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame miscellaneous steel fabrications and other steel items not defined as structural steel.
4. Section 099113 "Exterior Painting" and Section 099123 "Interior Painting" for painting requirements.

1.3 DEFINITIONS

A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in ANSI/AISC 303.

1.4 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data:

1. Structural-steel materials.
2. High-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Anchor rods.
5. Threaded rods.
6. Slide bearings.
7. Shop primer.
8. Galvanized-steel primer.
9. Etching cleaner.
10. Galvanized repair paint.
11. Shrinkage-resistant grout.

B. Shop Drawings: Show fabrication of structural-steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
2. Include embedment Drawings.
3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
5. Identify members not to be shop primed.

C. Welding Procedure Specifications (WPSs) and Procedure Qualification Records (PQRs): Provide in accordance with AWS D1.1/D1.1M for each welded joint whether prequalified or qualified by testing, including the following:

1. Power source (constant current or constant voltage).
2. Electrode manufacturer and trade name, for demand-critical welds.

D. Delegated Design Submittal: For structural-steel connections indicated on Drawings to comply with design loads, include analysis data signed and sealed by a qualified professional registered in the state, responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Mill test reports for structural-steel materials, including chemical and physical properties.

E. Product Test Reports: For the following:

1. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
2. Tension-control, high-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.

F. Field quality-control reports.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU or is accredited by the IAS Fabricator Inspection Program for Structural Steel (Acceptance Criteria 172).

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program and is designated an AISC-Certified Erector, Category CSE.

C. Shop-Painting Applicator Qualifications: Qualified in accordance with AISC's Sophisticated Paint Endorsement P2 or to SSPC-QP 3.

D. Welding Qualifications: Qualify procedures and personnel in accordance with AWS D1.1/D1.1M.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

1. Fasteners may be repackaged provided the testing and inspecting agency observes repackaging and seals containers.
2. Clean and relubricate bolts and nuts that become dry or rusty before use.
3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F3125/F3125M, Grade F1852 bolt assemblies and for retesting bolt assemblies after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with applicable provisions of the following specifications and documents:

1. ANSI/AISC 303.
2. ANSI/AISC 341.
3. ANSI/AISC 360.
4. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:

1. Option 3 and 3B: Design connections and final configuration of member reinforcement at connections in accordance with ANSI/AISC 303 by fabricator's qualified professional registered in the state.

a. Use Load and Resistance Factor Design; data are given at factored-load level.

C. Moment Connections: Type PR, partially and Type FR, fully restrained.

D. Construction: Combined system of moment frame and braced frame.

2.2 STRUCTURAL-STEEL MATERIALS

A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

B. W-Shapes: ASTM A992/A992M.

C. Channels, Angles, M-Shapes: ASTM A36/A36M.

D. Plate and Bar: ASTM A36/A36M.

E. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

F. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.

1. Weight Class: As Indicated.
2. Finish: Black.

G. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS AND CONNECTORS

A. High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

B. High-Strength A490 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A490, Type 1, heavy-hex steel structural bolts or Grade F2280 tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers; all with plain finish.

C. Zinc-Coated High-Strength A325 Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Hot-dip zinc coating.

D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round head assemblies, consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain.

E. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable, as specified on drawings.

1. Configuration: Straight.
2. Nuts: ASTM A563 heavy-hex carbon steel.
3. Plate Washers: ASTM A36/A36M carbon steel.
4. Washers: ASTM F436, Type 1, hardened carbon steel.
5. Finish: Plain orHot-dip zinc coating, ASTM A153/A153M, Class C, pending exposure as indicated on drawings.

B. Headed Anchor Rods: ASTM F1554, Grade 36 or ASTM F1554, Grade 55, weldable, as specified on drawings, straight.

1. Nuts: ASTM A563 heavy-hex carbon steel.
2. Plate Washers: ASTM A36/A36M carbon steel.
3. Washers: ASTM F436, Type 1, hardened carbon steel.
4. Finish: Plain orHot-dip zinc coating, ASTM A153/A153M, Class C, pending exposure as indicated on drawings.

C. Threaded Rods: ASTM A36/A36M.

1. Nuts: ASTM A63 heavy-hex carbon steel.
2. Washers: ASTM F436, Type 1, hardened carbon steel.
3. Finish: Plain.

2.5 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
2. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

B. Galvanized-Steel Primer: MPI#26.

1. Etching Cleaner: MPI#25, for galvanized steel.
2. Galvanizing Repair Paint: MPI#18, MPI#19, or SSPC-Paint 20.

2.6 SHRINKAGE-RESISTANT GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C1107/C1107M, factory-packaged, nonmetallic aggregate grout, noncorrosive and nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

2.7 FABRICATION

A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate in accordance with ANSI/AISC 303 and to ANSI/AISC 360.

1. Camber structural-steel members where indicated.

2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel in accordance with ASTM A6/A6M and maintain markings until structural-steel framing has been erected.
4. Mark and match-mark materials for field assembly.
5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted in accordance with SSPC-SP 2.

F. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using automatic end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.

1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.8 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.9 GALVANIZING

A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel in accordance with ASTM A123/A123M.

1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.

2.10 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces of high-strength bolted, slip-critical connections.
4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
5. Galvanized surfaces unless indicated to be painted.
6. Surfaces enclosed in interior construction.

B. Surface Preparation of Steel: Clean surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces in accordance with the following specifications and standards:

1. SSPC-SP 2.

C. Surface Preparation of Galvanized Steel: Prepare galvanized-steel surfaces for shop priming by thoroughly cleaning steel of grease, dirt, oil, flux, and other foreign matter, and treating with etching cleaner or in accordance with SSPC-SP 16.

D. Priming: Immediately after surface preparation, apply primer in accordance with manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

2.11 SOURCE QUALITY CONTROL

A. Testing Agency: (.1) General Construction Contractor will engage a qualified testing agency to perform shop tests and inspections.

1. Allow testing agency access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
2. Bolted Connections: Inspect and test shop-bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
3. Welded Connections: Visually inspect shop-welded connections in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

a. Liquid Penetrant Inspection: ASTM E165/E165M.
b. Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
c. Ultrasonic Inspection: ASTM E164.

4. In addition to visual inspection, test and inspect shop-welded shear stud connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear stud connector.
b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional

shear stud connectors if weld fracture occurs on shear stud connectors already tested.

5. Prepare test and inspection reports.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of existing conditions. Include bearing surfaces, anchor rods, bearing plates, and other embedments showing dimensions, locations, angles, and elevations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated on Drawings.

3.3 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and in accordance with ANSI/AISC 303 and ANSI/AISC 360.

B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.

1. Set plates for structural members on wedges, shims, or setting nuts as required.
2. Weld plate washers to top of baseplate.
3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
4. Promptly pack shrinkage-resistant grout solidly between bearing surfaces and plates, so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for grouting.

C. Maintain erection tolerances of structural steel within ANSI/AISC 303.

D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure. Slope roof framing members to slopes indicated on Drawings.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by The Professional. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts" for bolt and joint type specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

1. Comply with ANSI/AISC 303 and ANSI/AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

C. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.5 REPAIR

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing, and repair galvanizing to comply with ASTM A780/A780M.

B. Touchup Painting:

1. Immediately after erection, clean exposed areas where primer is damaged or missing, and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

3.6 FIELD QUALITY CONTROL

A. Special Inspections: (.1) General Construction Contractor will engage a special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: (.1) General Construction Contractor will engage a qualified testing agency to perform tests and inspections.

1. Bolted Connections: Inspect bolted connections in accordance with RCSC's "Specification for Structural Joints Using High-Strength Bolts."
2. Welded Connections: Visually inspect field welds in accordance with AWS D1.1/D1.1M.

    a. In addition to visual inspection, test and inspect field welds in accordance with AWS D1.1/D1.1M and the following inspection procedures, at testing agency's option:

        1) Liquid Penetrant Inspection: ASTM E165/E165M.
        2) Magnetic Particle Inspection: ASTM E709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
        3) Ultrasonic Inspection: ASTM E164.
        4) Radiographic Inspection: ASTM E94/E94M.

3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    b. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

END OF SECTION 051200

SECTION 051213

ARCHITECTURALLY EXPOSED STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Architecturally exposed structural steel (AESS).
2. Section 051200 "Structural Steel Framing" requirements that also apply to AESS.

B. Related Requirements:

1. Section 055000 "Metal Fabrications" for steel lintels and shelf angles not attached to structural-steel frame and other metal items not defined as structural steel.
2. Section 099123 "Interior Painting" for surface preparation and priming requirements.

1.3 DEFINITIONS

A. AESS: Architecturally exposed structural steel.

B. Category AESS 3: Structural steel that is categorized by ANSI/AISC 303, Section 10, as AESS 3 and is designated as AESS 3 or Category AESS 3in the Contract Documents.

1.4 COORDINATION

A. Coordinate surface preparation requirements for shop-primed items.

B. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.6 ACTION SUBMITTALS

A. Product Data:

1. Tension-control, high-strength, bolt-nut-washer assemblies.
2. Filler.
3. Primer.

B. Shop Drawings: Show fabrication of AESS components. Shop Drawings for structural steel may be used for AESS.

1. Identify AESS category for each steel member and connection, including transitions between AESS categories and between AESS and non-AESS.
2. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
3. Include embedment Drawings.
4. Indicate orientation of mill marks and HSS seams.
5. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain. Indicate grinding, finish, and profile of welds.
6. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections. Indicate orientation and location of bolt heads.
7. Indicate exposed surfaces and edges and surface preparation being used.
8. Indicate special tolerances and erection requirements.
9. Indicate weep holes for HSS .
10. Indicate surface preparation, primer, and coating requirements, including systems specified in other Sections.

C. Samples: Submit Samples to set quality standards for AESS.

1. Two steel plates, 3/8 by 8 by 4 inches, with long edges joined by a groove weld and with weld ground smooth.
2. Steel plate, 3/8 by 8 by 8 inches, with one end of a short length of rectangular steel tube, 4 by 6 by 3/8 inches, welded to plate with a continuous fillet weld and with weld ground smooth and blended.
3. Round steel tube or pipe, minimum 8 inches in diameter, with end of another round steel tube or pipe, approximately 4 inches in diameter, welded to its side at a 45-degree angle with a continuous fillet weld and with weld ground smooth and blended.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and fabricator.

B. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

1.8 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category BU, or is accredited by the IAS Fabricator Inspection Program for Structural Steel (AC 172) and is experienced in fabricating AESS similar to that indicated on this Project.

B. Installer Qualifications: A qualified Installer who participates in the AISC Quality Certification Program, is designated an AISC-Certified Erector, Category CSE, and is experienced in erecting AESS similar to that indicated on this Project.

C. Shop-Painting Applicators: Qualified according to AISC's Sophisticated Paint Endorsement P1 or SSPC-QP 3.

D. Mockups: Build mockups of AESS to set quality standards for fabrication and installation.

1. Build mockup of typical portion of AESS as shown on Drawings.
2. Coordinate painting requirements with Section 099123 "Interior Painting."
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Use special care in handling AESS to prevent twisting, warping, nicking, and other damage during fabrication, delivery, and erection. Store materials to permit easy access for inspection and identification. Keep AESS members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect AESS members and packaged materials from corrosion and deterioration.

1. Do not store AESS materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.10 FIELD CONDITIONS

A. Field Measurements: Where AESS is indicated to fit against other construction, verify actual dimensions by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Comply with requirements of ANSI/AISC 303, Sections 1 through 9 and as modified in Section 10, "Architecturally Exposed Structural Steel."

2.2 BOLTS, CONNECTORS, AND ANCHORS

A. Tension-Control, High-Strength, Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, round-head assemblies consisting of steel structural bolts with splined ends; ASTM A563, Grade DH, heavy-hex carbon-steel nuts; and ASTM F436/F436M, Type 1, hardened carbon-steel washers.

1. Finish: Plain.

2.3 FILLER

A. Polyester filler intended for use in repairing dents in automobile bodies.

2.4 PRIMER

A. Steel Primer:

1. Comply with Section 099113 "Exterior Painting" and Section 099123 "Interior Painting."
2. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

2.5 FABRICATION

A. Shop fabricate and assemble AESS to the maximum extent possible. Locate field joints at concealed locations if possible. Detail assemblies to minimize handling and to expedite erection.

1. Use special care handling and fabricating AESS before and after shop painting to minimize damage to shop finish.

B. Category AESS 3:

1. Comply with overall profile dimensions of AWS D1.1/D1.1M for welded built-up members. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
2. Prepare surfaces according to Part 2 "Shop Priming" Article and SSPC-SP 6 (WAB)/NACE WAB-3.
3. Grind sheared, punched, and flame-cut edges to remove burrs and provide smooth surfaces and eased edges.
4. Make intermittent welds appear continuous, using filler or additional welding.
5. Seal weld open ends of hollow structural sections with 3/8-inch closure plates.
6. Limit butt and plug weld projections to 1/16 inch.
7. Install bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
8. Remove weld spatter, slivers, and similar surface discontinuities.
9. Remove blemishes and surface irregularities resulting from temporary braces or fixtures by filling or grinding, before cleaning, treating, and shop priming.
10. Grind tack welds smooth unless incorporated into final welds.
11. Remove backing and runoff tabs, and grind welds smooth.
12. Limit as-fabricated straightness tolerance to one-half that permitted for structural-steel materials in ANSI/AISC 303.
13. Limit as-fabricated curved structural steel tolerance to that permitted for structural-steel materials in ANSI/AISC 303.
14. Limit as-fabricated straightness tolerance of welded built-up members to one-half that permitted by AWS D1.1/D1.1M.
15. Conceal fabrication and erection markings from view in the completed structure.
16. Make welds uniform and smooth.
17. Cut out mill marks from mill material or hide these markings from view in the completed structure. Where neither method is possible, remove mill marks by grinding and filling surfaces as approved by The Professional.
18. Grind butt and plug welds smooth or fill, removing weld splatter exposed to view.
19. Orient HSS seams as indicated or away from view.
20. Align and match abutting member cross sections.
21. At visible open joints of copes, miters, and cuts, maintain uniform clear gaps of 1/8 inch. At closed joints, maintain uniform contact within 1/16 inch.
22. Fabricate with exposed surfaces smooth, square, and of surface quality approved by The Professional.

2.6 SHOP CONNECTIONS

A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

2.7 SHOP PRIMING

A. Shop prime steel surfaces, except the following:

1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
2. Surfaces to be field welded.
3. Surfaces to be high-strength bolted with slip-critical connections.

B. Surface Preparation: Clean nongalvanized surfaces to be painted. Remove loose rust and mill scale and spatter, slag, or flux deposits. Prepare surfaces according to the following specifications and standards:

1. SSPC-SP 11.

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's written instructions and at rate recommended by SSPC to provide a minimum dry film thickness of 1.5 mils. Use priming methods that result in full coverage of joints, corners, edges, and exposed surfaces.

1. Stripe paint corners, crevices, bolts, welds, and eased edges.
2. Apply two coats of shop paint to surfaces that are inaccessible after assembly or erection. Change color of second coat to distinguish it from first.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

1. Prepare a certified survey of bearing surfaces, anchor rods, bearing plates, and other embedments, showing dimensions, locations, angles, and elevations.

B. Examine AESS for twists, kinks, warping, gouges, and other imperfections before erecting.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Provide temporary shores, guys, braces, and other supports during erection to keep AESS secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

A. Take special care during erection to avoid marking or distorting the AESS and to minimize damage to shop painting. Set AESS accurately in locations and to elevations indicated and according to ANSI/AISC 303 and ANSI/AISC 360.

1. Remove welded tabs that were used for attaching temporary bracing and safety cabling and that are exposed to view in the completed Work. Take care to avoid any blemishes, holes, or unsightly surfaces resulting from the use or removal of temporary elements.
2. Grind tack welds smooth.
3. Remove backing and runoff tabs, and grind welds smooth.
4. Orient bolt heads on the same side of each connection and maintain orientation consistently from one connection to another.
5. Conceal fabrication and erection markings from view in the completed structure.

B. In addition to ANSI/AISC 303, Section 10 requirements, comply with the following.

1. Erection of Category AESS 3:

a. Erect AESS to the standard frame tolerances specified in ANSI/AISC 303 for non-AESS.
b. Comply with AWS D1.1/D1.1M. Keep appearance and quality of welds consistent. Maintain true alignment of members without warp exceeding specified tolerances.
c. Remove weld spatter, slivers, and similar surface discontinuities.
d. Grind off butt and plug weld projections larger than 1/16 inch.
e. Continuous welds are to be of uniform size and profile.
f. Ream holes that must be enlarged. Use of drift pins or burning is not permitted. Replace misaligned connection plates where holes cannot be aligned with acceptable appearance.
g. Splice members only where indicated on Drawings.
h. No torch cutting or field fabrication is permitted.
i. Weld profiles, quality, and finish are be as approved by The Professional.
j. Make joint welds, including tack welds, appear continuous by filling intermittent welds.

3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M and AWS D1.8/D1.8M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.

3.5 REPAIR

A. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting, to comply with SSPC-PA 1 for touching up shop-painted surfaces.

a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

2. Cleaning and touchup painting are specified in Section 099123 "Interior Painting."

3.6 FIELD QUALITY CONTROL

A. Testing Agency: (.1) General Construction Contractor will engage a qualified testing agency to inspect AESS as specified in Section 051200 "Structural Steel Framing." The testing agency is not responsible for enforcing requirements relating to aesthetic effect.

B. The Professional will observe AESS in place to determine acceptability relating to aesthetic effect.

END OF SECTION 051213

SECTION 053100
STEEL DECKING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specification sections "General Conditions to the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Roof deck.
2. Composite floor deck.

B. Related Requirements:

1. Section 033000 "Cast-in-Place Concrete" for normal-weight and lightweight structural concrete fill over steel deck.
2. Section 051200 "Structural Steel Framing" for shop- and field-welded shear connectors.
3. Section 055000 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Roof deck.
2. Composite floor deck.

B. Shop Drawings:

1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. Test and Evaluation Reports:

1. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:

a. Power-actuated mechanical fasteners.

b. Acoustical roof deck.

2. Research Reports: For steel deck, from ICC-ES showing compliance with the building code.

D. Field Quality-Control Submittals:

1. Field quality-control reports.

E. Qualification Statements: For welding personnel and testing agency.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with SDI QA/QC and the following welding codes:

1. AWS D1.1/D1.1M.
2. AWS D1.3/D1.3M.

B. FM Approvals' RoofNav Listing: Provide steel roof deck evaluated by FM Approvals and listed in its "RoofNav" for Class 1 fire rating and Class 1-90 windstorm ratings. Identify materials with FM Approvals Certification markings.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store products in accordance with SDI MOC3. Stack steel deck on platforms or pallets and slope to provide drainage. Protect with a waterproof covering and ventilate to avoid condensation.

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. AISI Specifications: Comply with calculated structural characteristics of steel deck in accordance with AISI S100.

B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.

2.2 ROOF DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASC Steel Deck; ASC Profiles, LLC

2. Canam Buildings US Inc.; Canam Group Inc.
3. CSM Metal Deck
4. Epic Metals Corporation
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC
7. Verco Decking, Inc.; a Nucor company
8. Vulcraft Group; Division of Nucor Corp.
9. Or equal as approved by the Professional.

B. Fabrication of Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with SDI RD and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Deck Profile: Type WR, wide rib and Type 3DR, deep rib.
3. Profile Depth: 1-1/2 inches and3 inches.
4. Design Uncoated-Steel Thickness: 0.0358 inch.
5. Span Condition: As indicated.
6. Side Laps: Overlapped.

2.3 COMPOSITE FLOOR DECK

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ASC Steel Deck; ASC Profiles, LLC
2. Canam Buildings US Inc.; Canam Group Inc.
3. CSM Metal Deck
4. Epic Metals Corporation
5. Marlyn Steel Decks, Inc.
6. New Millennium Building Systems, LLC
7. Verco Decking, Inc.; a Nucor company
8. Vulcraft Group; Division of Nucor Corp.
9. Or equal as approved by the Professional.

B. Fabrication of Composite Floor Deck: Fabricate panels, with integrally embossed or raised pattern ribs and interlocking side laps, to comply with SDI C, with the minimum section properties indicated, and with the following:

1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), Grade 33, G60 zinc coating.
2. Profile Depth: 2 inches.
3. Design Uncoated-Steel Thickness: 0.0474 inch.
4. Span Condition: Triple span or more.

2.4 ACCESSORIES

A. Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000

psi, not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI standards for overhang and slab depth.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Shear Stud Connectors: ASTM A108, AISI C-1015 through C-1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.

I. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. Install deck panels and accessories in accordance with SDI C, SDI NC, and SDI RD, as applicable; manufacturer's written instructions; and requirements in this Section.

B. Install temporary shoring before placing deck panels if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical

fasteners and install in accordance with deck manufacturer's written instructions.

J. Shear Stud Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Weld using end welding of headed-stud shear connectors in accordance with AWS D1.1/D1.1M and manufacturer's written instructions.

3.3 INSTALLATION OF ROOF DECK

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1-1/2 inches long, and as follows:

1. Weld Diameter: 5/8 inch, nominal.
2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches apart in Zone 1 and 6 inches apart in Zones 2 and 3, based on roof-area definitions in FM Global Loss Prevention Data Sheet 1-28.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped 2 inches minimum or butted at (.1) General Construction Contractor's option.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and mechanically fasten.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels in accordance with deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.

3.4 INSTALLATION OF FLOOR DECK

A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:

1. Weld Diameter: 3/4 inch, nominal.
2. Weld Spacing:

    a. Weld edge ribs of panels at each support. Space additional welds an average of 16 inches apart, but not more than 18 inches apart.

B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of one-half of the span or 36 inches, and as follows:

1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
2. Mechanically clinch or button punch.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches, with end joints as follows:

1. End Joints: Lapped or butted at (.1) General Construction Contractor's option.

D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure in accordance with SDI recommendations unless otherwise indicated.

E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, in accordance with SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint in accordance with ASTM A780/A780M and manufacturer's written instructions.

3.6 FIELD QUALITY CONTROL

A. Testing Agency: (.1) General Construction Contractor will engage a qualified testing agency to perform tests and inspections.

B. Tests and Inspections:

1. Special inspections and qualification of welding special inspectors for cold-formed steel floor and roof deck in accordance with quality-assurance inspection requirements of SDI QA/QC.

    a. Field welds will be subject to inspection.

2. Steel decking will be considered defective if it does not pass tests and inspections.
3. Shear Stud Connectors: In addition to visual inspection, test and inspect field-welded shear connectors in accordance with requirements in AWS D1.1/D1.1M for stud welding and as follows:

    a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
    b. Conduct tests in accordance with requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors that are already tested.

C. Prepare test and inspection reports.

END OF SECTION 053100

SECTION 05 4000

COLD FORMED METAL FRAMING

PART 1 GENERAL

1.01 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SECTION INCLUDES

A. Non-load bearing formed steel stud exterior wall framing.

1.03 SYSTEM DESCRIPTION

A. Detail components and connections to withstand design loads shown on the drawings.

B. Detail connections to provide for movement of components without damage, failure of joint seals, undue stress on fasteners, or other detrimental effects when subject to seasonal or cyclic day/night temperature ranges.

C. Detail system to accommodate construction tolerances, deflection of building structural members, and clearances of intended openings.

1. Exterior Non-Load-Bearing Framing with brick veneer: Horizontal deflection of 1/600 of the wall height.

2. Exterior Non-Load-Bearing Framing of all other walls: Horizontal deflection of 1/360 of the wall height.

D. Detail to AISI - Cold-Formed Steel Design Manual and Steel Stud Manufacturers Association Product Technical Information.

E. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:

1. Upward and downward movement of 1/2 inch.

1.04 QUALITY CONTROL

A. Manufacturer: Company specializing in structural framing components with three years minimum experience.

B. Engineering Responsibility: Preparation of Shop Drawings, design calculations, and other structural data by a qualified professional engineer.

C. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who has minimum of 10 years of experience in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of cold-formed metal framing that are similar to those indicated for this Project in material, design, and extent.

D. Testing Agency Qualifications: An independent testing agency, acceptable to authorities having jurisdiction, qualified according to ASTM E 329 to conduct the testing indicated.

E. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, ductility, and metallic-coating thickness.

F. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code--Steel," and AWS D1.3, "Structural Welding Code--Sheet Steel."

G. AISI Specifications and Standards: Comply with AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members" and its "Standard for Cold-Formed Steel Framing - General Provisions."

1. Comply with AISI's "Standard for Cold-Formed Steel Framing - Truss Design."
2. Comply with AISI's "Standard for Cold-Formed Steel Framing - Header Design."

H. Calculate structural properties of framing members in accordance with Metal Framing Manufacturers Association (MFMA) requirements.

I. Mockup: Refer to Division 1 Section “Exterior Wall Mock-Up”.

1.05 SUBMITTALS

A. Submit shop drawings and product data under provisions of the General Conditions.

B. Qualification Data: For professional engineer.

C. Indicate on shop drawings, component details, framed openings, bearing, anchorage, loading, welds, type and location of fasteners, and accessories or items required of other related work.

C. Provide stud layout.

D. Describe method for securing studs to tracks and for connections to structural steel framing.

E. Provide calculations for loadings and stresses of specially fabricated, designed framing, sealed by a Professional Engineer registered in State where the project is located.

F. Provide product data on standard framing members. Describe materials and finish, product criteria, and limitations.

G. Submit manufacturer's installation instructions under provisions of the General Conditions.

PART 2 - PRODUCTS

2.01 FRAMING MATERIALS

A. Manufacturers/model:
1. Dietrich Metal Framing; Model: Dietrich C studs
2. Clark Steel Inc.; Model: Clark Western studs
3. The Steel Network, Inc.; Model: SSMA stud sections
4. Or Equal as approved by the Professional.

B. Studs: ASTM A1003 sheet steel, grade as indicated on the Drawings, formed to channel shape, gauge and size as indicated on Drawings.

C. Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows.

1. Minimum Base-Metal Thickness: Matching steel studs.

2. Flange Width: 1-1/4 inches

D. Vertical Deflection Clips: Manufacturer's standard bypass or head clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.

1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Dietrich Metal Framing; a Worthington Industries Company
b. MarinoWare, a division of Ware Industries
c. SCAFCO Corporation
d. Or Equal as approved by the Professional.

E. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:

1. Minimum Base-Metal Thickness: As required by structural performance.
2. Flange Width: 1 inch plus the design gap for 1-story structures.

F. Double Deflection Tracks: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. Outer Track: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal and lateral loads and transfer them to the primary structure, and as follows:

a. Minimum Base-Metal Thickness: As required by structural performance.
b. Flange Width: 1 inch plus the design gap for 1-story structures.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: As required by structural performance.
b. Flange Width: 1 1/2”.

G. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure

2.02 ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of same grade and coating weight used for framing members.

B. Provide accessories of manufacturer's standard thickness and configuration, unless otherwise indicated, as follows:

1. Supplementary framing
2. Bracing, bridging, and solid blocking
3. Web stiffeners
4. Anchor clips
5. End clips.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers, knee braces, and girts.
9. Hole reinforcing plates.

2.03 FASTENERS

A. Self-drilling, Self-tapping Screws, Bolts, Nuts and Washers: ASTM A90, hot dip galvanized.

B. Anchorage Devices: Power driven

C. Welding: In conformance with AWS D1.1 and AWS D1.3.

2.04 FABRICATION

A. Fabricate cold-formed metal framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed metal framing members by welding, screw fastening, clinch fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

   a. Comply with AWS D1.3 requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with screw penetrating joined members by not less than three exposed screw threads.

4. Fasten other materials to cold-formed metal framing by welding, bolting, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.

C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed metal framing assembly to a maximum out-of-square tolerance of 1/8 inch

2.05 FINISHES

A. Galvanize to G90 coating class.

PART 3 - EXECUTION

3.01 INSPECTION

A. Verify that substrate surfaces and building framing components are ready to receive work.

B. Beginning of installation means acceptance of existing conditions.

3.02 INSTALLATION, GENERAL

A. Install cold-formed metal framing according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions" and to manufacturer's written instructions unless more stringent requirements are indicated.

B. Align floor and ceiling tracks; locate to wall layout. Secure in place with fasteners or welding at maximum 24 inches o.c. Coordinate installation of sealant with floor and ceiling tracks.

C. Place studs at 16 inches o.c., max. (closer when required by calculations); not more than 2 inches from abutting walls and at each side of openings. Connect studs to tracks using fastener method.

D. Construct corners using minimum three studs. Double stud at wall opening, door, and window jambs.

E. Erect load bearing studs one piece full length. Splicing of studs is not permitted.

F. Erect load bearing studs, brace, and reinforce to develop full strength to meet design requirements.

G. Refer to Drawings for locations of partitions extending to ceiling only, and partitions extending through ceiling to structure above.

H. Coordinate placement of insulation in multiple stud spaces made inaccessible after erection.

I. Install intermediate studs above and below openings to match wall stud spacing.

J. Provide deflection allowance in stud track, directly below horizontal building framing for nonload bearing framing.

K. Attach cross studs or furring channels to studs for attachment of fixtures anchored to walls.

L. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's standard punched openings

M. Install framing between studs for attachment of mechanical and electrical items, and to prevent stud rotation.

N. Touch-up field welds and damaged galvanized surfaces with primer.

O. Maximum Variation from True Position: 1/16 inch.

P. Maximum Variation of any Member from Plane: 1/16 inch.

3.03 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

B. Fasten both flanges of studs to top and bottom track, unless otherwise indicated. Space studs as follows:

1. Stud Spacing: As indicated.

C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.

D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.

1. Install single-leg deflection tracks and anchor to building structure.
2. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing studs and anchor to building structure.
4. Connect drift clips to cold formed metal framing and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 18 inches of single deflection track. Install a combination of flat, taut, steel sheet straps of width and thickness indicated and stud or stud-track solid blocking of width and thickness matching studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

a. Install solid blocking at centers indicated on Shop Drawings.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
3. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, fasteners, and stud girts, to provide a complete and stable wall-framing system.

3.04 FIELD QUALITY CONTROL

A. Testing: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. Remove and replace work where test results indicate that it does not comply with specified requirements.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.05 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed metal framing with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed metal framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 05 5000

METAL FABRICATIONS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:
1. Steel framing and supports for countertops.
2. Steel tube reinforcement for low partitions.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Miscellaneous steel trim including steel angle corner guards, steel edgings.
6. Loose bearing and leveling plates for applications where they are not specified in other Sections.
7. Metal for handrails, guardrails and infills.
8. Loose steel lintels.
9. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
10. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

B. Related Requirements:

1. Section 03 30 00 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
2. Section 05 12 00 "Structural Steel Framing.".
3. Division 5 Section "Structural Steel" for structural steel framing system components.
4. Division 5 Section "Pipe and Tube Railings" for metal pipe and tube handrails and railing systems.

1.3 COORDINATION

A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.4 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:

1. Steel framing and supports for countertops.
2. Steel tube reinforcement for low partitions.
3. Steel framing and supports for mechanical and electrical equipment.
4. Steel framing and supports for applications where framing and supports are not specified in other Sections.
5. Loose bearing and leveling plates for applications where they are not specified in other Sections.

B. Welder certificates signed by Contractor certifying that welders comply with requirements specified under the "Quality Assurance" Article.

C. Qualification data for firms and persons specified in the "Quality Control" Article to demonstrate their capabilities and experience. Include a list of completed projects with project name, addresses, names of Professionals and Department, and other information specified.

1.5 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers, certifying that shop primers are compatible with topcoats.

D. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing metal fabrications similar to those indicated for this Project with a record of successful in-service performance, and with sufficient production capacity to produce required units without delaying the Work.

B. Manufacturer Qualifications: Firm experienced in manufacturing wall surface protection system components that are similar to those required for this Project and that have a record of successful in-service performance.

C. Single Source Responsibility: Obtain each color, grade, finish, and type of wall surface protection system component from a single source with resources to provided products of consistent quality in appearance and physical properties without delaying progress of the Work.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

E. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."
3. AWS D1.6/D1.6M, "Structural Welding Code - Stainless Steel."

1.7 FIELD CONDITIONS

A. Field Measurements: Check actual locations of walls and other construction to which metal fabrications must fit by accurate field measurements before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with fabricating products without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions. Allow for trimming and fitting.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

B. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

C. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, [Type 304].

D. Stainless-Steel Bars and Shapes: ASTM A 276, [Type 304] [Type 316L].

E. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.

F. Rolled-Stainless-Steel Floor Plate: ASTM A 793.

G. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

H. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

I. Zinc-Coated Steel Wire Rope: ASTM A 741.

1. Wire-Rope Fittings: Hot-dip galvanized-steel connectors with capability to sustain, without failure, a load equal to minimum breaking strength of wire rope with which they are used.

J. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

1. Size of Channels: As indicated.
2. Material: Galvanized steel, ASTM A 653/A 653M, commercial steel, Type B with G90 (Z275) coating; 0.108-inch (2.8-mm)] nominal thickness.
3. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch (2.5-mm) minimum thickness; hot-dip galvanized after fabrication.

K. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

L. Aluminum Plate and Sheet: ASTM B 209 (ASTM B 209M), Alloy 6061-T6.

M. Aluminum Extrusions: ASTM B 221 (ASTM B 221M), Alloy 6063-T6.

N. Aluminum-Alloy Rolled Tread Plate: ASTM B 632/B 632M, Alloy 6061-T6.

O. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.3 FASTENERS

A. General: Unless otherwise indicated, provide Type 304 stainless-steel fasteners for exterior use and zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

1. Provide stainless-steel fasteners for fastening aluminum.
2. Provide stainless-steel fasteners for fastening stainless steel.
3. Provide stainless-steel fasteners for fastening nickel silver.
4. Provide bronze fasteners for fastening bronze.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with hex nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3 (ASTM A 325M, Type 3); with hex nuts, ASTM A 563, Grade C3 (ASTM A 563M, Class 8S3); and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593 (ASTM F 738M); with hex nuts, ASTM F 594 (ASTM F 836M); and, where indicated, flat washers; Alloy Group 1 (A1).

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563 (ASTM A 563M); and, where indicated, flat washers.

1. Hot-dip galvanize or provide mechanically deposited, zinc coating where item being fastened is indicated to be galvanized.

F. Anchors, General: Anchors capable of sustaining, without failure, a load equal to six times the load imposed when installed in unit masonry and four times the load imposed when installed in

concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

G. Cast-in-Place Anchors in Concrete: Either threaded type or wedge type unless otherwise indicated; galvanized ferrous castings, either ASTM A 47/A 47M malleable iron or ASTM A 27/A 27M cast steel. Provide bolts, washers, and shims as needed, all hot-dip galvanized per ASTM F 2329.

H. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941 (ASTM F 1941M), Class Fe/Zn 5, unless otherwise indicated.
2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 (A1) stainless-steel bolts, ASTM F 593 (ASTM F 738M), and nuts, ASTM F 594 (ASTM F 836M).

I. Slotted-Channel Inserts: Cold-formed, hot-dip galvanized-steel box channels (struts) complying with MFMA-4, 1-5/8 by 7/8 inches (41 by 22 mm) by length indicated with anchor straps or studs not less than 3 inches (75 mm) long at not more than 8 inches (200 mm) o.c. Provide with temporary filler and tee-head bolts, complete with washers and nuts, all zinc-plated to comply with ASTM B 633, Class Fe/Zn 5, as needed for fastening to inserts.

2.4 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

F. Concrete: Comply with requirements in Section 033000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi (20 MPa).

2.5 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch (1 mm) unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches (3.2 by 38 mm), with a minimum 6-inch (150-mm) embedment and 2-inch (50-mm) hook, not less than 8 inches (200 mm) from ends and corners of units and 24 inches (600 mm) o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports for items listed here and those not specified in other Sections as needed to complete the Work.
1. Toilet Partitions: Provide C channels for ceiling supported partitions with an assumed loading of 350 lb/ft. One channel required at each dividing stall wall.
2. Side Folding Grilles: Provide C channels for ceiling supported Side Folding Grilles. Assumed capacity of 1.5 lb/ft., located at each respective grille.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.

1. Fabricate units from slotted channel framing where indicated.
2. Furnish inserts for units installed after concrete is placed.

C. Galvanize miscellaneous framing and supports where indicated.

D. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.7 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch (19-mm) bolts, spaced not more than 6 inches (150 mm) from ends and 24 inches (600 mm) o.c., unless otherwise indicated.

1. Provide mitered and welded units at corners.
2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches (50 mm) larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize and prime shelf angles located in exterior walls.

D. Prime shelf angles located in exterior walls with zinc-rich primer.

E. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 MISCELLANEOUS STEEL TRIM

A. Unless otherwise indicated, fabricate units from steel shapes, plates, and bars of profiles shown with continuously welded joints and smooth exposed edges. Miter corners and use concealed field splices where possible.

B. Provide cutouts, fittings, and anchorages as needed to coordinate assembly and installation with other work.

1. Provide with integrally welded steel strap anchors for embedding in concrete or masonry construction.

C. Galvanize and prime miscellaneous steel trim.

D. Prime exterior miscellaneous steel trim with zinc-rich primer.

2.9 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

C. Prime plates with zinc-rich primer.

2.10 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for

each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches (200 mm) unless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

D. Prime loose steel lintels located in exterior walls with zinc-rich primer.

2.11 STEEL WELD PLATES AND ANGLES

A. Provide steel weld plates and angles not specified in other Sections, for items supported from concrete construction as needed to complete the Work. Provide each unit with no fewer than two integrally welded steel strap anchors for embedding in concrete.

2.12 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.13 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."

E. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.19 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports for applications indicated that are not a part of structural steel framework as required to complete the Work.

B. Fabricate units to sizes, shapes, and profiles indicated and required to receive other adjacent construction retained by framing and supports. Fabricate from structural steel shapes, plates,

and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

E. Fabricate support for low partitions as follows:

1. Post: C3 x 6 (full height of low wall) with 3 5/8” x 5” x 3/8” plate. Weld plate to post. Anchor base plate to floor slab with two 3/8” diameter anchor bolts. Provide posts at wall ends and corners.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:

1. Cast Aluminum: Heavy coat of bituminous paint.
2. Extruded Aluminum: Two coats of clear lacquer.

3.2 INSTALLING BEARING AND LEVELING PLATES

A. Clean concrete and masonry bearing surfaces of bond-reducing materials, and roughen to improve bond to surfaces. Clean bottom surface of plates.

B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil (0.05-mm) dry film thickness.

B. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in painting sections of the specification.

C. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 50 00

SECTION 055213

PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Aluminum tube railings.
2. Stainless-steel pipe railings.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:

1. Manufacturer's product lines of mechanically connected railings.
2. Railing brackets.
3. Grout, anchoring cement, and paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:

a. Uniform load of 50 lbf/ ft. applied in any direction.
b. Concentrated load of 200 lbf applied in any direction.
c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:

a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft..
b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

A. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

1. Provide type of bracket with predrilled hole for exposed bolt anchorage and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL AND IRON

A. Tubing: ASTM A 500 (cold formed) or ASTM A 513.

B. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.

2.4 ALUMINUM (INTERIOR)

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

B. Extruded Structural Pipe and Round Tubing: ASTM B 429/B 429M, Alloy 6063-T6.

C. Drawn Seamless Tubing: ASTM B 210, Alloy 6063-T832.

D. Plate and Sheet: ASTM B 209, Alloy 6061-T6.

E. Die and Hand Forgings: ASTM B 247, Alloy 6061-T6.

F. Castings: ASTM B 26/B 26M, Alloy A356.0-T6.

2.5 STAINLESS STEEL (EXTERIOR)

A. Tubing: ASTM A 554, Grade MT 304.

B. Castings: ASTM A 743/A 743M, Grade CF 8 or CF 20.

C. Plate and Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.6 FASTENERS

A. General: Provide the following:

1. Aluminum Railings: Type 304 stainless-steel fasteners.
2. Stainless-Steel Railings: Type 304 stainless-steel fasteners.

B. Post-Installed Anchors: Torque-controlled expansion anchors or chemical anchors capable of sustaining, without failure, a load equal to 6 times the load imposed when installed in unit masonry and 4 times the load imposed when installed in concrete, as determined by testing according to ASTM E 488/E 488M, conducted by a qualified independent testing agency.

1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5, unless otherwise indicated.

2.7 MISCELLANEOUS MATERIALS

A. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

2.8 FABRICATION

A. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

B. Form work true to line and level with accurate angles and surfaces.

C. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

D. Form changes in direction by bending or by inserting prefabricated elbow fittings.

E. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

F. Close exposed ends of railing members with prefabricated end fittings.

G. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated.

H. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

2.9 ALUMINUM FINISHES

A. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are unacceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

B. Mill Finish: AA-M12, nonspecular as fabricated.

2.10 STAINLESS-STEEL FINISHES

A. 180-Grit Polished Finish: Oil-ground, uniform, directionally textured finish.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

3.2 ANCHORING POSTS

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions.

3.3 ATTACHING RAILINGS

A. Attach railings to wall with wall brackets. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3. For steel-framed partitions, use hanger or lag bolts set into fire-retardant-treated wood backing between studs. Coordinate with stud installation to locate backing members.

3.4 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 requirements for touching up shop-painted surfaces.

END OF SECTION 055213

SECTION 055813

COLUMN COVERS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes snap-together metal column covers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including finishing materials.

B. Shop Drawings: Show fabrication and installation details for column covers.

C. Samples: For each type of exposed finish required, prepared on 6-inch-square Samples of metal of same thickness and material indicated for the Work.

PART 2 - PRODUCTS

A. Form column covers to shapes indicated from metal of type and minimum thickness indicated below. Return vertical edges and bend to form hook that engages continuous mounting clips.

1. Steel Sheet: Uncoated, cold-rolled, ASTM A 1008/A 1008M, commercial steel, exposed, **0.060 inch (1.52 mm)** thick.

a. Finish: Powder coat.

2. Form returns at vertical joints to provide 1/2-inch- (12-mm-) wide reveal at joints. Provide snap-in metal filler strips at reveals that leave reveals 1/2 inch (12 mm) deep.
3. Fabricate base and ceiling ring to match column covers.

2.2 MISCELLANEOUS MATERIALS

A. Fasteners: Fabricated from same basic metal and alloy as fastened metal unless otherwise indicated. Do not use metals that are incompatible with materials joined.

1. Provide Tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

B. Sound-Deadening Materials:

1. Insulation: Unfaced, mineral-fiber blanket insulation complying with ASTM C 665, Type I, and passing ASTM E 136 test.
2. Mastic: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

C. Backing Materials: Provided or recommended by column cover manufacturer.

2.3 PAINTS AND COATINGS

A. Universal Shop Primer for Ferrous Metal: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

B. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

2.4 STEEL SHEET FINISHES

A. Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning," to remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning," or with SSPC-SP 8, "Pickling."

B. Pretreatment: Immediately after cleaning, apply a conversion coating of type suited to organic coating applied over it.

C. Factory Priming for Field-Painted Finish: Where field painting after installation is indicated, apply shop primer to prepared surfaces of items unless otherwise indicated.

D. Powder-Coat Finish: After cleaning and pretreating, apply manufacturer's standard thermosetting polyester or acrylic urethane powder coating with cured-film thickness not less than 1.5 mils (0.04 mm). Prepare, treat, and coat metal to comply with resin manufacturer's written instructions.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate and place column covers plumb and in alignment with adjacent construction. Perform cutting, drilling, and fitting required to install column covers.

1. Do not cut or abrade finishes that cannot be completely restored in the field. Return items with such finishes to the shop for required alterations, followed by complete refinishing, or provide new units as required.

B. Use concealed anchorages where possible.

C. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers as indicated.

D. Corrosion Protection: Apply bituminous paint or other permanent separation materials on concealed surfaces where metals would otherwise be in direct contact with substrate materials that are incompatible or could result in corrosion or deterioration of either material or finish.

E. Restore finishes damaged during installation and construction period so no evidence remains of correction work. Return items that cannot be refinished in the field to the shop; make required alterations and refinish entire unit or provide new units.

END OF SECTION 055813

SECTION 05 70 00
DECORATIVE METAL - EXPANDED MESH PANELS

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. Expanded mesh façade panels and mounting system.

1.3 SUBMITTALS

A. Delegated-Design Submittal: For fabrications indicated to comply with design loads. Include shop drawings, design calculations, and other structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation, licensed by the State in which the project is located.

B. Product Data:
1. Manufacturer's data sheets on each product to be used.
2. Preparation instructions and recommendations.
3. Storage and handling requirements and recommendations.
4. Typical installation methods.

C. Verification Samples: Two representative units of each type, size, pattern, and color.

D. Shop Drawings: Include details of materials, construction, and finish. Include relationship with adjacent construction.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section with a minimum of five years' documented experience.

B. Installer Qualifications: Company specializing in performing Work of this section with minimum two years documented experience with projects of similar scope and complexity.

C. Source Limitations: Provide each type of product from a single manufacturing source to ensure uniformity.

D. Field Measurements: The contractor is responsible for providing the final as-built dimensions of the installation to ensure proper fit. At the contractor’s discretion, this may be field-verified dimensions and locations of structural members or connection points. Information must be supplied in a format acceptable to the manufacturer.

E. Mock-Up: Construct a mock-up with actual materials in sufficient time for Architect's review and to not delay construction progress. Locate mock-up as acceptable to Architect and provide temporary foundations and support.
1. The intent of a mock-up is to demonstrate quality of workmanship and visual appearance.
2. If the mock-up is not acceptable, rebuild the mock-up until satisfactory results are

achieved.
3. Retain mock-up during construction as a standard for comparison with completed work.
4. Do not alter or remove mock-up until work is completed or removal is authorized.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store and handle in strict compliance with manufacturer's written instructions and recommendations.

B. Protect from damage due to weather, excessive temperature, and construction operations.

1.6 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.7 WARRANTY

A. Manufacturer's standard limited warranty unless indicated otherwise.
1. The manufacturer shall warrant its products to be of good quality, free from defects, in conformance with the specification, and when installed in accordance with the manufacturer’s published installation procedures for a period of 1-year from date of substantial completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: AMICO Architectural Metals, Apex 03 Expanded Mesh. Subject to compliance with requirements provide products by the listed manufacturer or from one of the following:
1. Direct Metals Company
2. Marco Specialty Steel
3. TBK Metal
4. Or equal as approved by Professional.

2.2 PERFORMANCE AND DESIGN CRITERIA

A. Delegated Design: Engage a qualified professional engineer to design the required fabrications, including comprehensive engineering analysis. Use performance requirements and design criteria specified in this document, and requirements according to Authorities Having Jurisdiction at the Project location. The most stringent criteria from these sources will establish the minimum engineering and design requirements for this work result.

B. General: Expanded mesh, perforated metal, attachment brackets, and/or fabricated elements and support frames.

C. Utilize expanded mesh and perforated materials cut and fabricated to the design specifications of the customer and confirmed by manufacturer’s shop drawings.

D. Tolerance of Panels and Components: Fabricated to a tolerance not exceeding 1/8 inch deviation in any dimension as shown in approved shop drawings.

E. Accessories: Attachment Clips: Stainless steel.

F. Material:

1. Thickness: 0.125 inches minimum.
2. Type: Aluminum Alloy 1100 H14.
3. Panel Size and Depth: Custom per design. Maximum dimensions are dependent on mesh style.
4. Finish: Fluoropolymer paint.
5. Color: As determined by the Architect from manufacturer’s full range.

2.3 EXPANDED MESH

A. Style: Expanded Mesh:
1. Max Panel Size: SWD: 60 inches. LWD: 132 inches.
2. Aluminum Alloy: 5005.
3. Visual Open: 26 percent.
4. Mechanical Open: 62 percent.
5. Weight: 1.34 lbs per sq ft.
6. Short Way Diamond: 2.5 inches.
7. Long Way Diamond: 6.0 inches.
8. Strand Width: 0.93 inches.
9. Strand Thickness: 0.125 inches.

2.4 ACCESSORIES

A. Stainless Steel, custom size attachment clips and brackets as determined by delegated design.

B. Stainless Steel fasteners as determined by delegated design.

C. Stainless Steel anchors of size and length as determined by delegated design and to penetrate brick veneer for anchorage to CMU substrate.

D. Aluminum corner reveals at outside corners.

2.5 FABRICATION

A. Panels produced by the Manufacturer will be in alignment with shop drawings and the Manufacturer's tolerances limitations.

B. Panel Layouts: To be designed with a 1 inch gap between panels to allow for expansion.
1. Drawings Supplied by the Manufacturer: Will guide the layout of panel spacing and attachment bracket layout.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substruction suitability for attachment. Do not begin installation until the substrates have been properly constructed and prepared.

B. Notify Architect in writing of unsatisfactory preparation before proceeding.
1. Correct any conditions that may impede proper completion of work.
2. The substructures must be plum and true, and capable of supporting the products without deflection or deformation.

C. Anchor attachment points should be examined to ensure the surfaces are clean and clear of obstacles and finished.
1. Attachment Brackets: To have slots allowing installation adjustments with 1/8 inch of play. When panels are attached, they can be subsequently adjusted within that range.

D. Ensure there is enough clearance in the surrounding area to allow installers and materials to be lifted into place.

E. Correct any conditions that may impede proper completion of work. The substructures must be plum & true, and capable of supporting the custom panels without deflection or deformation.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's instructions, approved submittals, and in proper relationship with adjacent construction.
   1. Suitable fasteners for attachment brackets are the responsibility of the contractor.
   2. Panels should be installed plumb and level as per shop drawings.
   3. Panel Joints: To have 1/8 inch gap designed into their placement plus or minus 1/16 inches.

3.4 CLEANING AND PROTECTION

A. Clean products in accordance with the manufacturer's recommendations.
   1. Maintain installed panels in a clean condition throughout construction and ensure that cleaning by other trades in proximity to the panels does not impart dust or debris. Avoid spilling, dripping, or splattering cleaning solutions onto panel surfaces.
   2. Clean exposed surfaces of panels promptly after completion of installation. Comply with the recommendation of the panel manufacturer.
      a. AAMA 609 and 610.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

06 06 60

TRANSLUCENT RESIN PANEL SYSTEM

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the Plastic Fabrication as shown and specified in the described system(s):

1. Partitions

1.3 SUBMITTALS

A. General: Submit the following in accordance with conditions of contact and Division 1 specification section 01 33 00 “Submittal Procedures”.

B. Product Data: Submit manufacturer’s product data; include product description, fabrication information, and compliance with specified performance requirements.

C. Submit product test reports from a qualified independent 3rd party testing agency indicating each type and class of panel system complies with the project performance requirements, based on comprehensive testing of current products. Previously completed test reports will be acceptable if for current manufacturer and indicative of products used on this project.

1. Test reports required are:
    a. Rate of Burning (ASTM D 635)
    b. Self-Ignition Temperature (ASTM D 1929)
    c. Density of Smoke (ASTM D 2843)
    d. Flame Spread and Smoke Developed testing (ASTM E 84)
    e. Room Corner Burn Test (NFPA 286)
    f. Extent of Burning (UL 94)
    g. Impact strength (ASTM D 3763)
    h. Safety glazing impact resistance (ANSI Z97.1-2004)
    i. UPITT Test for Combustion Product Toxicity
    j. Passes NFPA 269/ASTM1678 for Combustion Product Toxicity
    k. Dynamic environmental testing (ASTM standards D 5116 or D 6670)
    l. UL Yellowcard

D. Building Approvals: Plastic Fabrications are to have been evaluated and must be registered with and comply to requirements of the following jurisdictions:

1. ICC-ES Report for Light Transmitting Plastics and Interior Finishes

E. Shop Drawings: Include plans, elevations, sections, panel dimensions, details, and attachments to other work.

F. Samples for Initial Selection:

1. Submit minimum 2-inch by 2-inch samples. Indicate full color, texture and pattern variation.

G. Samples for Verification:

1. Submit minimum 4-inch by 4-inch sample for each type, texture, pattern and color of solid plastic fabrication.

H. Mockups:

1. Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects.
2. Build mockup of [**each type of**] Plastic Fabrication.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

I. Maintenance Data: Submit manufacturer's care and maintenance data, including care, repair and cleaning instructions. Include in Project closeout documents.

1.4 QUALITY ASSURANCE

A. Manufacturers Qualifications

1. Materials and systems shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least five (5) consecutive years and which can show evidence of those materials being satisfactorily used on at least six (6) projects of similar size, scope and location. At least three (3) of the projects shall have been successful for use five (5) years or longer.
2. Manufactured panels must be produced from a minimum of 40% pre-consumer recycle content. This recycle content must be certified by a recognized 3rd party certification group, such as Scientific Certification Systems (SCS).
3. Completely PVC – Free product
4. Manufacturer must offer a documented reclaim process that will take back, at the manufacturers cost, panels that are at their end-of life cycle. Return process is preceded by following requirements highlighted in Section 02 42 00 Removal and Salvage of Construction Materials.
5. Manufacturer must have a 3rd party completed Life Cycle Analysis
6. Manufacturer must have an Environmental Product Declaration (EPD).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver Plastic Fabrications, systems and specified items in manufacturer's standard protective packaging.

B. Do not deliver Plastic Fabrications, system, components and accessories to Project site until areas are ready for installation.

C. Store materials in a flat orientation in a dry place that is not exposed to exterior elements.

D. Handle materials to prevent damage to finished surfaces. Provide protective coverings to prevent damage or staining following installation for duration of project.

E. Before installing Plastic Fabrications, permit them to reach room temperature.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not install Solid Polymer Fabrications until spaces are enclosed and weatherproof, and ambient temperatures and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1.7 WARRANTY

A. Manufacturer's Special Warranty on Plastic Fabrications: Manufacturer's standard form agreeing to repair or replace units that fail in material or workmanship within the specified warranty period.

B. Warranty Period: 1 year after the date of substantial completion.

C. The warranty shall not deprive the Client Agency of other rights or remedies the Client Agency may have under other provisions of the Contract Documents, and is in addition to and runs concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. Basis of Design Manufacturer: Subject to compliance with requirements, provide listed product manufactured by 3form or one of the following:

1. Feeney.
2. Lumicor.
3. Or equal as approved by Professional.

2.2 MATERIALS

A. Resin Sheet

1. Engineered co-polyester resin produced in the USA
2. Sheet Size: Maximum 4' x 10'
3. Thickness: Minimum 1/16"
4. Basis of Design Product: The design of Plastic Fabrications is based on Varia Ecoresin Luster Orbit as provided by 3form, LLC.

B. Interlayer Materials: Compatible with polyesters and bonding process to create a monolithic sheet of material when complete.

C. Sheet minimum performance attributes:

1. Rate of Burning (ASTM D 635). Material must attain CC1 Rating for a nominal thickness of 1.5 mm (0.060 in.) and greater.
2. Self-Ignition Temperature (ASTM D 1929). Material must have a Self-ignition temperature greater than 650°F.
3. Density of Smoke (ASTM D 2843). Material must have a smoke density less than 75%.
4. Flame spread and Smoke developed testing (ASTM E 84). Material must be able to meet a level of Class A (Flame spread less than 25 and smoke less than 450) at thickness of 1/8",3/16" and 1".
5. Room Corner Burn Test (NFPA 286). Material must meet Class A criteria at ¼" (walls only) and 3/8" (walls only/standoffs only) thickness as described by the 2018 *International Building Code*.
6. Extent of Burning (UL 94). Must submit UL card.
7. Impact strength. Minimum impact strength test as measured by ASTM D 3763 of 20 ft. lbs. (for durability, shipping, installation, and use).
8. Safety Glazing. Material must attain a Class A impact rating in accordance with ANSI Z97.1-2004 at 1/8" thickness.
9. UPITT Test for Combustion Product Toxicity: Product must be recorded as "not more toxic than wood".
10. NFPA 269/ASTM 1678 test for toxicity: Product must have a best predicted LC_{50} value ≤ 80.8 g/m^3 Product must have a best predicted corrected for post-flashover conditions LC_{50} value ≤ 19.0 g/m^3

11. Building Approvals: Plastic Fabrications are to have been evaluated and must be registered with and comply to requirements of the following jurisdictions:
    a. ICC-ES Report for Interior Finishes and Light Transmitting plastics

2.3 FABRICATION

A. General: Fabricate Plastic Fabrications to designs, sizes and thicknesses indicated and to comply with indicated standards. Sizes, profiles and other characteristics are indicated on the drawings.

B. Comply with manufacturer's written recommendations for fabrication.

C. Machining: Acceptable means of machining are listed below. Ensure that material is not chipped or warped by machining operations.

1. Sawing: Select equipment and blades suitable for type of cut required.
2. Drilling: Drills specifically designed for use with plastic products.
3. Milling: Climb cut where possible.
4. Routing
5. Tapping

D. Forming: Form products to shapes indicated using the appropriate method listed below. Comply with manufacturer's written instructions.

1. Cold Bending
2. Hot Bending
3. Thermoforming: Acceptable only on uncoated material.
4. Drape Forming
5. Matched Mold Forming
6. Mechanical Forming

E. Laminating: Laminate to substrates indicated using adhesives and techniques recommended by manufacturer.

2.4 MISCELLANEOUS MATERIALS

A. General: Provide products of material, size, and shape required for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaner: Type recommended by manufacturer.

C. Fasteners: Use screws designed specifically for plastics. Self-threading screws are acceptable for permanent installations. Provide threaded metal inserts for applications requiring frequent disassembly such as light fixtures.

D. U-Channel: 1/2-inch satin anodized aluminum U-channel for panel perimeter.

1. Dry-Glazing Gasket: Pre-formed rubber or vinyl dry glazing gaskets sized to fit channel.

E. Bonding Cements: May be achieved with solvents or adhesives, suitable for use with product and application.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of Plastic Fabrications will occur, with Installer present, for compliance with manufacturer's requirements.

Verify that substrates and conditions are satisfactory for installation and comply with requirements specified.

3.2 INSTALLATION

A. General: Comply with manufacturer's written instructions for the installation of Plastic Fabrications.

B. Manufacturer's shop to fabricate items to the greatest degree possible.

C. Utilize fasteners, adhesives and bonding agents recommended by manufacturer for type of installation indicated. Material that is chipped, warped, hazed or discolored as a result of installation or fabrication methods will be rejected.

D. Install components plumb, level and rigid, scribed to adjacent finishes, in accordance with approved shop drawings and product data.

E. Form field joints using manufacturer's recommended procedures. Locate seams in panels so that they are not directly in line with seams in substrates.

3.3 CLEANING AND PROTECTION

A. Protect surfaces from damage until date of substantial completion. Repair work or replace damaged work, which cannot be repaired to Architect's satisfaction.

END OF SECTION

SECTION 061053

MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. This Section includes the following:

1. Wood blocking, cants, and nailers.
2. Wood furring and grounds.
3. Plywood backing panels.
4. Fasteners and accessories.

1.03 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.

1.04 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Stack lumber flat in dry location with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.01 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.

1. Factory mark each piece of lumber with grade stamp of grading agency.

2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece.
3. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
4. Provide dressed lumber, S4S, unless otherwise indicated.

2.02 WOOD PRESERVATIVE TREATED LUMBER

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.

C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
5. Wood floor plates that are installed over concrete slabs-on-grade.

2.03 FIRE RETARDANT TREATED MATERIALS

A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.

B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E 84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.

1. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D 2898. Use for exterior locations and where indicated.
2. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D 3201 at 92 percent relative humidity. Use where exterior type is not indicated.

C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.

D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.

E. Application: Treat all rough carpentry unless otherwise indicated.

2.04 MISCELLANEOUS LUMBER

A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:

1. Blocking.
2. Nailers.
3. Cants.
4. Furring.
5. Grounds.

B. For items of dimension lumber size, provide Construction or No. 2 grade lumber with 15 percent maximum moisture content of any species.

C. For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

D. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

E. For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.05 PLYWOOD BACKING PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged,in thickness indicated or, if not indicated, not less than 15/32-inch thickness.

2.06 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Bolts: Steel bolts complying with ASTM A 307, Grade A ; with ASTM A 563 hex nuts and, where indicated, flat washers.

2.07 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

B. Flexible Flashing separator between treated wood and metal decking: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber or rubberized-asphalt compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.

PART 3 - EXECUTION

3.01 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

B. Framing Standard: Comply with AF&PA's "Details for Conventional Wood Frame Construction," unless otherwise indicated.

C. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

D. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:

1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.

E. Sort and select lumber so that natural characteristics will not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

F. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

G. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code.
3. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in ICBO's Uniform Building Code.

H. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads, unless otherwise indicated.

3.02 WOOD BLOCKING, AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 PROTECTION

A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

B. Protect rough carpentry from weather. If, despite protection, rough carpentry becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION

SECTION 061600

SHEATHING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Wall and soffit sheathing.
2. Sheathing joint and penetration treatment.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product. Indicate component materials and dimensions and include construction and application details.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For assemblies with fire-resistance ratings, provide materials and construction identical to those of assemblies tested for fire resistance per ASTM E 119 by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Fire-Resistance Ratings: Indicated by design designations from UL's "Fire Resistance Directory."

2.2 WALL AND SOFFIT SHEATHING

A. Glass-Mat Gypsum Sheathing: ASTM C 1177/1177M.

1. Type and Thickness: Type X, 5/8 inch thick.

B. Cementitious Backer Units: ASTM C 1325, Type A.

1. Thickness: 5/8 inch

2.3 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. For wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

2.4 SHEATHING JOINT-AND-PENETRATION TREATMENT MATERIALS

A. Sealant for Glass-Mat Gypsum Sheathing: Silicone emulsion sealant complying with ASTM C 834, compatible with sheathing tape and sheathing and recommended by tape and sheathing manufacturers for use with glass-fiber sheathing tape and for covering exposed fasteners.

1. Sheathing Tape: Self-adhering glass-fiber tape, minimum 2 inches wide, 10 by 10 or 10 by 20 threads/inch, of type recommended by sheathing and tape manufacturers for use with silicone emulsion sealant in sealing joints in glass-mat gypsum sheathing and with a history of successful in-service use.

2.5 MISCELLANEOUS MATERIALS

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

1. NES NER-272 for power-driven fasteners.
2. Table 2304.9.1, "Fastening Schedule," in ICC's "International Building Code."

D. Coordinate wall sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

3.2 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

1. Fasten gypsum sheathing to cold-formed metal framing with screws.

2. Install boards with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
3. Install boards with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Seal sheathing joints according to sheathing manufacturer's written instructions.

1. Apply elastomeric sealant to joints and fasteners and trowel flat. Apply sufficient amount of sealant to completely cover joints and fasteners after troweling. Seal other penetrations and openings.
2. Apply glass-fiber sheathing tape to glass-mat gypsum sheathing joints and apply and trowel silicone emulsion sealant to embed entire face of tape in sealant. Apply sealant to exposed fasteners with a trowel so fasteners are completely covered. Seal other penetrations and openings.

3.3 CEMENTITIOUS BACKER UNIT INSTALLATION

A. Install panels and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Coordinate with requirements of Cement Board Finish System manufacturer.

END OF SECTION 061600

SECTION 062023

INTERIOR FINISH CARPENTRY

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Interior Trim.

2. Interior Decorative Wood Panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of process and factory-fabricated product.

B. Samples: For each type and profile of wood and of each finish.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. Lumber: DOC PS 20.

1. Factory mark each piece of lumber with grade stamp of inspection agency indicating grade, species, moisture content at time of surfacing, and mill.

a. For exposed lumber, mark grade stamp on end or back of each piece.

B. Softwood Plywood: DOC PS 1.

2.2 INTERIOR TRIM

A. Screens Frames:

1. Grade: A smooth and defect free.
2. Species: Maple.
a. Maximum Moisture Content: 9 percent.

3. Size: See drawings.

2.3 MISCELLANEOUS MATERIALS

A. Glue: Aliphatic-resin, polyurethane, or resorcinol wood glue recommended by manufacturer for general carpentry use.

1. Wood glue shall have a VOC content of 30 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 SHOP PRIMING

A. Wood Boards for Transparent Finish: Shop seal with stain (if required), other required pretreatments, and first coat of finish as specified in Section 099000 "Painting."

A. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing wood trim, as applicable to each unit of work.

1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of wood trim

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installing interior finish carpentry, condition materials to average prevailing humidity in installation areas for a minimum of 24 hours unless longer conditioning is recommended by manufacturer.

3.2 INSTALLATION, GENERAL

A. Install interior finish carpentry level, plumb, true, and aligned with adjacent materials. Use concealed shims where necessary for alignment.

1. Scribe and cut interior finish carpentry to fit adjoining work. Refinish and seal cuts as recommended by manufacturer.
2. Countersink fasteners, fill surface flush, and sand unless otherwise indicated.
3. Install to tolerance of 1/8 inch in 96 inches for level and plumb. Install adjoining interior finish carpentry with 1/32-inch maximum offset for flush installation and 1/16-inch maximum offset for reveal installation.

3.3 INSTALLATION

A. Install with minimum number of joints practical, using full-length pieces from maximum lengths of lumber available. Cope at returns, miter at outside corners, and cope at inside corners to produce tight-fitting joints with full-surface contact throughout length of joint. Use scarf joints for end-to-end joints. Install using concealed fasteners.

END OF SECTION

SECTION 064100

ARCHITECTURAL WOOD CASEWORK AND MILLWORK

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Plastic-laminate-faced architectural cabinets.
2. Plastic laminate faced millwork.
3. Metal base.
4. Exposed reglets.
5. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:

1. Division 06 Section "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets and concealed within other construction before cabinet installation.
2. Division 12 Section "Quartz Agglomerate Countertops."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including, panel products, high-pressure decorative laminate, adhesive for bonding plastic laminate, and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
2. Show locations and sizes of cutouts and holes for electrical switches and outlets installed in architectural plastic-laminate cabinets.

C. Samples for Initial Selection:

1. Plastic laminates.
2. Decorative panels.

D. Samples for Verification:

1. Plastic laminates, 8 by 10 inches , for each type, color, pattern, and surface finish, with one sample applied to core material.
2. Thermoset decorative panels, 8 by 10 inches , for each color, pattern, and surface finish.
3. Exposed cabinet hardware and accessories, one unit for each type.
4. Exposed reglet accessories.
5. Trim accessories.
6. Base.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance. Follow AWI Quality Standards.

B. Installer Qualifications: Follow AWI Quality Standards.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver cabinets until painting and similar operations that could damage woodwork have been completed in installation areas. If cabinets must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

C. Established Dimensions: Where cabinets are indicated to fit to other construction, establish dimensions for areas where cabinets are to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to ensure that cabinets can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 087100 "Door Hardware" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

1. Provide labels and certificates from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.
2. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Custom.

C. Type of Construction: Frameless.

D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

1. Manufacturers Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Formica
b. Nevamar, Panolam Industries International.
c. Wilsonart.
d. Or equal as approved by Professional.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGL.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade VGS.
4. Edges: Grade VGS.
5. Pattern Direction: Vertically for drawer fronts, doors, and fixed panels.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.

a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.

2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

H. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

I. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

2.2 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

B. Composite Wood and Agrifiber Products: Provide materials that comply with requirements of referenced quality standard for each type of woodwork and quality grade specified unless otherwise indicated.

1. Softwood Plywood: DOC PS 1.
2. Thermoset Decorative Panels: Particleboard or medium-density fiberboard finished with thermally fused, melamine-impregnated decorative paper and complying with requirements of NEMA LD 3, Grade VGL, for test methods 3.3, 3.4, 3.6, 3.8, and 3.10.

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087100 "Door Hardware."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 100 degrees of opening, self-closing.

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 4 inches long, 5/16 inch in diameter.

E. Adjustable Shelf Standards and Supports: BHMA A156.9, B04071; with shelf rests, B04081.

F. Shelf Rests: BHMA A156.9, B04013; metal.

G. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; zinc-plated steel with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.
4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.
6. For computer keyboard shelves, provide Grade 1.
7. For trash bins not more than 20 inches high and 16 inches wide, provide Grade 1HD-100.

H. Door and Drawer Silencers: BHMA A156.16, L03011.

I. Door Locks: BHMA A156.11, E07121.

J. Drawer Locks: BHMA A156.11, E07041.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

L. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesive for Bonding Plastic Laminate: Woodworker’s option. Do not use adhesives that contain urea formaldehyde. Use only products that comply with 40 CFR 59, Subpart D (EPA Method 24).

2.5 TRIM ACCESSORIES

A. Exposed Reglet Accessories:

1. Manufacturer: Subject to compliance with requirements, provide products manufactured by one of the following:
   a. Flannery, Inc
   b. Fry Reglet Corporation.
   c. Pittcon Industries
   d. Or equal as approved by Professional.
2. Material: Extruded High Grade 6063-T5 aluminum.
3. Finish: Color anodized finish.
   a. Two-step impregnated color Class II Architectural 0.40-0.70 mils (AA-M12C22A33).
   b. Thickness of anodic coating shall be tested in accord with ASTM B244-97 and sealed to pass modified dye stain test ASTM B136-84(1998).
   c. Color: As selected by Architect from Manufacturer’s standard color selection.
4. Reveal Profile: Reveal Channel.
5. Reveal Profile: Reveal Corner.
6. Accessories: Provide compatible factory fabricated intersections and end caps as required to provide seamless continuity of reglets and closures at ends of runs.
7. Fasteners: Exposed fasteners (provided by installer) shall be countersunk and shall match accessories in color.
   a. Aluminum to aluminum: Aluminum or Type 302 or 304 stainless steel.
8. Mounting Holes: Provide with mounting holes.

2.6 BASE

A. Stainless Steel Base:

1. Manufacturer: Subject to compliance with requirements, provide products manufactured by one of the following:
   a. Inpro Architectural Products.
   b. Profilitec.
   c. ProTek Systems.
   d. Sani-Base.
   e. Or equal as approved by Professional.
2. Material: Type 304 Stainless Steel.
3. Finish: #4 satin.
4. Thickness: 18 gauge.
5. Height: 6 inches.
6. Length, 8 feet minimum.
7. Style: Straight, without toe.
8. Accessories: Inside and outside corners.
9. Adhesive: Manufacturer’s standard polyurethane adhesive.

2.7 FABRICATION

A. Fabricate cabinets to dimensions, profiles, and details indicated.

B. Complete fabrication, including assembly and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches .

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.

1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 066400

PLASTIC PANELING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Fiberglass Reinforced Plastic sheet paneling (FRP).

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For plastic paneling and trim accessories, in manufacturer's standard sizes.

1.4 QUALITY ASSURANCE

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install plastic paneling until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

A. Obtain plastic paneling and trim accessories from single manufacturer.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by listed manufacturer of one of the following:

1. Marlite, Inc.
2. Altro

3. InPro
4. Or equal as approved by Professional.

2.3 PANELS

A. Smooth Fiberglass Reinforced Panels with Routed Grout Lines (FRP-1)

1. Basis-of-Design Manufacturer: Marlite
2. Type: Symmetrix FRP
3. Thickness: 0.090” nominal
4. Width: 4’-0” nominal
5. Length: 5’-0” nominal
6. Pattern: Subway Horizontal Direction, size as indicated on Drawings
7. Color: White Panel and Grey Grooves SS917
8. Finish: High Gloss
9. Fire Rating: Class A
10. Comply with ASTM D 5319

B. Smooth Fiberglass Reinforced Panels with Routed Grout Lines (FRP-2)

1. Basis-of-Design Manufacturer: Marlite
2. Type: Symmetrix FRP
3. Thickness: 0.090” nominal
4. Width: 4’-0” nominal
5. Length: 5’-0” nominal
6. Pattern: Subway Horizontal Direction, size as indicated on Drawings
7. Color: Naval Panel and White Grooves SS5462
8. Finish: High Gloss
9. Fire Rating: Class A
10. Comply with ASTM D 5319

C. Standard Fiberglass Reinforced Panels (FRP-3)

1. Basis-of-Design Manufacturer: Marlite
2. Type: Smooth FRP
3. Thickness: 0.090” nominal
4. Width: 4’-0” nominal
5. Length: 9’-0” nominal
6. Texture: Smooth
7. Color: P100 White
8. Fire Rating: Class A
9. Comply with ASTM D 5319

D. Standard Fiberglass Reinforced Panels (FRP-4)

1. Basis-of-Design Manufacturer: Marlite
2. Type: Smooth FRP
3. Thickness: 0.090” nominal
4. Width: 4’-0” nominal
5. Length: 8’-0” nominal
6. Texture: Smooth
7. Color: P100 White
8. Fire Rating: Class A
9. Comply with ASTM D 5319

2.4 ACCESSORIES

A. Trim Accessories: Manufacturer's standard one-piece vinyl extrusions designed to retain and cover edges of panels. Provide division bars, inside corners, outside corners, and caps as needed to conceal edges.

1. Color: Match panels.

B. Exposed Fasteners: Non-staining nylon drive rivets recommended by panel manufacturer.

1. Color: Match panels.

C. Concealed Mounting Splines: Continuous, H-shaped aluminum extrusions designed to fit into grooves routed in edges of factory-laminated panels and to be fastened to substrate.

D. Adhesive: As recommended by plastic paneling manufacturer.

1. Verify adhesives have a VOC content of 50 g/L or less.
2. Must comply with ASTM C 557.

E. Sealant: Mildew-resistant, single-component, neutral-curing silicone sealant recommended by plastic paneling manufacturer and complying with requirements in Section 07 9200 "Joint Sealants."

1. Verify sealant has a VOC content of 250 g/L or less.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove wallpaper, vinyl wall covering, loose or soluble paint, and other materials that might interfere with adhesive bond.

B. Prepare substrate by sanding high spots and filling low spots as needed to provide flat, even surface for panel installation.

C. Clean substrates of substances that could impair adhesive bond, including oil, grease, dirt, and dust.

D. Condition panels by unpacking and placing in installation space before installation according to manufacturer's written recommendations.

E. Lay out paneling before installing. Locate panel joints so that trimmed panels at corners are not less than 12 inches wide.

1. Mark plumb lines on substrate at trim accessory locations for accurate installation.
2. Locate trim accessories to allow clearance at panel edges according to manufacturer's written instructions.

3.3 INSTALLATION

A. Install plastic paneling according to manufacturer's written instructions.

B. Install panels in a full spread of adhesive.

C. Install panels with fasteners. Layout fastener locations and mark on face of panels so that fasteners are accurately aligned.

1. Drill oversized fastener holes in panels and center fasteners in holes.
2. Apply sealant to fastener holes before installing fasteners.

D. Install factory-laminated panels using concealed mounting splines in panel joints.

E. Install trim accessories with adhesive. Do not fasten through panels.

F. Fill grooves in trim accessories with sealant before installing panels, and bed inside corner trim in a bead of sealant.

G. Maintain uniform space between panels and wall fixtures. Fill space with sealant.

H. Maintain uniform space between adjacent panels and between panels and floors, ceilings, and fixtures. Fill space with sealant.

I. Remove excess sealant and smears as paneling is installed. Clean with solvent recommended by sealant manufacturer and then wipe with clean dry cloths until no residue remains.

END OF SECTION 066400

SECTION 071416

COLD FLUID-APPLIED WATERPROOFING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Polyurethane waterproofing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:

1. Show locations and extent of waterproofing.
2. Include details for substrate joints and cracks, sheet flashings, penetrations, inside and outside corners, tie-ins with adjoining waterproofing, and other termination conditions.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by waterproofing manufacturer.

1.6 WARRANTY

A. Manufacturer's Special Warranty: Manufacturer agrees to repair or replace waterproofing that fails in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SINGLE-COMPONENT POLYURETHANE WATERPROOFING

A. Single-Component, Modified Polyurethane Waterproofing: ASTM C 836/C 836M.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

a. Anti-Hydro International, Inc; A-H Seamless Membrane.
b. BASF Construction Chemicals, LLC, Building Systems; Sonoshield HLM 5000.
c. Carlisle Coatings & Waterproofing Inc; CCW-525.
d. Polyguard Products, Inc; Polyguard PG-250.
e. Tremco Incorporated; TREMproof 250 GC.
f. Or equal as approved by Professional.

2.2 AUXILIARY MATERIALS

A. Primer: Manufacturer's standard primer, sealer, or surface conditioner; factory-formulated acrylic latex, polyurethane, or epoxy.

B. Sheet Flashing: 50-mil- minimum, nonstaining, uncured sheet neoprene.

1. Adhesive: Manufacturer's recommended contact adhesive.

C. Membrane-Reinforcing Fabric: Manufacturer's recommended fiberglass mesh or polyester fabric.

D. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

E. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage and overspray affecting other construction.

C. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

D. Remove fins, ridges, and other projections, and fill honeycomb, aggregate pockets, holes, and other voids.

E. Prepare surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, sleeves, and corners according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898 and ASTM C 1471.

F. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.

G. Prepare, treat, rout, and fill joints and cracks in substrate according to waterproofing manufacturer's written instructions and to recommendations in ASTM C 898 and ASTM C 1471. Before coating surfaces, remove dust and dirt from joints and cracks according to ASTM D 4258.

H. Install sheet flashing and bond to deck and wall substrates where required according to waterproofing manufacturer's written instructions.

3.2 WATERPROOFING APPLICATION

A. Apply waterproofing according to manufacturer's written instructions and to recommendations in ASTM C 898/C 898M and ASTM C 1471.

3.3 PROTECTION

A. Protect waterproofing from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended in writing by manufacturer of affected construction.

END OF SECTION 071416

SECTION 072100

THERMAL INSULATION

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. This Section includes the following:

1. Rigid board insulation under slabs-on-grade.
2. Glass-fiber blanket, concealed building thermal insulation.
3. Mineral fiber (mineral wool) batt thermal insulation.
3. Extruded Polystyrene (XPS) rigid foam insulation board for continuous insulation.
5. Acoustic insulation.
6. Safing insulation.

1.03 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract.

B. Product Data for each type of insulation product specified.

C. Product test reports from and based on tests performed by a qualified independent testing agency evidencing compliance of insulation products with specified requirements including those for thermal resistance, fire-test-response characteristics, water-vapor transmission, water absorption, and other properties, based on comprehensive testing of current products.

1.04 QUALITY CONTROL

A. Single-Source Responsibility for Insulation Products: Obtain each type of building insulation from a single source with resources to provide products complying with requirements indicated without delaying the Work.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated on Drawings or specified elsewhere in this Section as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1. Surface-Burning Characteristics: ASTM E 84.
2. Fire-Resistance Ratings: ASTM E 119.
3. Combustion Characteristics: ASTM E 136.

C. Mockup: Refer to Division 1 Section “Exterior Wall Mock-Up”.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:

1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering insulation products that may be incorporated in the work include, but are not limited to, the following:

1. Extruded-Polystyrene Board Insulation:
   a. Amoco Foam Products Company.
   b. Dow Chemical Co.
   c. UC Industries, Inc.; Owens-Corning Co.
   d. Or Equal as approved by the Professional.

2. Glass-Fiber Blanket (Batt) Insulation:
   a. CertainTeed Corporation.
   b. Owens-Corning Fiberglas Corporation.
   c. Schuller International, Inc.
   d. Or Equal as approved by the Professional.

3. Mineral Fiber Batt Insulation:
   a. Johns Manville
   b. Knauf Insulation
   c. Owens Corning
   d. Rockwool Group
   e. Or Equal as approved by Professional.

2.02 INSULATING MATERIALS, GENERAL

A. Provide insulating materials that comply with requirements and with referenced standards.

1. Preformed Units: Sizes to fit applications indicated; selected from manufacturer's standard thicknesses, widths, and lengths.

2.03 BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: Rigid, cellular polystyrene thermal insulation formed from polystyrene base resin by an extrusion process using hydrochlorofluorocarbons as blowing agent to comply with ASTM C 578 for type and with other requirements indicated below:

1. Type IV, 1.60-lb/cu. ft. minimum density, unless otherwise indicated.
2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 75 and 450, respectively.

2.04 CONCEALED BUILDING INSULATION, EXTERIOR WALLS AND SOFFITS

A. Faced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type III, Class A (blankets with reflective vapor-retarder membrane facing and flame spread of 25 or less); with foil-scrim-kraft, foil-scrim, or foil-scrim-polyethylene vapor-retarder membrane on 1 face.

1. Mineral-Fiber Type: Fibers manufactured from glass or slag wool.

B. Alternate to “A. Faced Mineral-Fiber Blanket Insulation”, Unfaced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type I (blankets without membrane facing).

1. Mineral-Fiber Type: Fibers manufactured from glass or slag wool.
2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.
3. Vapor Retarder: refer to 2.09, Vapor Retarder paragraph below.

2.06 CONCEALED BUILDING INSULATION, INTERIOR PARTITIONS

A. Unfaced Mineral-Fiber Blanket Insulation: Thermal insulation combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665, Type I (blankets without membrane facing).

1. Mineral-Fiber Type: Fibers manufactured from glass or slag wool.
2. Surface-Burning Characteristics: Maximum flame-spread and smoke-developed indices of 25 and 50, respectively.

2.07 ACOUSTIC INSULATION

A. Glass fiber base board with fibers bonded together with a thermoset resin and a durable, black non-woven mat surface adhered to the glass fiber base board.

2.08 SAFING INSULATION AND ACCESSORIES

A. Slag-Wool-Fiber Board Safing Insulation: Semirigid boards designed for use as fire stop at openings between edge of slab and exterior wall panels, produced by combining slag-wool fibers with thermosetting resin binders to comply with ASTM C 612, Type IA and IB; nominal density of 4 lb/cu. ft.; passing ASTM E 136 for combustion characteristics; thermal resistivity of 4 deg F x h x sq. ft./Btu x in. at 75 deg F.

B. Caulking Compound: Material approved by manufacturer of safing insulation for sealing joint between foil backing of safing insulation and edge of concrete floor slab against penetration of smoke.

2.09 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

B. Vapor-Retarder Tape: Pressure-sensitive foil-faced tape for sealing joints and penetrations in vapor retarder

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and to determine if other conditions affecting performance of insulation are satisfactory. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrates of substances harmful to insulations or vapor retarders, including removing projections capable of puncturing vapor retarders or that interfere with insulation attachment.

B. Close off openings in cavities receiving poured-in-place insulation to prevent escape of insulation. Provide bronze or stainless-steel screens (inside) where openings must be maintained for drainage or ventilation.

3.03 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, unsoiled, and has not been exposed at any time to ice and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Apply single layer of insulation to produce thickness indicated, unless multiple layers are otherwise shown or required to make up total thickness.

3.04 INSTALLATION OF PERIMETER INSULATION

A. On vertical surfaces, set units in adhesive applied according to manufacturer's written instructions. Use adhesive recommended by insulation manufacturer.

B. Protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection board. Set in adhesive according to written instructions of insulation manufacturer.

C. Protect top surface of horizontal insulation from damage during concrete work by applying protection board.

3.05 INSTALLATION OF GENERAL BUILDING INSULATION

A. Apply insulation units to substrates by method indicated, complying with manufacturer's written instructions. If no specific method is indicated, bond units to substrate with adhesive or use mechanical anchorage to provide permanent placement and support of units.

B. Seal joints between closed-cell (nonbreathing) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed installation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

C. Set foil-faced units with vapor retarder to warm side of construction, unless otherwise indicated. Do not obstruct ventilation spaces, except for firestopping.

1. Fold tabs over studs and seal to studs.
2. Tape all seams. Where multiple studs occur, provide un-faced insulation in the stud space, and tape over all studs (to complete the vapor barrier).
3. Seal joints caused by pipes, conduits, electrical boxes, and similar items penetrating vapor retarders with vapor-retarder tape to create an airtight seal between penetrating objects and vapor retarder.
4. Tape joints and ruptures in vapor retarder, and seal each continuous area of insulation to surrounding construction to ensure airtight installation.
5. Foil facing to be continuous from slab to roof deck. Install vapor retarder where the insulation foil facing can not be installed.
6. Refer to “Installation of Vapor Retarder” below for additional requirements.

D. Install mineral-fiber blankets in cavities formed by framing members according to the following requirements:

1. Use blanket widths and lengths that fill cavities formed by framing members. Where more than one length is required to fill cavity, provide lengths that will produce a snug fit between ends.
2. Place blankets in cavities formed by framing members to produce a friction fit between edges of insulation and adjoining framing members.

E. Fit batt insulation in shim space around all exterior openings.

F. Stuff glass-fiber loose-fill insulation into miscellaneous voids and cavity spaces. Compact to approximately 40 percent of normal maximum volume equaling a density of approximately 2.5 lb/cu. ft.

3.07 INSTALLATION OF SAFING INSULATION

A. Install safing insulation to fill gap between edge of concrete floor slab and back of exterior spandrel panels on safing clips spaced as needed to support insulation, but not further apart than 24 inches o.c. Cut safing insulation wider than gap to be filled to ensure compression fit and seal joint between insulation and edge of slab with calking approved by safing insulation manufacturer for this purpose. Leave no voids in completed installation.

3.09 PROTECTION

A. General: Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION

SECTION 07 24 23

CEMENT BOARD FINISH SYSTEM

PART I - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY:

A. Section Includes:

1. Cement Board.
2. Cement Board Finish.
3. Accessories.

1.3 RELATED SECTIONS

A. Cold-Formed Metal Framing – Section 05 40 00
B. Sheathing – Section 06 16 00.
C. Weather Barriers – Section 07 25 00
D. Flashing and Sheet Metal – Section 07 62 00
E. Joint Sealants – Section 07 92 00

1.4 REFERENCES

A. AC59 Acceptance Criteria for Direct-Applied Exterior Finish Systems.
B. AC148 Acceptance Criteria for Flashing Materials.
C. ASTM B 117 (Federal Test Standard 141A Method 6061) Test Method of Salt Spray (Fog) Testing.
D. ASTM C 79 Specification for Gypsum Sheathing Board.
E. ASTM C 150 Specification for Portland Cement.
F. ASTM C 297 Test Method for Tensile Strength of Flat Sandwich Constructions in Flatwise Plane.
G. ASTM C 1177 Specification for Glass Mat Gypsum Substrate for Use as Sheathing.
H. ASTM C 1325 Standard Specification for non-asbestos fiber-mat reinforced cementitious backer units.
I. ASTM C 1516 Standard Practice for Application of Direct-Applied Exterior Finish Systems.
J. ASTM D 968 (Federal Test Standard 141A Method 6191) Test Method for Abrasion Resistance of Organic Coatings by Falling Abrasive.
K. ASTM D 2898 Standard Test Method for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing
L. ASTM D 3273 Test Method for Resistance to Growth of Mold on Surfaces.
M. ASTM E 84 Test Method for Surface Burning Characteristics of Building Materials.
N. ASTM E 96 Test Methods for Water Vapor Transmission of Materials.
O. ASTM G 23 (Federal Test Standard 141A Method 6151) Recommended Practice for Operating Exposure Apparatus (Carbon-Arc Type) With and Without Water, for Exposure of Nonmetalic Materials.
P. Manufacturer’s Data Sheets.

1.5 SUBMITTALS

A. Submittal requirements include:
1. Product literature.
2. Shop Drawings: Project specific shop drawings of the stucco assembly including details showing transition to adjacent work.
3. Mock-up.
4. Finish sample indicating color and texture for approval by architect/client agency.

1.6 DESCRIPTION

A. Cement Board MD Finish System consisting of base coat with reinforcing mesh, and finish applied over an exterior cement board that is installed over a code approved water-resistive barrier and approved drainage medium.

1. Design Requirements:

a. A sheathing board substrate installed over structural framing prior to installation of a code approved water-resistive barrier shall be one of the following:

1) Exterior sheathing having a water-resistant core with fiberglass mat facers meeting ASTM C 1177.
2) Exterior fiber reinforced cementitious backer meeting ASTM C 1325 or calcium silicate boards.

b. The outer layer sheathing shall be exterior cement board meeting ASTM C 1325, minimum 5/8 in.
c. The roofing materials shall be loaded onto the roof and interior wallboard stocked in the building prior to the installation of the Cement Board MD Finish System.
d. Deflection of substrate systems shall not exceed L/360.
e. Expansion joints:

1) Design and location of expansion/control joints in the substrate shall be as indicated on the contract documents and at the following locations:

a) Where expansion joints occur in the substrate system
b) Where building expansion joints occur
c) At floor lines in wood frame construction
d) Where Cement Board MD Finish System abuts dissimilar materials
e) Where the substrate changes
f) Where significant structural movement occurs such as changes in roofline, building shape or structural system

f. Control joints:

1) As a minimum, control joints shall be located at the following locations and as indicated:

a) Corners of openings.
b) Such that wall lengths do not exceed 20 ft (6 m).
c) Length to width ratios of wall areas shall not exceed 2.5:1.

g. Sealants

1) Refer to manufacturer for a sealants that have been tested for compatibility with products.

h. Vapor Retarders

i. Flashing

1) Flashing: shall be provided at all roof-wall intersections, windows, doors, chimneys, decks, balconies, and other areas as necessary to prevent water penetration behind Cement Board MD Finish System.

2. Performance Requirements: As a minimum, the Cement Board Finish System products shall be tested as follows:

a. ASTM B 117: Salt Spray Resistance – 300 hrs, no deleterious effects.
b. ASTM C 297 Bond Strength – Failure in the substrate.
c. ASTM D 968: Abrasion Resistance – 132 gal (500 L), no deleterious effects.
d. ASTM D 3273 Mildew/Fungus Resistance – Passed.
e. ASTM E 84 Flame Spread – Flame Spread Index less than 25, Smoke Developed less than 250.
f. ASTM E 96 Water Vapor Transmission – Vapor Permeable.

g. ASTM G 23 Accelerated Weathering – 2000 hrs, Passed.

1.7 QUALITY ASSURANCE

A. Qualifications:

1. Material shall be manufactured at a facility covered by a current ISO 9001:2015 and ISO 14001:2015 certification. Certification of the facility shall be by a registrar accredited by the American National Standards Institute-Registrar Accreditation Board (ANSI-RAB).
2. Plastering Contractor:

   a. Shall be knowledgeable in the proper installation of Cement Board MD Finish System components.
   b. Shall have qualified and properly trained people to perform work.
   c. Shall be licensed, bonded and insured.
   d. Shall have experience in application of direct-applied exterior finish systems on projects of comparable scope.

3. Third Party Inspection

   a. Client Agencies independent third-party inspection shall verify installation according to code and contract documents. It is recommended that as a minimum, inspection items include installation of the water-resistive barrier, flashings and accessories, Cement Board MD Finish System materials and sealants. The intent is to verify that the installation has been performed in accordance with code requirements, contract requirements and this specification.

4. All components of the Cement Board Finish System shall be obtained from the same manufacturer through its authorized distributors.
5. Reference manufacturer's data sheet for additional component and installation requirements.

B. Mock-Up

1. The contractor shall, before the work commences, provide the client agency/architect with a mock-up for approval.
2. The mock-up shall be of suitable size as required to accurately represent each color and texture to be utilized on the project.
3. The mock-up shall be prepared with the same products, tools, equipment and techniques required for the actual applications. The finish used shall be from the same batch as that being used for the project.
4. The approved mock-up shall be available and maintained at the job site.

1.8 DELIVERY, STORAGE AND HANDLING

A. All materials shall be delivered to the job site in the original, unopened packages with labels intact.
B. Upon arrival, materials shall be inspected for physical damage, freezing or overheating. Questionable materials shall not be used.

1. Materials shall be stored at the job site, and at all times, in a cool, dry location, out of direct sunlight, protected from weather and other sources of damage. Minimum storage temperature shall be as follows:
   a. 40 °F (4 °C).
   b. For other products, refer to specific product data sheets.
2. Maximum storage temperature shall not exceed 100 °F (38 °C). NOTE: Minimize exposure of materials to temperatures over 90 °F (32 °C). Finishes exposed to temperatures over 110 °F (43 °C) for even short periods may exhibit skinning, increased viscosity and should be inspected prior to use.

C. Protect all products from inclement weather and direct sunlight.

1.9 PROJECT CONDITIONS

A. Environmental Requirements

1. Application of wet materials shall not take place during inclement weather unless appropriate protection is provided. Protect materials from inclement weather until they are completely dry.
2. At the time of product application, the air and wall surface temperatures shall be from 40 °F (4 °C) minimum to 100 °F (38 °C) maximum for the following products:
   a. DPR, PMR, HDP, Weatherlastic and E Finishes, Color Prime, Primus, Genesis and NCB.
   b. For other products, refer to specific product data sheets.
3. These temperatures shall be maintained with adequate air ventilation and circulation for a minimum of 24 hours (48 hours for Weatherlastic Finishes, Ameristone, and TerraNeo) thereafter, or until the products are completely dry. Refer to published product data sheets for more specific information.

1.10 SEQUENCING AND SCHEDULING

A. Installation of Cement Board Finish System shall be coordinated with other construction trades.

1.11 WARRANTY

A. Manufacturer shall provide a written limited materials warranty against defective material upon written request.
B. The applicator shall warrant workmanship separately.

PART II-PRODUCTS

2.1 MANUFACTURER:

A. Basis-of-Design Products: Subject to compliance with requirements provide Cement Board MD Finish System as manufactured by one of the following:
   1. Dryvit Systems, Inc.
   2. Parex USA
   3. Senergy Wall Systems.
   4. Sto Corp.
   5. Or equal as approved by Professional.

2.2 MATERIALS

A. Water-Resistive Barrier.

1. A vapor permeable, flexible, polymer-based noncementitious water-resistive and air barrier coating available in Texture, Smooth, and Spray.
2. Grid Tape A 4 in (102 mm) wide, open weave fiberglass mesh tape used to reinforce sheathing joints and exposed edges of sheathing.

B. Spacer: Polyethylene spacer, which separates the exterior cement board from the sheathing substrate,.
C. Base Coat:

1. Sprayable: A dry blend cementitious, polymer-modified product, field mixed with water and specifically formulated for spray applications to provide longer pot life, less false set, extended open time and stronger wet grip.

D. Reinforcing Mesh(es): Shall be a balanced open weave, glass fiber fabric treated for compatibility with other system materials.

1. Detail Mesh®: 4.3 oz/yd^2 (146 g/m^2), 9 1/2 in (241 mm) wide. Required at all exterior cement board joints and inside and outside corners.
2. Standard Mesh: 4.3 oz/yd^2 (146 g/m^2). Shall be installed over the entire exterior cement board face.

G. Finish: Shall be the type, color and texture as selected by the client agency/architect and shall be one or more of the following:

1. Standard DPR (Dirt Pickup Resistance): Water based, acrylic coatings with integral color and texture and formulated with DPR chemistry:

a. Two-coats, Freestyle DPR Fine texture. Textured smooth. Match Architect's sample.

I. Accessories:

1. PVC accessories shall meet ASTM D 1784 and C 1063.
2. Soffit Drip Screed:
    a. Material: Extruded aluminum alloy 6063 T5 with chemical conversion coating. Color as selected by Architect from manufacturer's full range.

PART III-EXECUTION

3.1 EXAMINATION

A. Prior to installation of the Cement Board MD Finish System, it is the contractor's responsibility to ensure that:

1. The sheathing substrate and the exterior cement board surface are free of dust, loose particles, oil and other conditions that would affect the adhesion or installation of Cement Board MD Finish System materials.
2. All fasteners are corrosion resistant and installed in a manner as to be flush with the surface of the cement board.
3. All accessories including corner aids, control and expansion joints, casing beads, etc. are properly fastened and positioned according to contract drawings, manufacturer requirements and local building code requirements.
4. The water-resistive barrier is of a proper type and, if sheet form, has been installed in a weatherboard fashion in accordance with building code and manufacturer's requirements.
5. Doors, windows, decks, and other openings and penetrations have been properly flashed in accordance with manufacturer requirements, building code and contract documents.
6. Metal roof flashing has been installed in accordance with Asphalt Roofing Manufacturers Association (ARMA) Standards.
7. The cement board surface is flat within 1/4 in (6.4 mm) in 10 ft (3 m).
8. The contractor shall notify the general contractor and/or client agency and/or architect of all discrepancies. Do not proceed until unsatisfactory conditions are resolved.

3.2 PREPARATION

A. The Cement Board MD Finish System materials shall be protected by permanent or temporary means from weather and other damage prior to, during, and following application, until dry.
B. Protect adjoining work and property.

3.3 INSTALLATION

A. Mixing:

1. Due to shipping and storage, there may be some settling of materials. Prior to using, mix the material to a smooth homogeneous consistency.
2. Base coat materials shall be mixed in accordance with current manufacturer's printed Product Sheets.

3. Finishes:

    a. Finishes are factory blended and require no additives. Mix each pail to a uniform consistency adding a small amount of water as needed to adjust workability. Ensure that the same amount of water is added to each pail of the same color.
    b. Refer to the product data sheet for the specific finish being used for more complete instructions.

B. Application of Base Coat:

1. Prepare the substrate sheathing so as to be free of foreign materials such as oil, dust, dirt, paint, wax, water repellents, moisture, frost and any other materials that may inhibit adhesion.
2. Can be applied using a roller, trowel, or spray equipment (with backrolling) over the approved substrates.

C. Installation of MD Spacer:

1. Secure the MD Spacer to the substrate using corrosion resistant staples through the water-resistive barrier and into the substrate or framing. The spacer is 1/8 in (3.2 mm) thick by 3 in (76 mm) wide and is installed in continuous vertical strips spaced a maximum of 16 in (406 mm) on center installed over each framing member. Additionally, install the spacer flush with the vertical edge of all system terminations and changes in wall direction. If other spacers are used, follow manufacturers' instructions.

D. Install the exterior cement board in accordance with manufacturer's instructions and project requirements.

1. Align sheathing joints with the MD Spacer and install fasteners through the MD Spacer or other spacers as needed.
2. Do not align joints with corners of wall penetrations.
3. Exterior cement board joints shall be offset from sheathing board substrate joints.

E. Application of Base Coat:

1. Apply over all exterior cement board joints and inside and outside corners and embed a 9 1/2 in (241 mm) wide strip of Detail Reinforcing Mesh into the wet base coat mixture.
2. Allow the base coat mixture to take up until firm to the touch.
3. Apply a continuous layer over the exterior cement board face and embed a layer of Standard Reinforcing Mesh into the wet base coat mixture such that the entire surface of the board is covered. The reinforced base coat shall be applied to a uniform thickness of approximately 1/16 in (1.6 mm) and be sufficient to embed the reinforcing mesh.
4. All edges of reinforcing mesh shall be lapped a minimum of 2 1/2 inches (64 mm).

F. Application of Finishes:

1. Allow the base coat to cure a minimum of 24 hours until completely dry.
2. Ensure that the surface of the wall is clean, dry and free of any contaminants that may impair the adhesion of surface finish.
3. Finishes may be either spray or trowel applied.
4. Always apply the finish to a natural break to avoid visible cold joints.
5. Always work the shady side of the wall or provide shading to avoid application in direct sunlight.
6. Finishes shall be applied in accordance with published manufacturer's instructions for the specific finish being used. Refer to the published product data sheet for the specified finish.

3.4 FIELD QUALITY CONTROL

A. The contractor shall be responsible for the proper application of the Cement Board MD Finish System materials.
B. Independent third party inspection is required to verify installation according to code and contract documents. As a minimum, it is recommended that inspection items include installation of the water-resistive barrier, flashings, and accessories, Cement Board MD Finish System materials, and sealants.

3.05 CLEANING

A. All excess Cement Board MD Finish System materials shall be removed from the job site by the contractor in accordance with contract provisions.
B. All surrounding areas, where the Cement Board MD Finish System has been applied, shall be left free of debris and foreign substances resulting from the contractor's work.

3.06 PROTECTION

A. The system shall be protected from weather and other damage until permanent protection in the form of flashings, sealants, etc. are installed.

END OF SECTION

SECTION 07 27 26

WEATHER BARRIERS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section Includes
   1. Fluid applied, vapor permeable air barrier assembly

1.3 REFERENCES

A. Referenced Standards
   1. American Architectural Manufacturers Association (AAMA):
      a. AAMA 711, Specification for Self-Adhering Flashing Used for Installation of Exterior Wall Fenestration Products
   2. American Society for Testing and Materials (ASTM):
      a. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials
      b. ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials
      c. ASTM E2112, Standard Practice for Installation of Exterior Windows, Doors and Skylights
      d. ASTM E2178, Standard Test Method for Air Permeance of Building Materials
      e. ASTM E2357, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies
   3. International Living Future Institute:
      a. Declare Label, LBC Red List Free
   4. National Fire and Protection Agency (NFPA):
      a. NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components

1.4 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation Meetings
   1. Review conditions, installation procedures, schedules, and coordination with other Work.

1.5 SUBMITTALS

A. Provide submittals in accordance with Section 01 33 00 Submittal Procedures.

B. Action submittals:
   1. Product data:
      a. Standard details
      b. Technical data sheets
   2. Certificates:
      a. Product certification stating assembly components are supplied and warranted by a single source Manufacturer.

b. Declaration Status: LBC Red List Free

3. Tests and evaluation reports:
   a. NFPA 285 wall assembly compliance
   b. Air leakage compliance:
      1. ASTM E2178 3rd party test report
      2. ASTM E2357 3rd party test report

1.6 QUALITY ASSURANCE

A. Qualifications
   1. Manufacturer qualifications:
      a. Minimum of 20 years of experience in the production and sales of air barriers.
   2. Installer qualifications:
      a. Experienced in similar Work as described in this section.

B. Mock-ups
   1. Construct mockups at a size and location as directed by the Architect to verify project specific applications and set quality standards for materials and execution in accordance with Section 01 43 39 Mockups.
      a. Include transitions, moving joints, penetrations, flashings, and tie-ins to adjacent products as part of the mockup.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements
   1. Deliver materials in original, factory-sealed, unopened containers with intact and legible product label and manufacturer name.

B. Storage and Handling
   1. Store materials as recommended by the Manufacturer in a protected area and out of direct sunlight. Protect materials from rain and physical damage.

1.8 SITE CONDITIONS

A. Ambient Conditions
   1. Do not perform Work during rain or inclement weather.
   2. Do not perform Work on surfaces covered in frost, snow, or wet to touch. Damp surfaces are acceptable.
   3. Refer to product specific technical data sheet.

1.9 WARRANTY

A. Manufacturer Warranty
   1. Provide Air Barrier Manufacturer’s standard 10-year material warranty.

PART 2 - PRODUCTS

2.1 ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements provide products manufactured by one of the following or approved equal:
   1. GCP Applied Technologies
   2. Henry a Carlisle Company
   3. Soprema
   4. Tremco
   5. Or equal as approved by Professional.

B. Performance Criteria

1. Substrate conditions: Can be applied to damp surfaces
2. Vertical and lateral flame propagation: meets IBC NFPA 285 exception number 2
3. Rain ready within 30 minutes
4. Minimum application temperature: 10 degrees F (minus 12 degrees C)
5. Service temperature: minus 40 to 300 degrees F (minus 40 degrees C to 149 degrees C)
6. Water vapor permeance:
    a. ASTM E96 (Method A): 11 perms
    b. ASTM E96 (Method B): 16 perms
7. Air leakage (ASTM E2357): Pass
8. Elongation (ASTM D412): 350 percent
9. Flame spread and smoke development (ASTM E84): Class A
10. UV resistance:
    a. Accelerated weathering (ASTM G154): greater than 5000 hours
    b. UV resistance during construction: 12 months
    c. Allowed under open joint cladding: 2 inch (5 millimeter) joint and 40 percent area exposure maximum
11. Declaration status: LBC Red List Free
12. VOC content, max (EPA Method 24): 25 g/L

C. Materials
1. Fluid applied vapor permeable air barrier
    a. UV-resistant, moisture cure, single-component STPE water-resistive air barrier, having the following typical properties:
        1. Basis of design: Henry Air-Bloc All Weather STPE, UV-Resistant Vapor Permeable Air Barrier
        2. Color: Black
        3. Substrate conditions: Can be applied to damp surfaces
        4. Vertical and lateral flame propagation: meets IBC NFPA 285 exception number 2
        5. Rain ready within 30 minutes
        6. Minimum application temperature: 10 degrees F (minus 12 degrees C)
        7. Service temperature: minus 40 degrees F to 200 degrees F (minus 40 degrees C to 93 degrees C)
        8. Water vapor permeance:
            a. ASTM E96 (Method A): 11 perms
            b. ASTM E96 (Method B): 16 perms
        9. Air leakage (ASTM E2357): Pass
        10. Elongation (ASTM D412): 350 percent
        11. Flame spread and smoke development (ASTM E84): Class A
        12. UV resistance:
            a. Accelerated weathering (ASTM G154): greater than 5000 hours
            b. UV resistance during construction: 12 months
            c. Allowed under open joint cladding: 2 inch (5 millimeter) joint and 40 percent area exposure maximum
        13. Declaration status: LBC Red List Free
        14. VOC content, max (EPA Method 24): 25 g/L

2. Flashings
    a. Liquid-applied flashing
        1. UV-resistant, moisture cure, single-component STPE air barrier:
        2. Moisture-cure, single component STPE flashing:
    b. Self-adhered flashing
        1. Self-adhered synthetic butyl flashing:
        2. Self-adhered burn and UV resistant air and vapor barrier:
        3. Self-adhered water resistive air barrier:
3. Primers and adhesives for self-adhered flashing
    a. Polymer emulsion-based primer with low VOC content:

b. Quick drying, rubber-based adhesive:
c. Quick drying, low VOC rubber-based adhesive:
1. Basis of design: Blueskin LVC Adhesive
d. Quick drying, low VOC rubber-based spray primer:

4. Sealants
a. Moisture cure, STPE polymer-based sealant:
b. Moisture-cure, single component STPE flashing:

5. Thru-wall flashing
a. Self-adhered, SBS rubberized asphalt thru-wall flashing:

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verification of Conditions
1. Verify the substrate is in accordance with Air Barrier Manufacturer requirements and as specified in this Section prior to air barrier installation. Commencement of the Work indicates installer acceptance of the substrate.
a. Verify surfaces are sound, clean, and free of frost, oil, grease, dirt, excess mortar or other contaminants.
b. Verify substrates are continuous and secure, smooth and without large voids, spalled areas, or sharp protrusions.
c. Install sheathing fasteners into solid backing and set flush with sheathing.
1. Fill grout, strike mortar full, and remove mortar droppings to create a continuous and void free substrate.
2. Cure for 36 hours
3. Core fill grout: cure for 48 hours
d. Concrete surfaces:
1. Fill tie-holes.
2. Allow concrete to cure for 3 days after removing forms.
3. Curing compounds: resin based without oil, wax, or pigments.
4. Substrates must be free of form release agents.

3.2 PREPARATION

A. Protection of In-Place Conditions
1. Protect areas and surfaces not included in scope of Work against damage or soiling.
2. Cap and protect exposed back-up walls against wet weather conditions prior to, during, and after application of air barrier assembly.

3.3. INSTALLATION

A. Detailing and Flashing
1. Install detailing and flashings per Air Barrier Manufacturer’s details.

B. Air Barrier
1. Install air barrier in accordance with Air Barrier Manufacturer product specific technical data sheet to create a continuous air and watertight assembly without sags, runs or voids.
2. Application Rate:
a. Application rates and wet film thickness as verified with a comb gauge are approximate and may vary depending on texture and porosity of surface.
b. Wet film thickness (WFT): 20 mils as measured with a comb gauge
c. Resulting theoretical dry film thickness (DFT): 20 mils

C. Fastener Penetrations

1. It is the responsibility of the post-applied fastening component installer to preserve the integrity of the air barrier.
2. Supplemental sealant may be required at the point of fastener penetration depending on fastened component profiles, substrate type, and fastener installation workmanship.
3. Contact the Air Barrier Manufacturer for project specific recommendations.

3.4. SITE QUALITY CONTROL

A. Installation Observations
1. Observe air barrier installation during the following phases:
a. Air barrier membrane installation start
b. Prior to cladding installation

3.5 CLEANING

A. Waste Management
1. As the Work proceeds, and upon completion, promptly clean up and remove from the premises all rubbish and surplus materials resulting from the foregoing Work.
2. Clean soiled surfaces, spatters, and damage caused by Work of this Section.

3.6 PROTECTION

A. Protect air barrier from damage by other trades.

B. Install cladding as soon as practical after application. Refer to product specific technical data sheet for product limitations.

END OF SECTION

SECTION 07 4213.23

METAL COMPOSITE MATERIAL PANELS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Metal composite material (MCM) panels.

1.3 ACTION SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel, system, and accessory.

1. Metal composite material (MCM) panels.

B. Shop Drawings:

1. Include fabrication and installation layouts of MCM system; details of edge conditions, joints, panel profiles, corners, anchorages, attachment assembly, trim, flashings, closures, accessories, and special details.
2. Accessories: Include details of flashing, trim, and anchorage, at a scale of not less than 1-1/2 inches per 12 inches.
3. Provide signed and sealed drawings, by a qualified design professional in Project jurisdiction, of MCM system showing compliance with performance requirements and design criteria identified for this Project.

C. Samples for Initial Selection: For each type of MCM panel indicated, with factory-applied color finishes.

1. Size: Manufacturers' standard size .
2. Include Samples of trim and accessories involving color selection.

D. Samples for Verification: For each type of MCM panel required, with factory-applied color finishes.

1. MCM Panel: Two samples , 2 by 3 inches .

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports: For each MCM panel , for tests performed by manufacturer and witnessed by a qualified testing agency.
    a. MCM Panel Manufacturer's Material Test Reports: Certified test reports showing compliance with specific performance or third-party listing documenting compliance in accordance with the IBC.
2. Research Reports: For MCM systems, from an agency acceptable to authorities having jurisdiction showing compliance with applicable codes.

B. Qualification Statements: For manufacturer fabricator .

C. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For MCM panels.

B. Warranty Documentation:

1. Manufacturers' special warranties.
2. Installer's special warranties.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: Minimum 5 years' experience .

B. Fabricator Qualifications: Approved by MCM panel manufacturer .

1.7 MOCKUPS

A. Build mockups to demonstrate aesthetic effects .

1. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless client agency specifically approves such deviations by Change Order.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, MCM panels, and other manufactured items so as not to be damaged or deformed. Package MCM panels for protection during transportation and handling.

B. Unload, store, and erect MCM panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack MCM panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store MCM panels to ensure dryness, with positive slope for drainage of water. Do not store MCM panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on MCM panels during installation.

E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.

1.9 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of MCM panels to be performed in accordance with manufacturers' written instructions and warranty requirements.

1.10 COORDINATION

A. Coordinate MCM panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.11 WARRANTY

A. Panel Integrity Warranty: Manufacturer agrees to repair or replace components of MCM panels that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.
2. Warranty Period: Five years from date of Substantial Completion.

B. Panel Finish Warranty: Manufacturer agrees to repair finish or replace MCM panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested in accordance with ASTM D2244.
   b. Chalking in excess of a No. 8 rating when tested in accordance with ASTM D4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
2. Finish Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested in accordance with ASTM E283/E283M at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. .

B. Water Penetration under Static Pressure: No water penetration when tested in accordance with ASTM E331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. .

C. Water Penetration under Dynamic Pressure: No water penetration when tested in accordance with AAMA 501.1 at the following test pressure:

1. Test Pressure: 6.24 psf .

D. Pressure Cycling: Provide PER system with a pass rating in accordance with AAMA 508.

1. Lag between the cavity and the cyclic wind pressure to not exceed 0.08 seconds.
2. Maximum differential between the cavity and the cyclic wind pressure to not exceed 50 percent of the maximum test pressure.

E. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.

1. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces.

2.2 METAL COMPOSITE MATERIAL (MCM) WALL PANELS

A. Metal Composite Material (MCM) Wall Panels: Provide MCM panels fabricated from two metal facings bonded to a solid, extruded thermoplastic core.

1. Basis-of-Design Product: Subject to compliance with requirements, provide ALUCOBOND; 3A Composites USA, Inc; Panels Plus panels or
2. one of the following:
   a. Alfrex.
   b. Alpolic.
   c. Citadel.
   d. Laminators, Inc.
   e. Pac-Clad.
   f. Or equal as approved by Professional.
3. Core: Manufacturer's standard fire retardant core. .
4. Panel Thickness: 0.157 inch .
5. Bond Strength: 22.5 in-lb/in. when tested for bond integrity in accordance with ASTM D1781.
6. Fire Performance: Flame-spread index less than 25 and smoke-developed index less than 450, in accordance with ASTM E84 or UL 723.
7. Easy Fix attachment system.

B. MCM Panel Materials:

1. Aluminum-Faced Panels : ASTM B209/B209M alloy as standard with manufacturer, temper as required to suit finish and forming operations with 0.020-inch- thick, aluminum sheet facings.
   a. Exterior Finish: Color anodized .
      1) Color: As selected by Architect from manufacturer's full range.

2.3 ACCESSORIES

A. Metal Subframing and Furring: ASTM C955 cold-formed, metallic-coated steel sheet ASTM A653/A653M, G90 hot-dip galvanized coating designation or ASTM A792/A792M, Class AZ50 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of MCM system.

B. System Accessories: Provide components required for a complete, weathertight wall system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of MCM panels unless otherwise indicated.

C. Flashing and Trim: Provide flashing and trim formed from same material as MCM panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, framed openings, rakes, fasciae, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent MCM panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Use gasketed or approved coated fasteners between dissimilar metals.

1. Aluminum Panels: Use aluminum or stainless steel fasteners for surfaces exposed to the exterior; use aluminum or galvanized-steel fasteners for surfaces exposed to the interior.

E. Panel Sealants: ASTM C920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in MCM panels and remain weathertight; and as recommended in writing by MCM system manufacturer.

2.4 FABRICATION

A. Fabricate and finish MCM panels at the factory, by panel manufacturer's standard procedures and processes, as necessary to fulfill indicated panel performance requirements demonstrated by laboratory testing.

B. Shop-fabricate MCM systems and accessories by fabricator's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with requirements of MCM panel manufacturer, of indicated system profiles, and with dimensional and structural requirements.

1. Fabricate panels to dimensions indicated on Drawings based on an assumed design temperature of 70 deg F. Allow for ambient temperature range at time of fabrication.
2. Formed MCM panel lines, breaks, and angles to be sharp and straight, with surfaces free from warp or buckle.
3. Fabricate panels with sharply cut edges and no displacement of face sheet or protrusion of core.
4. Fabricated Panel Tolerances: Shop-fabricate panels to sizes and joint configurations indicated on Drawings.
    a. Width: Plus or minus 0.079 inch at 70 deg F.
    b. Length: Plus or minus 0.079 inch at 70 deg F.
    c. Squareness: Plus or minus 0.079 inch at 70 deg F.
5. Attach routed-and-returned panel flanges to panel clips with manufacturer's standard fasteners .

C. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's written instructions and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil-canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams.
4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.

5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal manufacturer.
    a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal manufacturer for application, but not less than thickness of metal being secured.

2.5 FINISHES

A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Anodized Aluminum Finish: Color in accordance with AAMA 611, AA-M12C22A41, Class I, 0.018 mm or thicker.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, MCM system supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by MCM system manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by MCM system manufacturer.
    a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and assemblies penetrating MCM system to verify actual locations of penetrations relative to seam locations of MCM panels before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF MCM SYSTEM

A. General: Install MCM system in accordance with system manufacturer's written instructions in orientation, sizes, and locations indicated on Drawings. Install panels perpendicular to supports unless otherwise indicated. Anchor MCM system securely in place, with provisions for thermal and structural movement.

1. Shim or otherwise plumb substrates receiving MCM system.
2. Flash and seal MCM system at perimeter of all openings. Fasten with self-tapping screws.
3. Install screw fasteners in predrilled holes.
4. Locate and space fastenings in uniform vertical and horizontal alignment.

5. Install flashing and trim as MCM system work proceeds.
6. Align bottoms of MCM panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
7. Provide weathertight escutcheons for all items penetrating system.
8. Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by MCM system manufacturer.
9. Attach MCM panels to supports at locations, spacings, and with fasteners recommended by manufacturer to meet listed performance requirements.

B. Dry-Seal MCM System: Attach MCM panels by interlocking panel clips into channels in a sequential series.

1. Seal horizontal and vertical joints between adjacent MCM panels with manufacturer's standard gaskets.

C. Install panels to allow individual panels to "free float" and be installed and removed without disturbing adjacent panels.

D. Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install accessory components required for a complete MCM system assembly including trim, copings, corners, seam covers, flashings, gaskets, fillers, closure strips, and similar items. Provide types indicated by MCM system manufacturer.

E. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.

1. Install exposed flashing and trim that is without buckling and tool marks and that is true to line and levels indicated, with exposed edges folded back to form hems. Install trim to fit substrates and to result in waterproof performance.
2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 ft. with no joints allowed within 24 inches of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.3 INSTALLATION TOLERANCES

A. Shim and align MCM panels within installed tolerance of 1/4 inch in 20 ft., non-accumulative, on level, plumb, and location lines as indicated, and within 1/8-inch offset of adjoining faces and of alignment of matching profiles.

3.4 CLEANING

A. Remove temporary protective coverings and strippable films as MCM panels are installed unless otherwise indicated in manufacturer's written installation instructions. On completion of installation, clean finished surfaces as recommended by MCM panel manufacturer. Maintain in a clean condition during construction.

B. After installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

3.5 PROTECTION

A. Replace MCM panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4213.23

SECTION 07 53 00
THERMOSET, EPDM, MEMBRANE ROOFING

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. Thermoset Membrane Roofing.

B. Membrane Flashings.

C. Metal Flashings.

D. Roof Insulation.

1.3 RELATED SECTIONS

A. Section 05 31 00 - Steel Decking.

B. Section 06 10 53 – Miscellaneous Rough Carpentry.

C. Section 07 62 00 - Sheet Metal Flashing and Trim.

1.4 REFERENCES

A. American Society of Civil Engineers (ASCE) - ASCE 7 - Minimum Design Loads for Buildings and Other Structures, Current Revision.

B. ASTM International (ASTM):
1. .
2. ASTM C 578 - Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
3. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
4. ASTM D 41 - Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
5. ASTM D 412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension.
6. ASTM D 624 - Standard Test Method for Tear Strength of Conventional Vulcanized Rubber and Thermoplastic Elastomers.
7. ASTM D 816 - Standard Test Methods for Rubber Cements.
8. ASTM D 4637 - Standard Specification for EPDM Sheet Used In Single-Ply Roof Membrane.
9. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.

C. International Code Council (ICC):
1. International Building Code (IBC).

D. National Roofing Contractors Association (NRCA) - Low Slope Roofing and Waterproofing Manual, Current Edition.

E. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA) - Architectural Sheet Metal Manual.

F. Underwriters Laboratories (UL):
   1. TGFU R1306 - "Roofing Systems and Materials Guide".
   2. UL-790 - Standard Test Method for Fire Tests of Roof Coverings.

1.5 DESIGN CRITERIA

A. Wind Uplift Performance:
   1. Roof system is designed to withstand wind uplift forces as calculated using the current revision of ASCE-7.
   2. Roof system is designed to achieve a FM 1 90 wind uplift rating.
   3. Warranted Wind Speed: 72 MPH.

B. Fire Resistance Performance:
   1. Roof system will achieve a UL Class A rating when tested in accordance with UL-790.

C. Thermal Performance: Roof system will achieve a minimum R value not less than 30.

D. Drainage: Provide a roof system with positive drainage where all standing water dissipates within 48 hours after precipitation ends.

E. Building Codes:
   1. Roof system will meet the requirements of all federal, state and local code bodies having jurisdiction.

1.6 SUBMITTALS

A. Product Data: Manufacturer's data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations.
   3. Installation methods.

B. Detail Drawings:
   1. Submit approved plan, section, elevation or isometric drawings which detail the appropriate methods for all flashing conditions found on the project.
   2. Coordinate approved drawings with locations found on the Contract Drawings.

C. Selection Samples: For each finish product specified, two complete sets of chips representing manufacturer's full range of available colors, membranes, and thicknesses.

D. Verification Samples: For each finish product specified, two samples, minimum size 4 inches (102 mm) square representing actual product, color, and patterns.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of fifteen (15) years experience.

B. Installer Qualifications:
   1. All products listed in this section are to be installed by a single installer with a minimum of five (5) years demonstrated experience in installing products of the same type and scope as specified.

2. Installer shall be capable of extending the Manufacturer's Labor and Materials guarantee.
3. Installer shall be capable of extending the Manufacturer's No Dollar Limit guarantee.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Store products in manufacturer's unopened packaging until ready for installation.

B. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

C. When loading materials onto the roof, comply with the requirements of Client Agency to prevent overloading and possible disturbance to the building structure.

D. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

1.9 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Refer to manufacturer's recommendations for general job site considerations.

C. Safety Data Sheets (SDS) must be on location at all times during the transportation, storage and application of materials.

D. Proceed with work so new roofing materials are not subject to construction traffic. When necessary, new roof sections shall be protected and inspected upon completion for possible damage.

E. New roofing shall be complete and weathertight at the end of the work day.

1.10 WARRANTY

A. At project closeout, provide to Client Agency or Client Agencies Representative an executed copy of the manufacturer's Total-System warranty, outlining its terms, conditions, and exclusions from coverage.
1. Duration: Twenty (20) years.
2. Coverage to be extended to include roof edge metal water tightness in accordance with terms stated in the Warranty document.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products manufactured by one of the following:
1. Carlisle Syntec.
2. Firestone Building Products
3. Johns Manville
4. Versico Roofing Systems
5. Or equal as approved by Professional.

B.

2.2 SCOPE / APPLICATION

A. Roof System: Provide a waterproof roof system, capable of withstanding uplift forces as specified in this section.
   1. Membrane Attachment: Fully Adhered.

B. Base Flashing: Provide a waterproof, fully adhered base flashing system at all penetrations, plane transitions and terminations.

C. Insulation: Provide a roof insulation system beneath the finish membrane.

2.3 INSULATION

A. Polyisocyanurate. Rigid board with glass fiber reinforced (GRF) facers on both sides, meeting or exceeding the requirements of ASTM C 1289, Type II, Class 1.
   1. Compressive Strength: Grade 2 (20 psi) (Typical at exposed roofing).
   2.
   3. Density: 2 lb per cubic foot (24 kg per cu m) minimum.

B. Roofing Board: Water-resistant and silicone treated gypsum panel with embedded fiberglass facer on both sides..
   1. Board Thickness: 1/2 inch (13 mm).
   2.

2.4 INSULATION ADHESIVE

A. Flexible DASH Adhesive: A spray or extruded applied, two-component polyurethane, low-rise expanding foam adhesive used for attaching approved insulations to compatible substrates (concrete, cellular lightweight insulating concrete, gypsum, cementitious wood fiber, wood or steel) or existing smooth or gravel surfaced BUR, modified bitumen or cap sheets.

2.5 ETHYLENE, PROPYLENE, DIENE TERPOLYMER (EPDM) MEMBRANE

A. Non-Reinforced Membrane: Cured, non-reinforced EPDM membrane meeting the requirements of ASTM D 4637 Type I.
   1. Attachment Method: Fully Adhered.
   2. Color: Black .
   3.
   4. Membrane Thickness: 90 mil (2.3 mm) nominal.Sheet Dimensions:
   5. Width: 10 feet (3.05 m) maximum.
   6. Width: 16.5 feet (5.0 m) maximum.
   7. .
   8. Length: 100 feet (30.5 m) maximum.
   9. Performance:
   a. Tensile Strength: 1550 psi (10.7 MPa) minimum (black).
   b. Tear Resistance: 200 lbf per in (35 kN per m) minimum.
   c. Elongation: 480 percent.

2.6 FLASHING ACCESSORIES

A. BlackQA Molded Pipe Seals: Factory applied QA tape on the deck flange, for use with VersiGard Black Roofing Systems.

B. Pourable Sealer Pocket: Pre-fabricated Pourable Sealer Pocket consisting of a 2 inch (51 mm) wide plastic support strip with pre-applied, adhesive backed uncured EPDM Flashing.

C. QA Inside/Outside Corner: A 7 inch by 9 inch (178 x 229 mm) precut 60-mil thick Uncured EPDM Flashing with a 30-mil (0.76 mm) pre-applied adhesive tape. Available in black and white.

D. 20 Inch Quick-Applied Cured Flashing: A 20 inch wide (508 mm) cured EPDM membrane with QA Seam TAPE the full width, factory applied, used to flash curbs/skylights, etc.

E. Quick-Applied Overlayment Strip: A nominal 40-mil (1.1 mm) black, semi-cured EPDM membrane laminated to a nominal 30-mil (0.76 mm) fully cured, pressure-sensitive adhesive for flashing gravel stops, metal edgings and Seam Fastening Plates.

F. QA Coverstrip: A nominal 40-mil (1.1 mm) black, semi-cured EPDM membrane laminated to a nominal 30-mil (0.76 mm) cured, pre-applied adhesive tape for flashing gravel stops, metal edgings and Seam Fastening Plates.

G. QA "T" Joint Covers: A factory cut 6 inch by 6 inch (152 mm x 152 mm) or 12 inch by 12 inch (304 mm x 304 mm) uncured 40-mil thick EPDM flashing laminated to a nominal 30-mil (0.76 mm) pre-applied adhesive tape, used to overlay field splice intersections and to cover field splices at angle changes.

H. Clean Cured Flashing: A cleaned, cured .060 inch (1.5 mm) thick non-reinforced (seamless) black EPDM membrane used to flash gravel stops, metal edgings, walls/curbs and Seam Fastening Plates used for additional membrane securement when the use of RTS is not feasible.

I.

J. Uncured EPDM Flashing: Formable 60-mil (1.5 mm) thick uncured EPDM flashing.

K. QA Uncured EPDM Flashing: 60-mil (1.5 mm) thick uncured EPDM Flashing laminated to a 30-mil (0.76 mm) pre-applied adhesive tape used in conjunction with VersiGard Primer as an option to VersiGard Uncured EPDM Flashing.

2.7 CLEANERS, PRIMERS, ADHESIVES AND SEALANTS

A. Weathered Membrane Cleaner: Clear, solvent-based cleaner used to loosen and remove contaminants from the surface of exposed EPDM membrane prior to the application of Seam Adhesive or EPDM Primer.

B. Lap Sealant: A black, heavy-bodied material (trowel or gun-consistency) used to seal the exposed edges of a membrane splice. A pre-formed Lap Sealant tool is included in each carton of Lap Sealant.
   1. Versico Lap Sealant: Black sealant for use with VersiGard Roofing Systems.
   2. White Lap Sealant: White sealant for use with White Roofing Systems.

C. Versico QA Seam Tape: 3 inch (76 mm) or 6 inch (152 mm) wide by 100 foot (30.5 M) long splice tape used for splicing adjoining sections of EPDM membrane. Complies with the South Coast Air Quality Management District Rule 1168.

D. Low VOC EPDM Primer: a solvent based primer designed for one-step cleaning and priming of EPDM surfaces prior to installation of quick-applied products. This product complies with the less than 250 g per L VOC content requirements for the OTC Model Rule for Single-Ply Roofing Adhesives.

E. Low-VOC Bonding Adhesive: a solvent-based contact adhesive that allows bonding to EPDM to various porous and non-porous substrates. This product complies with the less than 250 g per L VOC content requirements for the OTC Model Rule for Single-Ply Roofing Adhesives. This product does not comply with the following California counties' VOC

regulations: Alameda, Contra Costa, El Dorado, Los Angeles, Marin, Napa, Orange, Riverside, Sacramento, San Bernardino, San Diego, San Francisco, San Mateo, Santa Clara, Solano, Sonoma and Tehema.

F. Water Cut-Off Mastic: A one-component, low viscosity, self wetting, Butyl blend mastic used as a compression sealing agent between EPDM membranes or uncured flashing and applicable substrates.

G. One-Part Pourable Sealer: A black, one-component, moisture curing, elastomeric polyether sealant used for attaching lightning rod bases and ground cable clips to the membrane surface and as a sealant around hard-to-flash penetrations such as clusters of pipes.

H. Universal Single-Ply Sealant: A 100 percent solids, solvent free, one-part, polyether sealant that provides a weather tight sealant to a variety of building substrates; used as a termination bar sealant. Available in white only.

I. CAV-GRIP 3V Low-VOC Aerosol Contact Adhesive/Primer: a low-VOC, methylene chloride-free adhesive that can be used for a variety of applications including: Priming unexposed asphalt prior to applying Flexible DASH Adhesive, adhering EPDM, horizontally, for the field of the roof and to vertical walls. Coverage rate is approximately 2,000-2,500 sq. ft. (186 to 232 square meters) per 40 lb (18 kg) cylinder and 4,000-5,000 sq. ft. (372 to 465 square meters) per 85 lb (39 kg) cylinder as a primer, in a single-sided application and 750 sq. ft. (70 square meters) per 40 lb (18 kg) cylinder and 1,500 sq. ft. (139 square meters) per 85 lb (39 kg) cylinder as an adhesive for vertical walls, in a double-sided application; 1,000 sq. ft. (93 square meters) per 40 lb (18 kg) cylinder and 2,000 sq. ft. (186 square meters) per 85 lb (39 kg) cylinder as an adhesive, horizontally, for the field of the roof, in a double-sided application

2.8 FASTENING COMPONENTS

1. .

B. QA RTS (Reinforced Termination Strip): 6 or 9 inch (152 or 229 mm) wide, nominal 45-mil (1.1 mm) thick clean, cured, reinforced EPDM black membrane with 3 inch wide pre-applied adhesive tape laminated along one edge for the 6 inch wide RTS and along both edges for the 9 inch (229 mm) wide RTS. 9 inch (229 mm) wide QA RTS is utilized for perimeter membrane securement on Mechanically Attached Roofing Systems.

1. 6 inch RTS: 6 inch (152 mm) wide, 100 foot long (30.5 M), strip of (black) reinforced EPDM membrane for additional membrane securement on Adhered, Ballasted, and Mechanically Attached Roofing Systems.

C. Seam Fastening Plate: 2 inch (51 mm) diameter metal fastening plate used for membrane and RTS attachment on Mechanically Attached Roofing Systems over wood or structural concrete decks. Seam Fastening Plates are also used in conjunction with RTS or EPDM membrane for additional membrane securement on Adhered or Ballasted Roofing Systems. This plate may be used for insulation attachment on Mechanically Attached Roofing Systems.

D. Fasteners:

1. HPVX Fasteners: A heavy-duty No. 15 threaded fastener with a Phillips head used for adhered assemblies where increased pullout resistance is necessary for steel and wood decks.
2. Term Bar Nail-In: A 1 1/4 inch (32 mm) long expansion anchor with threaded drive pin used for fastening Termination Bar or Seam Fastening Plates to concrete, brick or block walls.

2.9 EDGINGS AND TERMINATIONS

A. An anchor bar roof edge fascia system consisting of 0.100 inch (2.5 mm) thick extruded aluminum bar, corrosion resistant stainless steel fasteners and snap-on fascia cover.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. The surface on which the insulation or roofing membrane is to be applied shall be clean, smooth, dry, and free of projections or contaminants that would prevent proper application of or be incompatible with the new installation, such as fins, sharp edges, foreign materials, oil and grease.

C. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Do not commence work until all other work trades have completed jobs that require them to traverse the deck on foot or with equipment.

D. A vapor retarder / temporary roof may be applied to protect the inside of the structure prior to the roof system installation.

3.3 SUBSTRATE PREPARATION

A. Structural Concrete Deck:
   1. Minimum deck thickness for structural concrete is 4 inches (102 mm).
   2. Allow roof deck to cure prior to application of the roofing system. Where curing is in question, evaluate surface moisture and deck's dryness with the ASTM D-4263 or hot bitumen test procedures.
   3. Repair cracks greater than 1/8 inch (3 mm) in width in accordance with the deck manufacturer's recommendations.
   4. Sumps for the roof drains shall be provided in the casting of the deck.
   5. Where insulation is to be adhered with hot asphalt, prime the deck with asphalt/concrete primer, ASTM D 41 at the rate of one gallon per 100 square feet (0.4 L per sq m). Allow the primer to dry prior to the application of the roofing system.

B. Steel Deck:
   1. Metal decks shall be a minimum uncoated thickness of 22 gauge and have a G-90 galvanized finish on all panels.
   2. Decks shall comply with the gauge and span requirements in the current Factory Mutual Approval Guide and be installed in accordance with Loss Prevention Data Sheet 1-28 or specific FM approval.
   3. Remove any surface corrosion and repair severely corroded areas. Properly fasten loose or inadequately secured decking.
   4.

3.4 INSULATION PLACEMENT

A. Install insulation or membrane underlayment over the substrate with boards butted tightly

together with no joints or gaps greater than 1/4 inch (6 mm). Stagger joints both horizontally and vertically if multiple layers are provided.

B. Secure insulation to the substrate with the required mechanical fasteners or insulation adhesive in accordance with the manufacturer's current application guidelines.

C. Do not install wet, damaged or warped insulation boards.

D. Stagger joints in one direction unless joints are to be taped. Install insulation boards snug. Gaps between board joints shall not exceed 1/4 inch (6 mm). Fill all gaps in excess of 1/4 inch (6 mm) with same insulation material.

E. Wood nailers shall be at least 3-1/2 inches (89 mm) wide or 1 inch (25 mm) wider than adjacent metal flange. Thickness shall equal that of insulation but not less than 1 inch (25 mm) thickness.

F. Miter and fill the edges of the insulation boards at ridges, valleys and other changes in plane to prevent open joints or irregular surfaces. Avoid breaking or crushing of the insulation at the corners.

G. Do not install any more insulation than will be completely waterproofed each day.

3.5 INSULATION ATTACHMENT

A. Securely attach insulation to the roof deck for Adhered Systems. Attachment shall have been successfully tested to meet or exceed the calculated uplift pressure required by the International Building Code (ASCE-7) or ANSI/SPRI WD-1.

B. Enhance the perimeter and corner areas in accordance with FM Loss Prevention Data Sheet 1-29.

C. Install insulation layers applied with adhesive, coverage rate as necessary to achieve the specified attachment and uplift rating. Press each board firmly into place after adhesive develops strings when touched, typically 1-1/2 to 2 minutes after adhesive was applied, and roll with a weighted roller. Add temporary weight and use relief cuts to ensure boards are well adhered. Stagger the joints of additional layers by a minimum of 6 inches (152 mm).

3.6 MEMBRANE PLACEMENT AND ATTACHMENT (Fully Adhered)

A. Unroll and position membrane without stretching. Allow the membrane to relax for approximately 1/2 hour before bonding. Fold the sheet back onto itself so half the underside of the membrane is exposed.

B. Apply the Bonding Adhesive in accordance with the manufacturer's published instructions, to both the underside of the membrane and the substrate. Allow the adhesive to dry until it is tacky but will not string or stick to a dry finger touch.

C. Roll the coated membrane into the coated substrate while avoiding wrinkles. Brush down the bonded half of the membrane sheet with a soft bristle push broom to achieve maximum contact.

D. Fold back the unbonded half of the membrane sheet and repeat the bonding procedure.

E. Install adjoining membrane sheets in the same manner, overlapping edges appropriately to provide for the minimum splice width. It is recommended that all splices be shingled to avoid bucking of water.

F. When positioning membrane sheets, exercise care to locate all field splices away from low

spots and out of drain sumps. All field splices should be shingled to prevent bucking of water.

3.7 MEMBRANE SPLICING (Tape Splice)

A. Overlap adjacent sheets and mark a line 1/2 inch (13 mm) out from the top sheet.

B. Fold the top sheet back and clean the dry splice area a minimum of 3 inches (76 mm) on both membrane sheets.

C. Apply Primer to the mating surfaces with a scrub pad, at a rate of approximately 450 square feet per gallon for a 3 inch (76 mm) wide seam, and allow to dry.

D. Apply 3 inch (76 mm) wide Seam Tape to bottom sheet with the edge of the release film along the marked line. Press tape onto the sheet using hand pressure. Overlap tape roll ends a minimum of 1 inch (25 mm).

E. Remove the release film and press the top sheet onto the tape using hand pressure.

F. Roll the seam toward the splice edge with a 2 inch (51 mm) wide steel roller.

G. Install QA "T" Joint Cover, a 6 inch wide (152 mm) section of QA Flashing or Non-QA Flashing over all field splice intersections. When using Non-QA Flashing, seal edges of flashing with Lap Sealant.

H. The use of Lap Sealant with tape splices is optional except at tape overlaps and cut edges of reinforced membrane where Lap Sealant is required.

3.8 FLASHING

A. Wall and curb flashing shall be cured EPDM membrane. Continue the deck membrane as wall flashing where practicable.

B. Follow manufacturer's typical flashing procedures for all wall, curb, and penetration flashing including metal edging/coping and roof drain applications.

3.9 DAILY SEALS

A. On phased roofing, when the completion of flashings and terminations is not achieved by the end of the work day, a daily seal shall be performed to temporarily close the membrane to prevent water infiltration.

B. Use Pourable Sealer or other acceptable membrane seal in accordance with the manufacturer's requirements.

3.10 CLEAN UP

A. Perform daily clean-up to collect all wrappings, empty containers, paper, and other debris from the project site. Upon completion, all debris shall be disposed of in a legally acceptable manner.

B. Prior to the manufacturer's inspection for warranty, the applicator shall perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

3.11 PROTECTION

A. Provide protection, such as 3/4 inch (19 mm) thick plywood, for all roof areas exposed to

traffic during construction. Plywood must be smooth and free of fasteners and splinters.

B. Protect installed products until completion of project.

C. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 07 6200

SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. This Section includes the following sheet metal flashing and trim:

1. Metal flashing.
2. Reglets.
3. Formed overhead-piping safety pans.

1.03 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F , ambient; 180 deg F , material surfaces.

C. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.
2. Trim: 12 inches long. Include fasteners and other exposed accessories.
3. Accessories: Full-size Sample.

1.05 QUALITY CONTROL

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Mockup: Refer to Division 1 Section “Exterior Wall Mock-Up”.

C. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 1 Section "Project Management and Coordination."

1. Meet with User, Professional, User's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.07 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

PART 2 - PRODUCTS

2.01 SHEET METALS

A. Aluminum Sheet: ASTM B 209 , Alloy 3003, 3004, 3105, or 5005, Temper suitable for forming and structural performance required, but not less than H14, finished as follows:

1. High-Performance Organic Finish: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: acid-chromate-fluoride-phosphate conversion coating; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Fluoropolymer 2-Coat System: Manufacturer's standard 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with AAMA 2604.
        1) Color: to match adjacent metals.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304, dead soft, fully annealed.

2.02 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil- thick polyethylene sheet complying with ASTM D 4397.

B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft. .

2.03 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
2. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

F. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

G. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

H. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.04 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.05 CONCEALED THROUGH-WALL SHEET METAL FLASHING

A. Material: Fabricate from the following metal:

1. Stainless Steel: 0.0156 inch thick.
2. Copper: 10 oz. for fully concealed flashing; 16 oz. elsewhere.
3. Fabricate through-wall metal flashings embedded in masonry as follows:
   a. With ribs formed in sawtooth pattern at 3-inch intervals along length of flashing to provide a 3-way integral mortar bond and weep-hole drainage.

B. Available Products: Subject to compliance with requirements, products that may be incorporated in the Work include, but are not limited to, the following:

1. Cheney Flashing (Sawtooth); Cheney Flashing Company, Inc.
2. Keystone Three-Way Interlocking Thruwall Flashing; Keystone Flashing Co.
3. York Flashings
4. Or Equal as approved by the Professional.

2.06 WALL SHEET METAL FABRICATIONS

A. Flashing Between Materials: Fabricate continuous flashings in minimum 96-inch- long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated.

Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch- high end dams. Fabricate from the following material:

1. Aluminum: 0.0320 inch thick.

B. Openings Flashing in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings. Form head and sill flashing with 2-inch- high end dams. Fabricate from the following material:

1. Aluminum: 0.0320 inch thick.

C. Exposed Trim, Fasciae, Gravel Stops, and Eave or Rake Flashing: Fabricate from the following material:

1. Aluminum: 0.050 inch thick.

D. Drip Edges: Fabricate from the following material:

1. Aluminum: 0.0320 inch thick.

E. Overhead-Piping Safety Pans: Fabricate from the following material:

1. Stainless Steel: 0.0250 inch thick.

2.07 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding

rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.
   1. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.
   2. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

   1. Space cleats not more than 12 inches apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with elastomeric sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.

   1. Aluminum: Use aluminum or stainless-steel fasteners.

H. Seal joints with elastomeric sealant as required for watertight construction.

   1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F , set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F .
   2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

I. Aluminum Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.03 ROOF FLASHING INSTALLATION

A. General: Install sheet metal flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch centers.
2. Anchor interior leg of coping with washers and screw fasteners through slotted holes at 16-inch centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with sealant. Secure in a waterproof manner by means of interlocking folded seam or blind rivets and sealant.

F. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Seal with elastomeric sealant and clamp flashing to pipes that penetrate roof.

3.04 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Openings Flashing in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches beyond wall openings.

3.05 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07 7100

ROOF SPECIALTIES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Copings.
2. Roof-edge specialties.
3. Roof-edge drainage systems.
4. Reglets and counterflashings.

B. Related Requirements:

1. Section 05 50 00 "Metal Fabrications" for downspout guards and downspout boots.
2. Section 06 10 53 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
3. Section 07 62 00 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
4. Section 07 72 00 "Roof Accessories" for set-on-type curbs, equipment supports, roof hatches, vents, and other manufactured roof accessory units.
5. Section 07 92 00 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

C. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Client Agency, Architect, Client Agencies insurer if applicable, roofing-system testing and inspecting agency representative, roofing Installer, roofing-system manufacturer's representative, Installer, structural-support Installer, and installers whose work interfaces with or affects roof specialties, including installers of roofing materials and accessories.
2. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
3. Review special roof details, roof drainage, and condition of other construction that will affect roof specialties.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.

1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.
2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.
3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.
4. Detail termination points and assemblies, including fixed points.
5. Include details of special conditions.

C. Samples: For each type of roof specialty and for each color and texture specified.

D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

E. Samples for Verification:

1. Include Samples of each type of roof specialty to verify finish and color selection, in manufacturer's standard sizes.
2. Include copings, roof-edge specialties, roof-edge drainage systems, reglets and counterflashings made from 12-inch (300-mm) lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of roof specialty.

C. Product Test Reports: For copings and roof-edge flashings, for tests performed by a qualified testing agency.

D. Sample Warranty: For manufacturer's special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roofing specialties to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class] [and] [SPRI ES-1 tested to specified design pressure.

B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and set quality standards for fabrication and installation.

1. Build mockup of typical roof edge as shown on Drawings.

2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store roof specialties in contact with other materials that might cause staining, denting, or other surface damage. Store roof specialties away from uncured concrete and masonry.

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS

A. Field Measurements: Verify profiles and tolerances of roof-specialty substrates by field measurements before fabrication, and indicate measurements on Shop Drawings.

B. Coordination: Coordinate roof specialties with flashing, trim, and construction of parapets, roof deck, roof and wall panels, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Roofing-System Warranty: Roof specialties to be the same as roof warranty.

B. Special Warranty on Painted Finishes: Manufacturer agrees to repair finish or replace roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:

a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: 110 mile per hour wind.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F , ambient; 180 deg F, material surfaces.

2.2 COPINGS AND FASCIAS

A. Metal Coping System: Cantilever.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elevate, Single Cantilever.
      b. GAF, EverGuard Cantilever
      c. Hickman, PermaSnap
      d. Metal Era, Inc., Perma-Tite Cantilever.
      e. Or equal as approved by Professional.
   2. Description:
      a. Snap-on coping with intermittent clips with factory-applied saddle for capping parapet walls over non-structural building facade.
      b. Does not require exposed fasteners or joint sealants.
   3. Performance Characteristics:
      a. Snap-on Coping Cap Sections: Capable of expanding and contracting freely, statically engaged onto mechanically secured clips.
      b. Snap-on Coping Cap Joints: Underlayed with concealed splices.
   4. Approvals
      a. ANSI/SPRI/FM 4435 ES-1 up to 130 psf Vertical and 75 psf Horizontal.
   5. Intermittent Clips:
      a. Material:
         1) Base: 20 ga. galvanized steel.
         2) Saddle: 16 ga. galvanized steel.
      b. Width: 12”
      c. Fastener Holes: Pre-Punched.
   6. Concealed Splices:
      a. Material: Same as snap-on coping cap.
      b. Finish and Color: Same as snap-on coping cap.
      c. Width: 8”
      d. Sealant Strips: Factory-applied dual non-curing isocryl butyl sealant strips.

B. Metal Coping and Fascia Caps: Manufactured coping and fascia system consisting of metal caps in section lengths not exceeding 12 feet (3.6 m) concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Architectural Products Company.
   b. ATAS International, Inc.
   c. Cheney Flashing Company.
   d. Hickman Company, W. P.
   e. Merchant & Evans Inc.
   f. Metal-Era, Inc.
   g. Petersen Aluminum Corporation.
   h. Or equal as approved by Professional.

2. Formed Aluminum Sheet Coping Caps: Aluminum sheet, 0.063 inch (1.60 mm) thick

   a. Surface: Smooth, flat finish.
   b. Finish: Kynar 500
   c. Color: As selected by Architect from manufacturer's full range.

3. Corners: Factory mitered and continuously welded.
4. Coping-Cap Attachment Method: Snap-on fabricated from coping-cap material.

   a. Snap-on Coping Anchor Plates: Concealed, galvanized-steel sheet, 12 inches (300 mm) wide, with integral cleats.

2.3 ROOF DRAINAGE SYSTEMS

A. Downspouts: Plain round complete with mitered elbows, manufactured from the following exposed metal. Furnish with metal hangers, from same material as downspouts, and anchors.
   1. Formed Aluminum: **0.050 inch (1.27 mm)** thick.
   2. Diameter: 4 inches.

2.4 REGLETS AND COUNTERFLASHINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   1. Castle Metal Products.
   2. Cheney Flashing Company.
   3. Fry Reglet Corporation.
   4. Heckmann Building Products, Inc.
   5. Hickman Company, W. P.
   6. Keystone Flashing Company, Inc.
   7. Metal-Era, Inc.
   8. Or equal as approved by the Professional.

B. Reglets: Manufactured units formed to provide secure interlocking of separate reglet and counterflashing pieces, from the following exposed metal:

   1. Stainless Steel: 0.025 inch (0.64 mm) thick.
   2. Corners: Factory mitered and continuously welded.
   3. Surface-Mounted Type: Provide reglets with slotted holes for fastening to substrate, with neoprene or other suitable weatherproofing washers, and with channel for sealant at top edge.
   4. Concrete Type, Embedded: Provide temporary closure tape to keep reglet free of concrete materials, special fasteners for attaching reglet to concrete forms, and guides to ensure alignment of reglet section ends.
   5. Masonry Type, Embedded: Provide reglets with offset top flange for embedment in masonry mortar joint.

C. Counterflashings: Manufactured units of heights to overlap top edges of base flashings by 4 inches (100 mm) and in lengths not exceeding 12 feet (3.6 m) designed to snap into reglets or through-wall-flashing receiver and compress against base flashings with joints lapped, from the following exposed metal:
   1. Stainless Steel:0.025 inch (0.64 mm) thick.

D. Accessories:

1. Flexible-Flashing Retainer: Provide resilient plastic or rubber accessory to secure flexible flashing in reglet where clearance does not permit use of standard metal counterflashing or where reglet is provided separate from metal counterflashing.
2. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.

3. Color: As selected by Architect from manufacturer's full range

E. Stainless-Steel Finish: No. 3 (coarse, polished directional satin)

2.5 MATERIALS

A. Aluminum Sheet: ASTM B 209 (ASTM B 209M), alloy as standard with manufacturer for finish required, with temper to suit forming operations and performance required.

B. Stainless-Steel Sheet: ASTM A 240/A 240M or ASTM A 666, Type 304.

2.6 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970/D 1970M; stable after testing at 240 deg F (116 deg C).
2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F (29 deg C).

3. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Carlisle Coatings & Waterproofing Inc.
b. Grace Construction Products; W.R. Grace & Co. -- Conn.
c. Henry Company.
d. Metal-Fab Manufacturing, LLC.
e. Owens Corning.
f. Or equal as approved by the Professional.

B. Felt: ASTM D 226/D 226M, Type II (No. 30), asphalt-saturated organic felt, nonperforated.

C. Slip Sheet: Rosin-sized building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum.

2.7 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
1. Fasteners for Stainless-Steel Sheet: Series 300 stainless steel.

B. Elastomeric Sealant: ASTM C 920, elastomeric [polyurethane] [silicone] polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

E. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.8 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Aluminum Sheet Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    a. Three-Coat Fluoropolymer: AAMA 2605. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with Finish in "Concealed Surface Finish" Subparagraph below is frequently retained for nonexposed surfaces of organic-finished coil-coated sheet.
    b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

E. Aluminum Extrusion Finishes:

1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

    a. Two-Coat Fluoropolymer: AAMA [2604] [2605]. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
    b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm). Roll laps with roller. Cover underlayment within 14 days.

1. Apply continuously under copings roof-edge specialties and reglets and counterflashings.
2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

B. Felt Underlayment: Install with adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

C. Slip Sheet: Install with tape or adhesive for temporary anchorage to minimize use of mechanical fasteners under roof specialties. Apply in shingle fashion to shed water, with lapped joints of not less than 2 inches (50 mm).

3.3 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayments, sealants, and other miscellaneous items as required to complete roof-specialty systems.

1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
2. Provide uniform, neat seams with minimum exposure of solder and sealant.
3. Install roof specialties to fit substrates and to result in weathertight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
4. Torch cutting of roof specialties is not permitted.
5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

1. Coat concealed side of uncoated aluminum and stainless-steel roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

C. Expansion Provisions: Allow for thermal expansion of exposed roof specialties.

1. Space movement joints at a maximum of 12 feet (3.6 m) with no joints within 18 inches (450 mm) of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F (4 deg C).

3.4 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

1. Interlock face and back leg drip edges of snap-on coping cap into cleated anchor plates anchored to substrate at manufacturer's required spacing that meets performance requirements.

3.5 ROOF-EDGE SPECIALITIES INSTALLATION

A. Install cleats, cants, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor roof edgings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

3.6 ROOF DRAINAGE-SYSTEM INSTALLATION

A. General: Install components to produce a complete roof-edge drainage system according to manufacturer's written instructions. Coordinate installation of roof perimeter flashing with installation of roof-edge drainage system.

B. Downspouts: Join sections with manufacturer's standard telescoping joints. Provide hangers with fasteners designed to hold downspouts securely to walls and 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1500 mm) o.c.

1. Provide elbows at base of downspouts at grade to direct water away from building.

2. Connect downspouts to underground drainage system indicated.

3.7 REGLET AND COUNTERFLASHING INSTALLATION

A. General: Coordinate installation of reglets and counterflashings with installation of base flashings.

B. Embedded Reglets: See Section 033000 "Cast-in-Place Concrete" and Section 042000 "Unit Masonry" for installation of reglets.

C. Surface-Mounted Reglets: Install reglets to receive flashings where flashing without embedded reglets is indicated on Drawings. Install at height so that inserted counterflashings overlap 4 inches (100 mm) over top edge of base flashings.

D. Counterflashings: Insert counterflashings into reglets or other indicated receivers; ensure that counterflashings overlap 4 inches (100 mm) over top edge of base flashings. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with butyl sealant. Fit counterflashings tightly to base flashings.

3.8 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

D. Replace roof specialties that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7100

SECTION 078413

PENETRATION FIRESTOPPING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Penetrations in fire-resistance-rated walls.
2. Penetrations in horizontal assemblies.

B. Related Requirements:

1. Section 078443 "Joint Firestopping" for joints in or between fire-resistance-rated construction, at exterior curtain-wall/floor intersections, and in smoke barriers.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Product Schedule: For each penetration firestopping system. Include location, illustration of firestopping system, and design designation of qualified testing and inspecting agency.

1. Engineering Judgments: Where Project conditions require modification to a qualified testing and inspecting agency's illustration for a particular penetration firestopping system, submit illustration, with modifications marked, approved by penetration firestopping system manufacturer's fire-protection engineer as an engineering judgment or equivalent fire-resistance-rated assembly. Obtain approval of authorities having jurisdiction prior to submittal.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Test Reports: For each penetration firestopping system, for tests performed by a qualified testing agency.

1.6 CLOSEOUT SUBMITTALS

A. Installer Certificates: From Installer indicating that penetration firestopping systems have been installed in compliance with requirements and manufacturer's written instructions.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A firm that has been approved by FM Global according to FM Global 4991, "Approval of Firestop Contractors," or been evaluated by UL and found to comply with its "Qualified Firestop Contractor Program Requirements."

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install penetration firestopping system when ambient or substrate temperatures are outside limits permitted by penetration firestopping system manufacturers or when substrates are wet because of rain, frost, condensation, or other causes.

B. Install and cure penetration firestopping materials per manufacturer's written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.9 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.
2. Test per testing standards referenced in "Penetration Firestopping Systems" Article. Provide rated systems complying with the following requirements:

a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

1) UL in its "Fire Resistance Directory."

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. 3M Fire Protection Products.
b. Hilti, Inc.
c. Sika Group
d. Or equal as approved by Professional.

B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Penetrations in Horizontal Assemblies: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg .

1. F-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated.
2. T-Rating: At least one hour, but not less than the fire-resistance rating of constructions penetrated except for floor penetrations within the cavity of a wall.

D. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

E. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Cast-in-Place Firestop Devices: Factory-assembled devices for use in cast-in-place concrete floors and consisting of an outer sleeve lined with an intumescent strip, a flange attached to one end of the sleeve for fastening to concrete formwork, and a neoprene gasket.

B. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

C. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

D. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

E. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

F. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

G. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

H. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

I. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.

J. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants.

2.4 MIXING

A. Penetration Firestopping Materials: For those products requiring mixing before application, comply with penetration firestopping system manufacturer's written instructions for accurate proportioning of materials, water (if required), type of mixing equipment, selection of mixer speeds, mixing containers, mixing time, and other items or procedures needed to produce products of uniform quality with optimum performance characteristics for application indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for opening configurations, penetrating items, substrates, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer's written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.

3.4 IDENTIFICATION

A. Wall Identification: Permanently label walls containing penetration firestopping systems with the words "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS," using lettering not less than 3 inches high and with minimum 0.375-inch strokes.

1. Locate in accessible concealed floor, floor-ceiling, or attic space at 15 feet from end of wall and at intervals not exceeding 30 feet.

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

1. The words "Warning - Penetration Firestopping - Do Not Disturb. Notify Building Management of Any Damage."
2. Contractor's name, address, and phone number.
3. Designation of applicable testing and inspecting agency.
4. Date of installation.
5. Manufacturer's name.
6. Installer's name.

3.5 FIELD QUALITY CONTROL

A. Client Agency will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL's "Fire Resistance Directory" under product Category XHEZ.

B. Refer to drawings for firestopping systems.

END OF SECTION 078413

SECTION 07 9200

JOINT SEALANTS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. This Section includes joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Joints in masonry systems.
   b. Joints in “Exterior Composite Metal Panel System”.
   c. Joints between different exterior materials.
   d. Perimeter joints between exterior materials and frames of doors, windows and louvers.
   e. Other joints as indicated.

2. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Perimeter joints between interior wall surfaces and frames of interior doors windows and elevator entrances.
   b. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   c. Other joints as indicated.

1.03 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.04 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. Color Chart: Provide color chart for initial color selections.

C. Samples for Verification: For each location, type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.05 QUALITY CONTROL

A. Installer Qualifications: Manufacturer's authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Manufacturers representative shall provide field adhesion testing for exterior sealant at each type of substrate, and shall test each condition at least once for every 1,000 S.F of installed joint.

D. Mockup: Refer to Division 1 Section “Exterior Wall Mock-Up”.

1.06 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products listed in other Part 3 articles.

1. Exterior sealant shall be provided by a single manufacturer.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Professional from manufacturer's full range.

2.03 ELASTOMERIC JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

B. Stain-Test-Response Characteristics: Where elastomeric sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

C. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

D. Multicomponent Nonsag Urethane Sealant:

1. Type and Grade: M (multicomponent) and P (pourable).
2. Class: 50.
3. Use Related to Exposure: NT (nontraffic).
4. Color: Custom

E. Single-Component Neutral and Basic-Curing Silicone Sealant

1. Type and Grade: S (single component) and NS (nonsag).
2. Class: 50.
3. Use Related to Exposure: NT (nontraffic).
4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

F. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant

1. Type and Grade: S (single component) and NS (nonsag).
2. Class: 25.
3. Use Related to Exposure: NT (nontraffic).
4. Uses Related to Joint Substrates: M,]G, A, and, as applicable to joint substrates indicated, O.

G. Single-Component Nonsag Urethane Sealant

1. Type and Grade: S (single component) and NS (nonsag).
2. Class: 25.
3. Uses Related to Exposure: T (traffic) and NT (nontraffic).
4. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.

2.04 LATEX JOINT SEALANTS

A. Latex Sealant: Comply with ASTM C 834, Type P, Grade NF.

2.05 JOINT-SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance:

2.06 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or

harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:

    a. Concrete.
    b. Masonry.
    c. Unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.
4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:

    a. Metal.
    b. Glass.
    c. Porcelain enamel.
    d. Glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
4. Provide flush joint configuration where indicated per Figure 5B in ASTM C 1193.
5. Provide recessed joint configuration of recess depth and at locations indicated per Figure 5C in ASTM C 1193.

    a. Use masking tape to protect surfaces adjacent to recessed tooled joints.

3.04 CLEANING

A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.05 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.06 SCHEDULE

A. Provide sealants as specified in Part 2 for the following locations and applications:

1. Control joints in brick veneer:
   a. Tremco: Spectrem 3
   b. Pecora: 890 Silicone
   c. Sika: Sikaflex 2c NS and/or Sikaflex 15 LM
   d. Or Equal as approved by the Professional.

2. At the perimeter of exterior aluminum window systems and curtainwalls:
   a. Tremco: Spectrem 3
   b. Pecora: 890 Silicone
   c. Sika: Sikaflex 1a
   d. Or Equal as approved by the Professional.

3. At the perimeter of interior doors and windows:
   a. Tremco: Spectrem 3
   b. Pecora: AC-20
   c. Sika: Sikaflex 1a
   d. Or Equal as approved by the Professional.

4. At exterior composite metal ceiling and fascia panels:
   a. Tremco: Spectrem 3
   b. Pecora: 890 Silicone
   c. Sika: Sikaflex 1a
   d. Or Equal as approved by the Professional.

5. Around plumbing fixtures:
   a. Tremco: Tremsil 200
   b. Pecora: 898 Silicone
   c. Sika: Sikaflex 1a
   d. Or Equal as approved by the Professional.

6. At ceramic tile
   a. Tremco: Tremsil 200.
   b. Pecora: 898 Silicone
   c. Sika: Sikaflex 1a
   d. Or Equal as approved by the Professional.

7. Around casework
   a. Tremco: Vulkem 116
   b. Pecora: AC-20
   c. Sika: Sikaflex 1a
   d. Or Equal as approved by the Professional.

8. Acoustical sealants around gyp. board walls.
   a. Tremco: Acoustical sealant
   b. Pecora: AC-20 FTR
   c. Acoustical Surfaces: Noise S.T.O.P Acoustical Sealant
   d. Or Equal as approved by the Professional.

END OF SECTION

SECTION 080671

DOOR HARDWARE SCHEDULE

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUMMARY

A. This Section references specification sections relating to commercial door hardware for the following:

1. Swinging doors.
2. Sliding Doors.
3. Other doors to the extent indicated.

B. Commercial door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical and access control door hardware.
3. Electromechanical and access control door hardware power supplies, back-ups and surge protection.
4. Automatic operators.
5. Cylinders specified for doors in other sections.

C. Related Sections:

1. Division 08 Section “Door Hardware”.
2. Division 26 Section “Electrical”.
3. Division 28 Section “Access Control”.

D. Codes and References: Comply with the version adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. State Building Codes, Local Amendments.

E. Standards: Reference Related Sections for requirements regarding compliance with applicable industry standards.

1.4 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."

2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.

3. Content: Include the following information:

a. Type, style, function, size, label, hand, and finish of each door hardware item.
b. Manufacturer of each item.
c. Fastenings and other pertinent information.
d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
e. Explanation of abbreviations, symbols, and codes contained in schedule.
f. Mounting locations for door hardware.
g. Door and frame sizes and materials.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.

D. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact

information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include "as built" modifications made during installation, checkout, and acceptance.

F. Warranties and Maintenance: Special warranties and maintenance agreements specified in the Related Sections.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.6 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

1.7 MAINTENANCE SERVICE

A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Refer to “PART 3 – EXECUTION” for required specification sections.

PART 3 - EXECUTION

3.1 DOOR HARDWARE SETS

A. The door hardware sets represent the design intent and direction of the owner and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set

should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.

2. The supplier is responsible for handing and sizing all products.

3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.

4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Products listed in the hardware sets shall be supplied by and in accordance with the requirements described in the specification section as noted for each item.

1. Section 08 71 00 – Door Hardware.
2. Section 28 13 00 – Access Control.

C. Manufacturer's Abbreviations:

1. MK - McKinney
2. PE - Pemko
3. SU - Securitron
4. RO - Rockwood
5. SA - SARGENT
6. AD - Adams Rite
7. BE - BEST Locks & Closers
8. NO - Norton Rixson
9. PP - Pedestal PRO
10. OT - Other

Hardware Sets

Set: 1.0

Doors: 2/200

2 Continuous Hinge	FM__SLF-HD1 x PT	10BE	PE	087100	
2 Electric Power Transfer	EL-CEPT	613E	SU	087100	
1 Mullion	L980	PC	SA	087100	
1 Rim Exit Device, Storeroom	16 55 56 72 PE8504 Less Pull	US10BE	SA	087100	
1 Rim Exit Device, Exit Only	16 55 56 72 PE8510 EO	US10BE	SA	087100	
4 Permanent Core	Compatible with Facility's Existing System	606	BE	087100	
1 Cylinder	980C1	US26D	SA	087100	

2 Pull	RM5277-18	10BE	RO	087100	
2 Concealed Overhead Holder/Stop	6-X36	613E	NO	087100	
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100	
1 Automatic Opener	6331	690	NO	087100	
2 Sweep	345-10BE-V		PE	087100	
1 Threshold	253x3-10BE-FG MSES10SS-2 (Coordinate with Architect's Details)		PE	087100	
2 ElectroLynx Harness - Frame	QC-C1500P		MK	087100	
2 ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	087100	
1 Wiring Diagram	Point to Point			087100	
2 Position Switch	DPS-M/W-BK		SU	087100	
1 Card Reader	HID Signo Series by Security System Supplier		OT		
2 Wall Switch	700		NO	087100	
1 Power Supply	by Security System Supplier		OT		
1 Custom Bollard	SS 47 x 4 x 6 Tapered Pedestal - see Arch Drawing		PP	087100	

Notes:
Door closed & locked at all times. Presenting valid credential outside shunts door position switches, activates outside operator paddle & allows for authorized entrance. Operating inside touchpad or inside operator paddle activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Cheyney University utilizes a proprietary lock and card reader access control system manufactured by Assa Abloy and Software House. This lock system is standard across all campus buildings and integrates with the security access system Ccure and Gentec. That system also integrates into the University student one-card system. To continue this uniformity, the same platform and hardware are required for this project. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

Set: 1.1

Doors: 3/205

2 Continuous Hinge	FM__SLF-HD1 x PT	10BE	PE	087100	
2 Electric Power Transfer	EL-CEPT	613E	SU	087100	
1 Mullion	L980	PC	SA	087100	
1 Rim Exit Device, Storeroom	16 55 56 72 PE8504 Less Pull	US10BE	SA	087100	
1 Rim Exit Device, Exit Only	16 55 56 72 PE8510 EO	US10BE	SA	087100	
4 Permanent Core	Compatible with Facility's Existing System	606	BE	087100	
1 Cylinder	980C1	US26D	SA	087100	
2 Pull	RM5277-18	10BE	RO	087100	

2 Concealed Overhead Holder/Stop	6-X36	613E	NO	087100	
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100	
1 Automatic Opener	6331	690	NO	087100	
2 Sweep	345-10BE-V		PE	087100	
1 Threshold	253x3-10BE-FG MSES10SS-2 (Coordinate with Architect's Details)		PE	087100	
2 ElectroLynx Harness - Frame	QC-C1500P		MK	087100	
2 ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	087100	
1 Wiring Diagram	Point to Point			087100	
2 Position Switch	DPS-M/W-BK		SU	087100	
1 Mullion Switch	503		NO	087100	
1 Card Reader	HID Signo Series by Security System Supplier		OT		
1 Wall Switch	700		NO	087100	
1 Power Supply	by Security System Supplier		OT		
1 Bollard	ADA-SS-TWR-47x4x6-2		PP	087100	

Notes:
Door closed & locked at all times. Presenting valid credential outside shunts door position switches, activates outside operator paddle & allows for authorized entrance. Operating inside touchpad or inside operator paddle activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Cheyney University utilizes a proprietary lock and card reader access control system manufactured by Assa Abloy and Software House. This lock system is standard across all campus buildings and integrates with the security access system Ccure and Gentec. That system also integrates into the University student one-card system. To continue this uniformity, the same platform and hardware are required for this project. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

Set: 2.0

Doors: 1/200

1 Continuous Hinge	FM__SLF-HD1 x PT	10BE	PE	087100	
1 Electric Power Transfer	EL-CEPT	613E	SU	087100	
1 Rim Exit Device, Storeroom	16 55 56 72 PE8504 Less Pull	US10BE	SA	087100	
2 Permanent Core	Compatible with Facility's Existing System	606	BE	087100	
1 Pull	RM5277-18	10BE	RO	087100	
1 Concealed Overhead Holder/Stop	6-X36	613E	NO	087100	
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100	
1 Sweep	345-10BE-V		PE	087100	

1	Threshold	253x3-10BE-FG MSES10SS-2 (Coordinate with Architect's Details)		PE	087100	
1	ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	087100	⚡
1	Wiring Diagram	Point to Point			087100	
1	Position Switch	DPS-M/W-BK		SU	087100	⚡
1	Card Reader	HID Signo Series by Security System Supplier		OT		
1	Power Supply	by Security System Supplier		OT		⚡

Notes:
Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Cheyney University utilizes a proprietary lock and card reader access control system manufactured by Assa Abloy and Software House. This lock system is standard across all campus buildings and integrates with the security access system Ccure and Gentec. That system also integrates into the University student one-card system. To continue this uniformity, the same platform and hardware are required for this project. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

Set: 3.0

Doors: 1/101A, 1/101B, 1/134, 1/135

2	Continuous Hinge	FM__SLF-HD1 x PT	10BE	PE	087100	
2	Electric Power Transfer	EL-CEPT	613E	SU	087100	⚡
1	Concealed Vert Rod Exit, Nightlatch	16 55 56 72 ADPE8410 P106	US10BE	SA	087100	⚡
1	Concealed Vert Rod Exit, Exit Only	16 55 56 72 ADPE8410 EO	US10BE	SA	087100	⚡
3	Permanent Core	Compatible with Facility's Existing System	606	BE	087100	
2	Pull	RM5277-18	10BE	RO	087100	
2	Concealed Overhead Holder/Stop	6-X36	613E	NO	087100	
2	Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100	
2	Sweep	345-10BE-V		PE	087100	
1	Threshold	to architect detail		PE	087100	
2	ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
2	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	087100	⚡
1	Wiring Diagram	Point to Point			087100	
2	Position Switch	DPS-M/W-BK		SU	087100	⚡
1	Card Reader	HID Signo Series by Security System Supplier		OT		

1	Power Supply	by Security System Supplier		OT	

Notes:
Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Cheyney University utilizes a proprietary lock and card reader access control system manufactured by Assa Abloy and Software House. This lock system is standard across all campus buildings and integrates with the security access system Ccure and Gentec. That system also integrates into the University student one-card system. To continue this uniformity, the same platform and hardware are required for this project. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

Set: 4.0

Doors: 1/ST-2, 1/ST-3, 2/104A, 4/101B

1	Continuous Hinge	FM__SLF-HD1	10BE	PE	087100
1	Rim Exit Device, Exit Only	LD PE8510 EO	US10BE	SA	087100
1	Concealed Overhead Holder/Stop	6-X36	613E	NO	087100
1	Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1	Sweep	345-10BE-V		PE	087100
1	Threshold	253x3-10BE-FG MSES10SS-2 (Coordinate with Architect's Details)		PE	087100

Set: 5.0

Doors: 1/120

3	Hinge, Full Mortise, Hvy Wt	T4A3386	US10BE	MK	087100
1	Electric Power Transfer	EL-CEPT	613E	SU	087100
1	Electrified Mortise Lock	72 IDP NAC-82271-XXv LNND	US10BE	SA	087100
1	Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1	Conc Overhead Stop	1-X36	613E	NO	087100
1	Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1	Sweep	345-10BE-V		PE	087100
1	Threshold	253x3-10BE-FG MSES10SS-2 (Coordinate with Architect's Details)		PE	087100
1	ElectroLynx Harness - Frame	QC-C1500P		MK	087100
1	ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	087100
1	Wiring Diagram	Point to Point			087100
1	Card Reader	HID Signo Series by Security System Supplier		OT	

1 Power Supply	by Security System Supplier	OT	

Notes:
Door closed & locked at all times. Presenting valid credential outside shunts integrated door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch in lock shunting integrated door position switch and allowing authorized egress at all times. With loss of power or activation of building fire system door remains locked.

Cheyney University utilizes a proprietary lock and card reader access control system manufactured by Assa Abloy and Software House. This lock system is standard across all campus buildings and integrates with the security access system Ccure and Gentec. That system also integrates into the University student one-card system. To continue this uniformity, the same platform and hardware are required for this project. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

Set: 6.0

Doors: 2/117

6 Hinge, Full Mortise, Hvy Wt	T4A3386	US10BE	MK	087100
1 Dust Proof Strike	570	10BE	RO	087100
2 Flush Bolt	555	10BE	RO	087100
1 Storeroom/Closet Lock	72 8204 LNMD	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
2 Conc Overhead Stop	1-X36	613E	NO	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
2 Astragal	297-10BE-V		PE	087100
2 Sweep	345-10BE-V		PE	087100
1 Threshold	253x3-10BE-FG MSES10SS-2 (Coordinate with Architect's Details)		PE	087100

Set: 7.0

Doors: 1/119

3 Hinge, Full Mortise, Hvy Wt	T4A3386	US10BE	MK	087100
1 Storeroom/Closet Lock	72 8204 LNMD	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1 Conc Overhead Stop	1-X36	613E	NO	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Sweep	345-10BE-V		PE	087100
1 Threshold	253x3-10BE-FG MSES10SS-2 (Coordinate with Architect's Details)		PE	087100

Set: 8.0

Doors: 2/201

2 Continuous Hinge	FM__SLF-HD1 x PT	10BE	PE	087100
2 Push Bar	PE8893	US32D	SA	087100
2 Pull	RM5277-18	10BE	RO	087100
1 Concealed Overhead Holder/Stop	6-X36	613E	NO	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Automatic Opener	6331	690	NO	087100

Notes:

Set: 9.0

Doors: 1/201

1 Continuous Hinge	FM__SLF-HD1	10BE	PE	087100
1 Push Bar	PE8893	US32D	SA	087100
1 Pull	RM5277-18	10BE	RO	087100
1 Concealed Overhead Holder/Stop	6-X36	613E	NO	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100

Notes:

Set: 10.0

Doors: 2/211

1 Continuous Hinge	FM__SLF-HD1	10BE	PE	087100
1 Mortise Deadlock	MS1850S	313	AD	087100
1 Cylinder	as required	US10BE	SA	087100
1 Pull	RM5277-18	10BE	RO	087100
1 Push Bar	RM5222 LAR	10BE	RO	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100

Set: 12.0

Doors: 1/205

2 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Hinge, Full Mortise, Hvy Wt	T4A3786 QC	US10BE	MK	087100
1 Rim Exit Device, Storeroom	16 55 56 72 PE8804 NEMD	US10BE	SA	087100

1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100	
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100	
1 Door Stop	RM850 / RM860	10BE	RO	087100	
3 Silencer	608		RO	087100	
1 ElectroLynx Harness - Frame	QC-C1500P		MK	087100	
1 ElectroLynx Harness - Door	QC-CXXX (Size as Required)		MK	087100	
1 Wiring Diagram	Point to Point			087100	
1 Position Switch	DPS-M/W-BK		SU	087100	
1 Card Reader	HID Signo Series by Security System Supplier		OT		
1 Power Supply	by Security System Supplier		OT		

Notes:
Door closed & locked at all times. Presenting valid credential outside shunts door position switches & allows for authorized entrance. Operating inside trim activates request to exit switch shunting door contact and allowing authorized egress at all times. With loss of power door remains locked.

Cheyney University utilizes a proprietary lock and card reader access control system manufactured by Assa Abloy and Software House. This lock system is standard across all campus buildings and integrates with the security access system Ccure and Gentec. That system also integrates into the University student one-card system. To continue this uniformity, the same platform and hardware are required for this project. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

Set: 13.0

Doors: 1/230, 2/231

6 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
2 Surface Vert Rod Exit, Classroom	16 72 NB-PE8713 NEMD	US10BE	SA	087100
4 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
2 Conc Overhead Stop	1-X36	613E	NO	087100
2 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
2 Silencer	608		RO	087100

Set: 15.0

Doors: 1/ST-1

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Rim Exit Device, Classroom	16 72 PE8813 NEMD	US10BE	SA	087100
2 Permanent Core	Compatible with Facility's Existing System	606	BE	087100

1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100

Set: 16.0

Doors: 1/206B

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Rim Exit Device, Passage	16 72 PE8815 NEMD	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
1 Gasketing	S44BL		PE	087100

Set: 16.1

Doors: 2/ST-3

4 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Rim Exit Device, Passage	12 PE8815 NEMD	US10BE	SA	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
1 Gasketing	S44BL		PE	087100

Set: 17.0

Doors: 1/215, 1/216, 1/222

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Classroom Deadlock	72 4877	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1 Pull	RM5275-12	10BE	RO	087100
1 Push Plate	70C-RKW	10BE	RO	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
3 Silencer	608		RO	087100

Set: 18.0

Doors: 1/231, 2/230

1 Classroom Deadlock	72 4877	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
2 Push Plate	70C-RKW	10BE	RO	087100
1 Concealed Closer	73N	613E	NO	087100

2 Door Stop	RM850 / RM860	10BE	RO	087100

Set: 19.0

Doors: 1/117, 1/202, 1/203, 1/210, 1/218, 1/224, 1/226, 1/229, 1/232

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Storeroom/Closet Lock	72 8204 LNMD	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
3 Silencer	608		RO	087100

Set: 20.0

Doors: 1/220, 1/221, 1/225, 1/233, 2/233

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Storeroom/Closet Lock	72 8204 LNMD	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1 Conc Overhead Stop	1-X36	613E	NO	087100
3 Silencer	608		RO	087100

Set: 21.0

Doors: 6/207

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Storeroom/Closet Lock	72 8204 LNMD	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
3 Silencer	608		RO	087100

Set: 21.1

Doors: 1/234

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Storeroom/Closet Lock	72 8204 LNMD	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
1 Gasketing	S44BL		PE	087100

Set: 22.0

Doors: 1/133

6 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100
1 Storeroom/Closet Lock	72 8204 LNND	US26D	SA	087100
2 Interchangeable Core	Compatible with Facility's Existing System	626	BE	087100
2 Conc Overhead Stop	1-X36	613E	NO	087100
2 Surface Closer	351 O / P3 / P9 (Arm as Required)	EN	SA	087100
2 Silencer	608		RO	087100

Set: 23.0

Doors: 1/208, 1/223

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Office/Entry Lock	LB 72 8205 LNMD	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
3 Silencer	608		RO	087100

Set: 25.0

Doors: 3/207

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Classroom Lock	72 8237 LNMD	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
3 Silencer	608		RO	087100

Set: 27.0

Doors: 1/219, 1/227, 1/228

3 Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US10BE	MK	087100
1 Privacy Lock	LB V21 8265 LNMD	US10BE	SA	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
3 Silencer	608		RO	087100

Set: 28.0

Doors: 1/111, 1/112

1 Continuous Hinge	FM__SLF-HD1	10BE	PE	087100
1 Privacy Lock	LB V21 8265 LNMD	US10BE	SA	087100
1 Surface Closer	351 O / P3 / P9 (Arm as Required)	US10BE	SA	087100
1 Door Stop	RM850 / RM860	10BE	RO	087100
3 Silencer	608		RO	087100

Set: 29.0

Doors: 1/211, 4/207, 5/207

1 Classroom Deadlock	72 4877	US10BE	SA	087100
1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100
2 Push Plate	70C-RKW	10BE	RO	087100
1 Concealed Closer	73N	613E	NO	087100
2 Door Stop	RM850 / RM860	10BE	RO	087100

Set: 35.0

Doors: 2/205

1 Permanent Core	Compatible with Facility's Existing System	606	BE	087100

Notes: Balancve of existing hardware to remain.

Mark	Hardware
1/101A	3.0
1/101B	3.0
1/111	28.0
1/112	28.0
1/117	19.0
1/119	7.0
1/120	5.0
1/133	22.0
1/134	3.0
1/135	3.0
1/200	2.0
1/201	9.0
1/202	19.0
1/203	19.0
1/205	12.0
1/206B	16.0
1/207	Traffic

1/208	23.0
1/210	19.0
1/211	29.0
1/212	Traffic
1/215	17.0
1/216	17.0
1/218	19.0
1/219	27.0
1/220	20.0
1/221	20.0
1/222	17.0
2/222	35.0
1/223	23.0
1/224	19.0
1/225	20.0
1/226	19.0
1/227	27.0
1/228	27.0
1/229	19.0
1/230	13.0
1/231	18.0
1/232	19.0
1/233	20.0
1/234	21.1
1/ST-1	15.0
1/ST-2	4.0
1/ST-3	4.0
2/104A	4.0
2/117	6.0
2/200	1.0
2/201	8.0
2/205	35.0
2/207	Traffic
2/211	10.0
2/230	18.0
2/231	13.0
2/233	20.0
2/ST-3	16.1
3/205	1.0
3/207	25.0

4/101B	4.0
4/207	29.0
5/207	29.0
6/207	21.0

END OF SECTION 080671

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Standard and custom hollow metal doors and frames.
2. Steel sidelight, borrowed lite and transom frames.
3. Louvers installed in hollow metal doors.
4. Light frames and glazing installed in hollow metal doors.

B. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. ANSI/SDI A250.8 - Recommended Specifications for Standard Steel Doors and Frames.
2. ANSI/SDI A250.4 - Test Procedure and Acceptance Criteria for Physical Endurance for Steel Doors, Frames, Frames Anchors and Hardware Reinforcing.
3. ANSI/SDI A250.6 - Recommended Practice for Hardware Reinforcing on Standard Steel Doors and Frames.
4. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames.
5. ANSI/SDI A250.11 - Recommended Erection Instructions for Steel Frames.
6. ASTM A1008 - Standard Specification for Steel Sheet, Cold-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.
7. ASTM A653 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
8. ASTM A924 - Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
9. SDI-113 Standard Practice for Determining the Steady-State Thermal Transmittance of Steel Door & Frame Assemblies.
10. ASTM C 1363 - Standard Test Method for Thermal Performance of Building Assemblies by Means of a Hot Box Apparatus.
11. ASTM C1199 - Standard Test Method for Measuring the Steady-State Thermal Transmittance of Fenestration Systems Using Hot Box Methods
12. ASTM E1423 - Practice for Determining Steady State Thermal Transmittance of Fenestration Systems.
13. ANSI/BHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
14. ANSI/SDI 122 - Installation and Troubleshooting Guide for Standard Steel Doors and Frames.

15. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.
16. ANSI/NFPA 105: Standard for the Installation of Smoke Door Assemblies.
17. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association.
18. UL 10C - Positive Pressure Fire Tests of Door Assemblies.
19. UL 1784 - Standard for Air Leakage Tests of Door Assemblies.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, core descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

B. Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the steel door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

C. Shop Drawings: Include the following:

1. Elevations of each door design.
2. Details of doors, including vertical and horizontal edge details and metal thicknesses.
3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
4. Locations of reinforcement and preparations for hardware.
5. Details of anchorages, joints, field splices, and connections.
6. Details of accessories.
7. Details of moldings, removable stops, and glazing.
8. Details of conduit and preparations for power, signal, and control systems.

D. Samples for Verification:

1. Samples are only required by request of the architect and for manufacturers that are not current members of the Steel Door Institute.

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain hollow metal doors and frames through one source from a single manufacturer wherever possible.

B. Quality Standard: In addition to requirements specified, furnish SDI-Certified manufacturer products that comply with ANSI/SDI A250.8, latest edition, "Recommended Specifications for Standard Steel Doors and Frames".

C. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to UL10C (neutral pressure at 40” above sill) or UL 10C.

1. Oversize Fire-Rated Door Assemblies Construction: For units exceeding sizes of tested assemblies, attach construction label certifying doors are built to standard construction requirements for tested and labeled fire rated door assemblies except for size.
2. Temperature-Rise Limit: Where indicated and at vertical exit enclosures (stairwell openings) and exit passageways, provide doors that have a maximum transmitted temperature end point of not more than 450 deg F (250 deg C) above ambient after 30 minutes of standard fire-test exposure.

3. Smoke Control Door Assemblies: Comply with NFPA 105.

a. Smoke "S" Label: Doors to bear “S” label, and include smoke and draft control gasketing applied to frame and on meeting stiles of pair doors.

D. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Provide labeled glazing material.

E. Pre-Submittal Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing hollow metal doors and frames and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow metal work palletized, wrapped, or crated to provide protection during transit and Project site storage. Do not use non-vented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow metal work under cover at Project site. Place in stacks of five units maximum in a vertical position with heads up, spaced by blocking, on minimum 4-inch high wood blocking. Do not store in a manner that traps excess humidity.

1. Provide minimum 1/4-inch space between each stacked door to permit air circulation. Door and frames to be stacked in a vertical upright position.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.7 COORDINATION

A. Coordinate installation of anchorages for hollow metal frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors. Deliver such items to Project site in time for installation.

B. Building Information Modeling (BIM) Support: Utilize designated BIM software tools and obtain training needed to successfully participate in the Project BIM processes. All technical disciplines are responsible for the product data integration and data reliability of their Work into the coordinated BIM applications.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

B. Warranty includes installation and finishing that may be required due to repair or replacement of defective doors.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide steel doors and frames from a SDI Certified manufacturer:

1. CECO Door Products (C).
2. Curries Company (CU).
3. Steelcraft (S).
4. Or equal as approved by Professional.

2.2 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

C. Frame Anchors: ASTM A 653/A 653M, Commercial Steel (CS), Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.

2.3 HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces unless otherwise indicated. Comply with ANSI/SDI A250.8 and ANSI/NAAMM HMMA 867.

B. Exterior Doors: Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard polystyrene. Where indicated, provide doors fabricated as thermal-rated assemblies with a minimum R-value of 2.8 or better.
3. Core Construction: Manufacturer’s thermally enhanced QMax core. Where indicated provide doors fabricated as thermal-rated assemblies with a minimum thermal rating of 0.35 BTU/hr-ft2-F.
4. Level/Model: Level 3 and Physical Performance Level A (Extra Heavy Duty), Minimum 16 gauge (0.053-inch - 1.3-mm) thick steel, Model 2.
5. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
6. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. Doors with an inverted top channel to include a steel closure channel, screw

attached, with the web of the channel flush with the face sheets of the door. Plastic or composite channel fillers are not acceptable.

7. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
8. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Interior Doors: Face sheets fabricated of commercial quality cold rolled steel that complies with ASTM A 1008/A 1008M. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model and ANSI/SDI A250.4 for physical performance level:

1. Design: Flush panel.
2. Core Construction: Manufacturer's standard kraft-paper honeycomb, or one-piece polystyrene core, securely bonded to both faces.

    a. Fire Door Core: As required to provide fire-protection and temperature-rise ratings indicated.

3. Level/Model: Level 2 and Physical Performance Level B (Heavy Duty), Minimum 18 gauge (0.042-inch - 1.0-mm) thick steel, Model 2.
4. Vertical Edges: Vertical edges to have the face sheets spot welded and filled full height with an epoxy filler. Welds are to be ground, filled and dressed smooth. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9" or minimum 14 gauge continuous channel with pierced holes, drilled and tapped.
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design. Subject to compliance with requirements provide listed product or equal as approved by Professional:

1. Curries Company (CU) - Polystyrene Core - 707 Series.
2. Curries Company (CU) - QMax Core - 707 Series.

2.4 HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

B. Thermal Break Frames: Subject to the same compliance standards and requirements as standard hollow metal frames. Tested for thermal performance in accordance with NFRC 102, and resistance to air infiltration in accordance with NFRC 400. Where indicated provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with 1/16” positive thermal break and integral vinyl weatherstripping.

C. Exterior Frames: Fabricated of hot-dipped zinc coated steel that complies with ASTM A 653/A 653M, Coating Designation A60.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 14 gauge (0.067-inch -1.7-mm) thick steel sheet.
3. Manufacturers Basis of Design:

a. Curries Company (CU) - Mercury 3 Thermal Break TQ Series.

D. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners. Profile as indicated on drawings.
2. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.
3. Manufacturers Basis of Design. Subject to compliance with requirements provide listed product or equal as approved by Professional:

a. Curries Company (CU) - C Series.
b. Curries Company (CU) - M Series.

E. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

F. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.5 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, formed from A60 metallic coated material, not less than 0.042 inch thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
2. Stud Wall Type: Designed to engage stud and not less than 0.042 inch thick.
3. Compression Type for Drywall Slip-on (Knock-Down) Frames: Adjustable compression anchors.

B. Floor Anchors: Floor anchors to be provided at each jamb, formed from A60 metallic coated material, not less than 0.042 inches thick.

C. Mortar Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.6 LIGHT OPENINGS AND GLAZING

A. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints at fabricator’s shop. Fixed and removable stops to allow multiple glazed lites each to be removed independently. Coordinate frame rabbet widths between fixed and removable stops with the type of glazing and installation indicated.

B. Moldings for Glazed Lites in Doors and Loose Stops for Glazed Lites in Frames: Minimum 20 gauge thick, fabricated from same material as door face sheet in which they are installed.

C. Fixed Frame Moldings: Formed integral with hollow metal frames, a minimum of 5/8 inch (16 mm) high unless otherwise indicated. Provide fixed frame moldings and stops on outside of exterior and on secure side of interior doors and frames.

D. Preformed Metal Frames for Light Openings: Manufacturer's standard frame formed of 0.048-inch-thick, cold rolled steel sheet; with baked enamel or powder coated finish; and approved for

use in doors of fire protection rating indicated. Match pre-finished door paint color where applicable.

2.7 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inches thick.

2.8 FABRICATION

A. Fabricate hollow metal work to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. When shipping limitations so dictate, frames for large openings are to be fabricated in sections for splicing or splining in the field by others.

B. Tolerances: Fabricate hollow metal work to tolerances indicated in ANSI/SDI A250.8.

C. Hollow Metal Doors:

1. Exterior Doors: Provide optional weep-hole openings in bottom of exterior doors to permit moisture to escape where specified.
2. Glazed Lites: Factory cut openings in doors with applied trim or kits to fit. Factory install glazing where indicated.
3. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge strap for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".

D. Hollow Metal Frames:

1. Shipping Limitations: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
2. Welded Frames: Weld joints continuously through full throat width of frames, including rabbets, soffits, and stops; grind, fill, dress, and make smooth, flush, and invisible.

    a. Welded frames are to be provided with two steel spreaders temporarily attached to the bottom of both jambs to serve as a brace during shipping and handling. Spreader bars are for bracing only and are not to be used to size the frame opening.

3. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.
4. High Frequency Hinge Reinforcement: Provide high frequency hinge reinforcements at door openings 48-inches and wider with mortise butt type hinges at top hinge locations.
5. Continuous Hinge Reinforcement: Provide welded continuous 12 gauge straps for continuous hinges specified in hardware sets in Division 08 Section "Door Hardware".
6. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated for removable stops, provide security screws at exterior locations.
7. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
8. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
9. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches on-center and as follows:

1) Two anchors per jamb up to 60 inches high.
2) Three anchors per jamb from 60 to 90 inches high.
3) Four anchors per jamb from 90 to 120 inches high.
4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.

b. Stud Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:

1) Three anchors per jamb up to 60 inches high.
2) Four anchors per jamb from 60 to 90 inches high.
3) Five anchors per jamb from 90 to 96 inches high.
4) Five anchors per jamb plus 1 additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.
5) Two anchors per head for frames above 42 inches wide and mounted in metal stud partitions.

10. Door Silencers: Except on weatherstripped or gasketed doors, drill stops to receive door silencers. Silencers to be supplied by frame manufacturer regardless if specified in Division 08 Section "Door Hardware".
11. Bituminous Coating: Where frames are fully grouted with an approved Portland Cement based grout or mortar, coat inside of frame throat with a water based bituminous or asphaltic emulsion coating to a minimum thickness of 3 mils DFT, tested in accordance with UL 10C and applied to the frame under a 3rd party independent follow-up service procedure.

E. Hardware Preparation: Factory prepare hollow metal work to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Division 08 Section "Door Hardware."

1. Locate hardware as indicated, or if not indicated, according to ANSI/SDI A250.8.
2. Reinforce doors and frames to receive non-template, mortised and surface mounted door hardware.
3. Comply with applicable requirements in ANSI/SDI A250.6 and ANSI/DHI A115 Series specifications for preparation of hollow metal work for hardware.
4. Coordinate locations of conduit and wiring boxes for electrical connections with Division 26 Sections.

2.9 STEEL FINISHES

A. Prime Finishes: Doors and frames to be cleaned, and chemically treated to insure maximum finish paint adhesion. Surfaces of the door and frame exposed to view to receive a factory applied coat of rust inhibiting shop primer.

1. Shop Primer: Manufacturer's standard, fast-curing, lead and chromate free primer complying with ANSI/SDI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; and compatible with substrate and field-applied coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. General Contractor to verify the accuracy of dimensions given to the steel door and frame manufacturer for existing openings or existing frames (strike height, hinge spacing, hinge back set, etc.).

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove welded in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

B. Prior to installation, adjust and securely brace welded hollow metal frames for square, level, twist, and plumb condition.

C. Tolerances shall comply with SDI-117 "Manufacturing Tolerances Standard Steel Doors and Frames."

D. Drill and tap doors and frames to receive non-template, mortised, and surface-mounted door hardware.

E. Verify tolerances against manufacturers installations instructions for tornado and hurricane storm shelter openings.

3.3 INSTALLATION

A. General: Install hollow metal work plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

B. Hollow Metal Frames: Install hollow metal frames of size and profile indicated. Comply with ANSI/SDI A250.11 and NFPA 80 at fire rated openings.

1. Set frames accurately in position, plumbed, leveled, aligned, and braced securely until permanent anchors are set. After wall construction is complete and frames properly set and secured, remove temporary braces, leaving surfaces smooth and undamaged. Shim as necessary to comply with installation tolerances.
2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with post-installed expansion anchors.
3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar.
4. Grout Requirements: Do not grout head of frames unless reinforcing has been installed in head of frame. Do not grout vertical or horizontal closed mullion members.

C. Hollow Metal Doors: Fit hollow metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

    a. Jambs and Head: 1/8 inch plus or minus 1/16 inch.
    b. Between Edges of Pairs of Doors: 1/8 inch plus or minus 1/16 inch.
    c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch.
    d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Division 08 Section "Glazing" and with hollow metal manufacturer's written instructions.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow metal work immediately after installation.

C. Prime-Coat and Painted Finish Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, or painted finishes, and apply touchup of compatible air drying, rust-inhibitive primer, zinc rich primer (exterior and galvanized openings) or finish paint.

3.5 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

END OF SECTION 081113

SECTION 08 11 16

DOUBLE-ACTING TRAFFIC DOORS

PART 1 GENERAL

1.01 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SECTION INCLUDES

A. Aluminum Double-Acting Traffic Doors.

1.03 SUBMITTALS

A. Action Submittals/ Informational Submittals.
   1. Product Data.
      a. Submit manufacturer’s product data sheets, catalog pages illustrating the products, description of materials, components, fabrication, finishes, installation instructions, and applicable test reports.
   2. Shop Drawings.
      a. Submit manufacturer’s shop drawings, including elevations, sections, and details indicating dimensions, tolerances, materials, fabrication, doors, panels, framing, hardware schedule, and finish.
   3. Samples.
      a. Submit manufacturer’s door sample composed of door face sheet, core, and finish.
      b. Submit manufacturer’s sample of standard colors for door face.

B. Closeout Submittals.
   1. Operation and Maintenance Manual.
      a. Submit manufacturer’s maintenance and cleaning instructions for doors and frames, including maintenance and operating instructions for hardware.
   2. Warranty Documentation.
      a. Submit manufacturer’s standard warranty.

1.04 QUALITY ASSURANCE

A. Manufacturer’s Qualifications.
   1. Continuously engaged in manufacturing of doors of similar type to that specified, with a minimum of 25 years concurrent successful experience.
   2. Evidence of a documented complaint resolution quality management system.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Delivery.
   1. Deliver materials to site in manufacturer’s original, unopened, containers and packaging.
   2. Labels clearly identifying opening, door mark, and manufacturer.

B. Storage.
   1. Store materials in a clean, dry area, indoors in accordance with manufacturer’s instructions.

C. Handling.
   1. Protect materials and finish from damage during handling and installation.

1.06 WARRANTY

A. Warrant doors, and factory installed hardware against failure in materials and workmanship, including excessive deflection, faulty operation, defects in hardware installation, and deterioration of finish or construction in excess of normal weathering.

B. Standard Period.
   1. One year from date of substantial completion.

PART 2 PRODUCTS

2.01 Double-Acting FRP Traffic Doors

A. Manufacturers: Subject to compliance with requirements provide products from one of the following:

1. Aleco.
2. Curtron Products.
3. Eliason Corporation.
4. Special-Lite, Inc.
5. Or equal as approved by the Professional.

2.02 DESCRIPTION

A. Model.
1. Double-Acting Aluminum Traffic Door

B. Construction.
1. Door Thickness.
   a. 1-1/4".
2. Stiles & Rails.
   a. Aluminum extrusions made from 6063 aluminum alloys with a minimum temper of T5.
   b. Minimum 1-9/16" deep one-piece extrusion with integral reglets to accept face sheet on both interior and exterior side of door which secure face sheet into place and permit flush appearance.
   c. Screw or snap in place applied caps are not acceptable.
3. Corners.
   a. Mitered.
   b. 1-1/2"x1-1/2"x1/8" 6061 aluminum angle reinforcement at corner.
   c. Weld, glue, or other methods of corner joinery are not acceptable.
4. Core.
   a. Poured-in-place polyurethane foam.
   b. Laid in foam cores are not acceptable.
5. Face Sheet.
   a. Standard interior 0.062" thick smooth aluminum sheet (DA-16S).
   b. Attachment of face sheet.
      1. Extruded stiles and rails to have integral reglets to accept face sheet on both interior and exterior side of door which secure face sheet into place and permit flush appearance.
      2. Use of glue to bond face sheet to core or extrusions is not acceptable.
6. Cutouts.
   a. Manufacture doors with cutouts for required vision lites, louvers, and panels.
7. Hardware.
   a. Pre-machine doors in accordance with templates from specified hardware manufacturers.
   b. Factory install door hardware.
8. Reinforcements.
   a. Aluminum extrusions made from 6061 or 6063 aluminum alloys.
   b. Sheet and plate to conform to ASTM-B209.
   c. Alloy and temper to be selected by manufacturer for strength, corrosion resistance, and application of required finish, and control of color.
   d. Bars and tubes to meet ASTM-B221.

C. Fasteners.
1. All exposed fasteners will have a finish to match material being fastened.
2. 410 stainless steel or other non-corrosive metal.
3. Must be compatible with items being fastened.

2.03 PERFORMANCE

A. Face Sheet.
1. ASTM B209.

B. Door Core.
1. Density, ASTM-D1622: ≤ 5.0 pcf.
2. Compressive Properties, ASTM-D1621: Compressive Strength ≥ 60 psi, Compressive Modulus ≥ 1948 psi.
3. Tensile and Tensile Adhesion Properties, ASTM-D1623: Tensile Adhesion, 3" x 3" FRP Facers ≥ 53 psi, Tensile Adhesion, 1" x 1" Foam ≥ 104 psi.
4. Thermal and Humid Aging, ASTM-D2126: Volume Change at 158 °F, 100% humidity, 14 days ≤ 13%.
5. Thermal Conductivity, ASTM-C518, Thermal Resistance ≥ 0.10 m^2K/W.

2.04 FABRICATION

A. Factory Assembly.
1. Required size for door units, shall be as indicated on the drawings.
2. Complete cutting, fitting, forming, drilling, and grinding of metal before assembly.
3. All cut edges to be free of burs.
4. Welding of doors is not acceptable.

5. Maintain continuity of line and accurate relation of planes and angles.
6. Secure attachments and support at mechanical joints with hairline fit at contact surfaces.

B. Shop Fabrication
1. All shop fabrication to be completed in accordance with manufacturer's process work instructions.
2. Quality control to be performed before leaving each department.

2.05 FINISHES

A. Door.
1. Aluminum Perimeter Frame.
a. Anodizing.
1. Class 1 Anodizing, minimum 0.7 mils thick.
2. Clear 215 R1, AA-M10C12C22A41.
2. Face Sheet
a. Aluminum
1. Textures
a. Smooth (.062" thickness, DA-16S)
2. Anodized
a. Color.
1. Clear 215 R1, AA-M10C12C22A41.

2.06 ACCESSORIES

A. Vision Lites
1. 14" x 9" Thermoplastic vulcanizates gasket with 1/4" acrylic, clear.

B. Hardware.
1. Pre-machine doors in accordance with templates from specified hardware manufacturers and hardware schedule.
2. Factory install hardware.
3. Hardware Schedule.
a. ABH 8500 Gravity Pivot Set

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas to receive doors.
B. Notify architect of conditions that would adversely affect installation or subsequent use.
C. Do not proceed with installation until unsatisfactory conditions are corrected.

3.02 PREPARATION

A. Ensure openings to receive frames are plumb, level, square, and in tolerance.

3.03 ERECTION

A. Install doors in accordance with manufacturer's instructions.
B. Install doors plumb, level, square, true to line, and without warp or rack.
C. Anchor frames securely in place.
D. Separate aluminum from other metal surfaces with bituminous coatings or other means approved by architect.
E. Repair minor damages to finish in accordance with manufacturer's instructions and as approved by architect.
F. Remove and replace damaged components that cannot be successfully repaired as determined by architect.

3.04 FIELD QUALITY CONTROL

A. Manufacture's Field Services.
1. Manufacturer's representative shall provide technical assistance and guidance for installation of doors.

3.05 ADJUSTING

A. Adjust doors, and hinges for smooth operation without binding.

3.06 CLEANING

A. Clean doors promptly after installation in accordance with manufacturer's instructions.
B. Do not use harsh cleaning materials or methods that would damage finish.

3.07 PROTECTION

A. Protect installed doors to ensure that, except for normal weathering, doors will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 08 1200

INTERIOR ALUMINUM DOORS AND FRAMES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Pre-finished aluminum door frames for interior use.
2. Pre-finished aluminum window frames for interior use.
3. Pre-finished aluminum framing systems for interior use.
4. Pre-finished aluminum doors for interior use.

B. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

1. AAMA 603.8 - Performance Requirements and Test Procedures for Pigmented Organic Coatings on Extruded Aluminum.
2. AAMA 607.1 - Guide Specification and Inspection Methods for Clear Anodize Finishes for Architectural Aluminum.
3. AAMA 608.1 - Guide Specification and Inspections Methods for Electrolytically Deposited Color Anodic Finished for Architectural Aluminum.
4. AAMA 609 & 610-02 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum.
5. ASTM B221 - Standard specification for aluminum and aluminum-alloy extruded bars, rods, wire, profiles, and tubes.
6. NAAMM - "Metal Finishes Manual for Architectural and Metal Products'.
7. ANSI/NFPA 80 - Standard for Fire Doors and Fire Windows; National Fire Protection Association.

8. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
9. ICC/IBC - International Building Code.

1.3 SUBMITTALS

A. Submit under the provisions of Section 01300.

B. Product Data: For each type of product indicated. Include construction details, material descriptions, hardware reinforcements, profiles, anchors, fire-resistance rating, and finishes.

C. Templates: Door hardware supplier is to furnish templates, template reference number and/or physical hardware to the interior aluminum door and frame supplier in order to prepare the doors and frames to receive the finish hardware items.

D. Shop Drawings: Include the following:

1. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
2. Locations of reinforcement and preparations for hardware.
3. Details of each different wall opening condition. Include requirements for steel framing at partitions for fit and securing of frames, partition widths and tolerances, direction of framing members, clips and attachments.
4. Details of anchorages, joints, field splices, and connections.
5. Details of accessories.
6. Details of moldings, removable stops, and glazing.
7. Elevations of each door design.
8. Details of doors, including vertical and horizontal edge details and metal thicknesses.
9. Details of preparations for power, signal, and control systems.

E. Samples for Verification: Provide at the request of architect, prepared Samples as indicated below:

1. Framing Member: 12 inches long.
2. Corner Fabrication: 12-by-12-inch-long, full-size window corner, including full-size sections of extrusions with factory-applied color finish.
3. Aluminum chips in full range manufacturer's standard finishes for architect's color selection.

F. Interior Aluminum Door and Frame Schedule: Use same designations indicated on Drawings. Coordinate with Door Hardware schedule and glazing.

G. Informational Submittals

1. Certificates of Compliance: Submit any product test report or information necessary to indicate compliance with this specification section.

1.4 QUALITY CONTROL

A. Source Limitations: Obtain interior aluminum frames and doors through one source from a single qualified manufacturer.

B. Manufacturer Qualifications: A firm experienced in the manufacturing of interior aluminum framing systems and doors with a minimum five (5) years successful in-service performance providing product similar to those indicated for this project, including pre-engineering and pre-fabricating all components of aluminum framing systems and doors.

C. Installer Qualifications: An experienced installer with a minimum five years (5) experience who has completed aluminum framing systems and door installations similar in material, design, and extent to those indicated for this project and whose work has resulted in construction with a record of successful in-service performance.

D. Aesthetic Effects: Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.

E. Fire-Rated Door Assemblies: Assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 (neutral pressure at 40" above sill) or UL 10C.

1. Provide labels permanently fastened on each frame or door within size limits established by NFPA and the testing authority.

F. Fire-Rated, Borrowed-Light Frame Assemblies: Assemblies complying with NFPA 80 that are listed and labeled, by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 257. Label each individual glazed lite.

G. Smoke-Control Door Assemblies: Comply with NFPA 105.

H. Pre-Installation Conference: Conduct conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier, Installer, and Contractor to review proper methods and procedures for installing interior aluminum frames and doors and to verify installation of electrical knockout boxes and conduit at frames with electrified or access control hardware.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver interior aluminum frames and doors individually protective wrapped within cartons and marked for the corresponding scheduled opening. Do not bulk pack frames.

B. Inspect frames upon delivery for damage.

1. Repair minor damage to pre-finished products as recommended by manufacturer.
2. Replace frames that cannot be satisfactorily repaired.

C. Store interior aluminum frames and doors at Project site under cover and as near as possible to final installation location. Do not use covering material that will cause discoloration of aluminum finish.

1.6 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of interior aluminum frame openings by field measurements before fabrication and indicate measurements on Shop Drawings submittals.

B. Do not install aluminum frames and doors until area of work has been completely enclosed and interior is protected from the elements.

C. Maintain temperature and humidity in areas of installation within reasonable limits, as close as possible to final occupancy standards. If necessary, provide artificial heating, cooling and ventilation to maintain required environmental conditions.

1.7 WARRANTY

A. Provide manufacturer's written warranty against defects in materials and workmanship upon final completion and acceptance of Work in this section.

1. Warrant framing and door finishes against defects and excessive fading and non-uniformity in color for a period of 5 years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Frameworks Manufacturing.
2. Custom Components Company.
3. Versatrac Frames, a Division of American Door Products Inc.
4. Or Equal as approved by the Professional.

B. Substitutions: Material from alternate interior aluminum framing system and door fabricators will not be accepted on jobsite without prior written and sample approval in accordance with requirements specified in Division 01 and at the discretion of Architect and their designated openings consultant.

2.2 MATERIALS

A. Extruded Aluminum: ASTM B 221 alloy 6063-T5 or alloy and temper required to suit structural and finish requirements.

B. INTERIOR ALUMINUM FRAMES

1. Provide interior aluminum framing components complying with dimensions, profiles, and relationships to adjoining work of components as indicated on Drawings. Provide frames that are adjustable for partition types and throat openings, or that are fitted to each partition type, meeting the throat opening and required clearances per frame manufacturer's recommendations. Reinforce for specified hinges, strikes, and closers

2. Type-2 Framing System: Provide frames with the following characteristics:

a. Rectilinear design.
b. Snap on trim:

1) 2 inch.

c. .070 inch rabbet wall thickness.
d. Standard throat sizes (drywall partition thickness): 3-1/2", 3-3/4", 4-5/8", 4-7/8", 5-1/4", 5-1/2", 6-1/8" and 7-1/4".
e. Adjustable throat frames expandable from 2-7/8" up to 8-3/8".

3. Glass Trim: Extruded aluminum, not less than 0.062 inch thick, designed for glass thickness indicated with removable snap-in casing trim, glazing stops, and door stops without exposed fasteners.

C. INTERIOR ALUMINUM DOORS

1. General: Provide 1-3/4 inch doors of type and design indicated, not less than 0.062 inch thick material.
2. Aluminum Stile & Rail Type Swinging Doors: Door stiles and rails to have tubular design with the following characteristics:

a. Stiles:

1) Wide Stile (5").

b. Rails:

1) 5" TopBottom Rail.
2) 10" Bottom Rail.

3. Snap-in stops with factory applied glazing gaskets for 1/4", 3/8", or 1/2" thick glass.

D. Aluminum Stile & Rail Sliding Type Doors: Subject to the same tubular design standards as Stile & Rail Type Swinging Doors with the following characteristics.

1. Sliding door track to be installed in properly blocked ceiling or wall above frame, or to header clip (by manufacturer) attached to the frame header. Sliding track to be provided with snap on covers.
2. Sliding Door Hardware:

a. Tricycle Rollers: 2 each per panel. Maximum 1 each roller per 75 lbs.
b. Provide bumper stops in track assemblies.
c. Provide concealed door guide at floor (track assemblies are not allowed).

2.3 ACCESSORIES

A. Fasteners: Aluminum, nonmagnetic, stainless-steel or other noncorrosive metal fasteners compatible with frames, stops, panels, reinforcement plates, hardware, anchors, and other items being fastened.

B. Door Silencers: Manufacturer's standard continuous mohair, wool pile, or vinyl seals.

C. Glazing Gaskets: Manufacturer's standard extruded or molded plastic, to accommodate glazing thickness indicated.

D. Glazing: Comply with requirements in Division 08 Section, "Glazing."

E. Hardware: As specified in Division 08 Section, "Door Hardware".

2.4 FABRICATION

A. FRAME CONSTRUCTION

1. Factory pre-engineer and pre-cut interior aluminum frame components to the greatest extent practical. Linear glazing components fabricated in the field are not allowed. Allow for 2 inches excess vertical length for scribing to suit floor conditions. Machine jambs and prepare for hardware, with concealed plates, drilled and tapped as required, fastened in frame with concealed screws.
2. Provide concealed corner reinforcements and alignment clips for precise joints at butt or mitered connections.
3. Hardware Preparation: Factory interior aluminum frames to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates as specified in Division 08 Section, "Door Hardware."

a. Reinforce frames to receive surface mounted door hardware. Machine jambs and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required and fastened within frame with concealed screws.
b. Locate hardware as indicated.
c. Coordinate locations of conduit, wiring boxes, and power transfers for electrical connections with Division 26 Sections.

4. Fabricate frames for glazing with removable stops to allow glazing replacement without dismantling frame.
5. Fabricate all components to allow secure installation without exposed fasteners.

B. DOOR CONSTRUCTION

1. Factory pre-engineer aluminum doors and components to the greatest extent practical.
2. Hardware Preparation: Factory interior aluminum doors to receive template mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates as specified in Division 08 Section, "Door Hardware."

a. Reinforce doors to receive surface mounted door hardware. Machine and prepare for hardware, with concealed reinforcement plates, drilled and tapped as required and fastened within door with concealed screws.
b. Locate hardware as indicated.
c. Coordinate locations of conduit and power transfers for electrical connections with Division 26 Sections.

3. Clearances for Non-Fire-Rated Door Frames: Not more than 1/8 inch at jambs and heads, not more than 1/4 inch between pairs of doors. Not more than 3/4 inch at bottom.
4. Fabricate kits for glazing with removable stops to allow glazing replacement without dismantling.

2.5 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products' for recommendations for apply and designated finishes. Exposed surfaces to be free of scratches and other serious blemishes.

B. Factory finish extruded frame components so that any part exposed to view upon completion of installation will be uniform in finish and color.

C. Color anodic coating:

1. Class 1, AAMA 611, AA-M12C22A42/A44 color anodized coating, 0.018 mill thickness minimum.

a. Color: As selected by Architect from Manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify wall thickness does not exceed standard tolerances allowed by specified frame throat sizes.

C. General Contractor to verify the accuracy of dimensions given to frame and door manufacturer for pre-cut openings.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install and set interior aluminum frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.

1. At fire-protection-rated openings, install frames according to NFPA 80.

B. Install frame components in the longest possible lengths with no component less than 48 inches.

1. Fasten to suspended ceiling grid at 48 inches on center maximum, using #6 sheet metal screws or other fasteners approved by frame manufacturer.
2. Use concealed installation clips to produce tightly fitted and aligned splices and connections.
3. Secure clips to extruded main-frame components and not to snap-in or trim members.
4. Do not use screws or other fasteners exposed to view when installation is complete.

3.3 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition.

B. Clean exposed frame surfaces promptly after installation, using cleaning methods recommended by frame manufacturer and according to AMMA 609 & 610.

C. Touch up marred areas so that touch up is not visible from a distance of 48 inches. Remove and replace frames that cannot be satisfactorily repaired.

3.4 PROTECTION

A. Provide protection as required to assure that frames will be without damage or deterioration upon substantial completion of the project.

END OF SECTION

SECTION 08 3110

ACCESS DOORS AND PANELS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. This Section includes the following types of access doors:

1. Wall access doors.
2. Ceiling access doors.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 4 Sections for building in anchors and grouting frames set in masonry construction.
2. Division 9 Section "Gypsum Board Assemblies" for gypsum board walls and ceilings.
3. Division 9 Section "Acoustical Tile Ceilings" for access tile in suspended or furred acoustical tile ceilings.
4. Divisions 22, 23 and 26: HVAC, plumbing, and electrical equipment requiring access doors.

1.03 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of Contract Section.

B. Product data for each type of access door assembly specified, including details of construction relative to materials, individual components, profiles, finishes, and fire-protection ratings (if required).

1. Include complete schedule, including types, general locations, sizes, wall and ceiling construction details, latching or locking provisions, and other data pertinent to installation.

1.04 QUALITY CONTROL

A. Single-Source Responsibility: Obtain access doors for entire Project from one source and by a single manufacturer.

B. Fire-Rated Door Assemblies: Units that comply with NFPA 80, are identical to door and frame assemblies tested for fire-test-response characteristics per test method as indicated below, and are labeled and listed by UL, Warnock Hersey, or another testing and inspecting agency acceptable to authorities having jurisdiction.

1. Test Method for Vertical Installations: ASTM E 152.

2. Test Method for Horizontal Installations: ASTM E 119.

1.05 COORDINATION

A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified under "Submittals" Article.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to the following:

1. Babcock-Davis.
2. Nystrom
3. Williams Brothers Corp.
4. Or Equal as approved by the Professional.

2.02 MATERIALS

A. Steel Sheet: ASTM A 366 commercial-quality, cold-rolled steel sheet with baked-on, rust-inhibitive primer.

2.03 ACCESS DOORS AND FRAMES

A. Flush Access Doors with Exposed Flanges:
1. Description: Face of door flush with frame, with exposed flange and concealed hinge.
2. Locations: Wall and ceiling.
3. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage, factory primed.
4. Frame Material: Same material, thickness, and finish as door.
5. Latch and Lock: Cam latch, key operated.

2.04 FABRICATION

A. General: Manufacture each access door assembly as an integral unit ready for installation.

B. Steel Access Doors and Frames: Continuous welded construction. Grind welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.

1. For gypsum board assemblies or gypsum veneer plaster, furnish frames with edge trim for gypsum board or gypsum base.
2. For installation in masonry construction, furnish frames with adjustable metal masonry anchors.

PART 3 - EXECUTION

3.01 PREPARATION

A. Advise Installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices. Furnish inserts and anchoring devices for access doors that must be built into other construction. Coordinate delivery with other work to avoid delay.

3.02 INSTALLATION

A. Comply with manufacturer's instructions for installing access doors.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finished surfaces.

C. Install concealed-frame access doors flush with adjacent finish surfaces.

3.03 ADJUST AND CLEAN

A. Adjust hardware and panels after installation for proper operation.

B. Remove and replace panels or frames that are warped, bowed, or otherwise damaged.

END OF SECTION

SECTION 083313

COILING COUNTER DOORS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Counter door assemblies.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of coiling counter door and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data.

1. Include points of attachment and their corresponding static and dynamic loads imposed on structure.
2. Show locations of controls, locking devices, detectors or replaceable fusible links, and other accessories.
3. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both installation and maintenance of units required for this Project.

PART 2 - PRODUCTS

2.1 COUNTER DOOR ASSEMBLY

A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Cookson Company.
   b. Cornell Iron Works, Inc.
   c. McKeon Rolling Steel Door Company, Inc.
   d. Overhead Door Corporation.
   e. Raynor.
   f. Or equal as approved by Professional.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000.

C. Door Curtain Material: Aluminum.

D. Door Curtain Slats: Flat profile slats of 1-1/4-inch center-to-center height.

1. Insulated-Slat Interior Facing: Metal.

E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated [**or**] aluminum extrusion and finished to match door .

F. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

G. Hood: Match curtain material and finish .

1. Mounting: Face of wall .

H. Sill Configuration: No sill .

I. Locking Devices: Equip door with locking device assembly .

1. Locking Device Assembly: Cremone-type, both jamb sides locking bars, operable from inside with thumbturn .

J. Electric Door Operator:

1. Usage Classification: Standard duty, up to 25 cycles per hour and up to 90 cycles per day.
2. Motor Exposure: Interior .
3. Motor Electrical Characteristics:
   a. Horsepower: 1 hp.
   b. Voltage:
      1) 208-V ac , three phase, 60 Hz.
4. Emergency Manual Operation: Push-up type.
5. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar .
6. Control Station(s): Interior-side mounted .

K. Door Finish:

1. Aluminum Finish: Anodized color as selected by Architect from full range of industry colors and color densities.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.2 MATERIALS, GENERAL

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.3 DOOR CURTAIN MATERIALS AND FABRICATION

A. Door Curtains: Fabricate coiling counter door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

2.4 HOODS

A. General: Form sheet metal hood to entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Form closed ends for surface-mounted hoods and fascia for any portion of between-jamb mounting that projects beyond wall face. Equip hood with intermediate support brackets as required to prevent sagging.

1. Include automatic drop baffle on fire-rated doors to guard against passage of smoke or flame.

2.5 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Keys: Three for each cylinder.

B. Safety Interlock Switch: Equip power-operated doors with safety interlock switch to disengage power supply when door is locked.

2.6 CURTAIN ACCESSORIES

A. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

2.7 COUNTERBALANCE MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 ELECTRIC DOOR OPERATORS

A. General: Electric door operator assembly of size and capacity recommended and provided by door manufacturer for door and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, control stations, control devices, integral gearing for locking door, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24-V ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each door.

C. Motors: Reversible-type motor with controller (disconnect switch) for motor exposure indicated for each door assembly.

1. Electrical Characteristics: Minimum as indicated for each door assembly. If not indicated, large enough to start, accelerate, and operate door in either direction from any position, at a speed not less than 8 in./sec. and not more than 12 in./sec., without exceeding nameplate ratings or service factor.
2. Operating Controls, Controllers, Disconnect Switches, Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

D. Obstruction-Detection Devices: External entrapment protection consisting of indicated automatic safety sensor capable of protecting full width of door opening. For non-fire-rated doors, activation of device immediately stops and reverses downward door travel.

1. Electric Sensor Edge: Automatic safety sensor edge, located within astragal mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable.
    a. Self-Monitoring Type: Four-wire-configured device designed to interface with door operator control circuit to detect damage to or disconnection of sensor edge.

E. Control Station: Three-button control station in fixed location with momentary-contact push-button controls labeled "Open" and "Stop" and sustained- or constant-pressure push-button control labeled "Close."

1. Type: Full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

F. Emergency Manual Operation: Equip each electrically powered door with capability for emergency manual operation. Design manual mechanism so required force for door operation does not exceed 25 lbf.

G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Client Agencies maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

SECTION 083326

OVERHEAD COILING GRILLES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes open-curtain overhead coiling grilles.

B. Related Section:

1. Section 055000 "Metal Fabrications" for miscellaneous steel supports.

1.3 ACTION SUBMITTALS

A. Product Data: For each type and size of overhead coiling grille and accessory.

B. Shop Drawings: For each installation and for special components not dimensioned or detailed in manufacturer's product data. Include plans, elevations, sections, details, and attachments to other work.

1. Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Wiring Diagrams: For power, signal, and control wiring.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For overhead coiling grilles**,** accessories, and components, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 GRILLE CURTAIN MATERIALS AND CONSTRUCTION

A. Open-Curtain Grilles: Fabricate metal grille curtain as an open network of horizontal rods, spaced at regular intervals, that are interconnected with vertical links, which are formed and spaced as indicated and are free to rotate on the rods.

B. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, finished to match grille.

1. Astragal: Equip each grille bottom bar with a replaceable, adjustable, continuous, compressible gasket of flexible vinyl, rubber, or neoprene as a cushion bumper.
2. Provide motor-operated grilles with combination bottom astragal and sensor edge.

C. Grille Curtain Jamb Guides: Manufacturer's standard shape having curtain groove with return lips or bars to retain curtain. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise; with removable stops on guides to prevent overtravel of curtain.

1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.2 HOODS AND ACCESSORIES

A. Mounting Frame: Manufacturer's standard mounting frame designed to support grille; factory fabricated from ASTM A 36/A 36M structural-steel tubes, hot-dip galvanized per ASTM A 123/A 123M; fastened to floor and structure above grille; to be built into wall construction; and complete with anchors, connections, and fasteners.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated grille with lifting handles on each side of grille, finished to match grille. Provide pull-down straps or pole hooks for grilles more than 84 inches (2130 mm) high.

2.3 LOCKING DEVICES

A. Locking Device Assembly: Fabricate with cylinder lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bars to engage through slots in tracks.

1. Lock Cylinders: Provide cylinders standard with manufacturer and keyed to building keying system.
2. Keys: Three for each cylinder.

B. Safety Interlock Switch: Equip power-operated grilles with safety interlock switch to disengage power supply when grille is locked.

2.4 COUNTERBALANCING MECHANISM

A. General: Counterbalance grilles by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.5 ELECTRIC GRILLE OPERATORS

A. General: Electric grille operator assembly of size and capacity recommended and provided by grille manufacturer for grille and operation-cycles requirement specified, with electric motor and factory-prewired motor controls, starter, gear-reduction unit, solenoid-operated brake, clutch, remote-control stations, control devices, integral gearing for locking grille, and accessories required for proper operation.

1. Comply with NFPA 70.
2. Provide control equipment complying with NEMA ICS 1, NEMA ICS 2, and NEMA ICS 6, with NFPA 70 Class 2 control circuit, maximum 24 V, ac or dc.

B. Usage Classification: Electric operator and components capable of operating for not less than number of cycles per hour indicated for each grille.

C. Electric Motors: Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 110513 "Common Motor Requirements for Equipment" unless otherwise indicated.

1. Electrical Characteristics:

    a. Phase: Single phase.
    b. Volts: 208 V.
    c. Hertz: 60.

2. Motor Type and Controller: Reversible motor and controller (disconnect switch) for motor exposure indicated.
3. Motor Size: Minimum size as indicated. If not indicated, large enough to start, accelerate, and operate grille in either direction from any position, at a speed not less than 8 in./sec. (203 mm/s) and not more than 12 in./sec. (305 mm/s), without exceeding nameplate ratings or service factor.
4. Operating Controls, Controllers (Disconnect Switches), Wiring Devices, and Wiring: Manufacturer's standard unless otherwise indicated.

D. Obstruction Detection Device: Equip motorized grille with indicated external automatic safety sensor capable of protecting full width of grille opening. Activation of sensor immediately stops and reverses downward grille travel.

1. Sensor Edge: Automatic safety sensor edge, located within astragal or weather stripping mounted to bottom bar. Contact with sensor activates device. Connect to control circuit using manufacturer's standard take-up reel or self-coiling cable. Provide self-monitoring

capability designed to interface with grille operator control circuit to detect damage to or disconnection of sensing device.

E. Remote-Control Station: Momentary-contact, three-button control station with push-button controls labeled "Open," "Close," and "Stop"; interior units, full-guarded, surface-mounted, heavy-duty type, with general-purpose NEMA ICS 6, Type 1 enclosure.

F. Emergency Manual Operation: Equip each electrically powered grille with capability for emergency manual operation. Design manual mechanism so required force for grille operation does not exceed **25 lbf (111 N)**.

G. Emergency Operation Disconnect Device: Equip operator with hand-operated disconnect mechanism for automatically engaging manual operator and releasing brake for emergency manual operation while disconnecting motor without affecting timing of limit switch. Mount mechanism so it is accessible from floor level. Include interlock device to automatically prevent motor from operating when emergency operator is engaged.

H. Motor Removal: Design operator so motor may be removed without disturbing limit-switch adjustment and without affecting emergency manual operation.

I. Audible and Visual Signals: Audible alarm and visual indicator lights in compliance with regulatory requirements for accessibility.

2.6 OPEN-CURTAIN GRILLE ASSEMBLY

A. Open-Curtain Grille: Overhead coiling grille with a curtain having a network of horizontal rods that interconnect with vertical links.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Cookson Company.
b. Cornell Iron Works, Inc.
c. McKeon Rolling Steel Door Company, Inc.
d. Overhead Door Corporation.
e. Raynor.
f. Or equal as approved by Professional.

B. Operation Cycles: Not less than 20,000.

C. Grille Curtain Material: Aluminum.

1. Space rods at approximately **1-1/2 inches (38 mm)** o.c.
2. Space links approximately 3 inches (76 mm) apart in a straight in-line pattern.
3. Spacers: Metal tubes matching curtain material.

D. Curtain Jamb Guides: Aluminum with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

E. Locking Devices: Equip grille with locking device assembly.

1. Locking Device Assembly: outside with cylinder.

F. Electric Grille Operator:

1. Usage Classification: Standard duty, up to 60 cycles per hour.
2. Emergency Manual Operation: Push-up type.
3. Obstruction-Detection Device: Automatic electric sensor edge on bottom bar; self-monitoring type.
4. Remote-Control Station: Where shown on Drawings.
5. Other Equipment: Audible and visual signals.

G. Grille Finish:

1. Aluminum Finish: Mill.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install overhead coiling grilles and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Adjust hardware and moving parts to function smoothly so that grilles operate easily, free of warp, twist, or distortion. Lubricate bearings and sliding parts as recommended by manufacturer.

3.2 DEMONSTRATION

A. Engage a factory-authorized service representative to train Client Agencies maintenance personnel to adjust, operate, and maintain overhead coiling grilles.

END OF SECTION 083326

SECTION 084113

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Exterior manual-swing entrance doors and door frame units.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Aluminum-framed systems shall withstand the effects of the following performance requirements without exceeding performance criteria or failure due to defective manufacture, fabrication, installation, or other defects in construction:

1. Movements of supporting structure indicated on Drawings including, but not limited to, story drift and deflection from uniformly distributed and concentrated live loads.
2. Dimensional tolerances of building frame and other adjacent construction.
3. Failure includes the following:

a. Deflection exceeding specified limits.
b. Thermal stresses transferring to building structure.
c. Framing members transferring stresses, including those caused by thermal and structural movements to glazing.
d. Noise or vibration created by wind and by thermal and structural movements.
e. Loosening or weakening of fasteners, attachments, and other components.
f. Failure of operating units.

B. Delegated Design: Design aluminum-framed systems, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind Loads: As indicated on Drawings.

D. Deflection of Framing Members:

1. Deflection Normal to Wall Plane: Limited to edge of glass in a direction perpendicular to glass plane shall not exceed L/175 of the glass edge length for each individual glazing lite.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.

E. Structural-Test Performance: Provide aluminum-framed systems tested according to ASTM E 330 as follows:

1. When tested at **150** percent of positive and negative wind-load design pressures, systems, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding [**0.2**] <**Insert number**> percent of span.
2. Test Durations: **10** seconds.

F. Air Infiltration: Provide aluminum-framed systems with maximum air leakage through fixed glazing and framing areas of **0.06 cfm/sq. ft. (0.03 L/s per sq. m)** of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of **6.24 lbf/sq. ft. (300 Pa**.

G. Water Penetration under Static Pressure: Provide aluminum-framed systems that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than **6.24 lbf/sq. ft. (300 Pa)**.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For aluminum-framed systems. Include plans, elevations, sections, details, and attachments to other work.

1. Include details of provisions for system expansion and contraction and for drainage of moisture in the system to the exterior.

C. Samples: For each type of exposed finish required.

D. Other Action Submittals:

1. Entrance Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.

E. Delegated-Design Submittal: For aluminum-framed systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Field quality-control reports.

C. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Engineering Responsibility: Prepare data for aluminum-framed systems, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in systems similar to those indicated for this Project.

D. Product Options: Information on Drawings and in Specifications establishes requirements for systems' aesthetic effects and performance characteristics. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction. Performance characteristics are indicated by criteria subject to verification by one or more methods including preconstruction testing, field testing, and in-service performance.

E. Accessible Entrances: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.

F. Source Limitations for Aluminum-Framed Systems: Obtain from single source from single manufacturer.

G. Preinstallation Conference: Conduct conference at [**Project site**] <**Insert location**>.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of aluminum-framed systems that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components on which finishes do not comply with requirements or that fail in materials or workmanship within specified warranty period. Warranty does not include normal weathering.

1. Warranty Period: 20> years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide systems as manufactured by one of the following:

1. EFCO Corporation.
2. Kawneer North America; an Alcoa company.
3. Oldcastle Building Systems.

4. YKK AP America Inc.
5. Or equal as approved by Professional.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209.
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: Manufacturer's standard zinc-rich, corrosion-resistant primer, complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.
4. Finish: Color anodic finish.
5. Fabrication Method: Field-fabricated stick system.

B. Backer Plates: Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

2.4 GLAZING SYSTEMS

A. Glazing: As specified in Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, molded or extruded, of profile and hardness required to maintain watertight seal.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.5 ENTRANCE DOOR SYSTEMS

A. Entrance Doors: Manufacturer's standard glazed entrance doors for manual-swing operation.

1. Door Construction: **1-3/4-inch** overall thickness, with minimum **0.125-inch- (3.2-mm-)** thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.

a. Thermal Construction: High-performance plastic connectors separate aluminum members exposed to the exterior from members exposed to the interior.

2. Door Design: Wide stile; 5-inch nominal width.

a. Accessible Doors: Smooth surfaced for width of door in area within 10 inches above floor or ground plane.

3. Glazing Stops and Gaskets: Beveled, snap-on, extruded-aluminum stops and preformed gaskets.

a. Provide nonremovable glazing stops on outside of door.

B. Entrance Door Hardware: As specified in Section 087100 "Door Hardware."

2.6 ENTRANCE DOOR HARDWARE

A. General: Provide entrance door hardware and entrance door hardware sets indicated in door and frame schedule for each entrance door to comply with requirements of Section 080671.

2.7 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied, asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos; formulated for 30-mil (0.762-mm) thickness per coat.

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

D. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

E. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Dark Bronze.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or applying sealant or tape, or by installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within the system to exterior.

D. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

E. Install components plumb and true in alignment with established lines and grades, and without warp or rack.

F. Install glazing as specified in Section 088000 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.2 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed systems with specified requirements shall take place as follows. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

a. Test Area: A minimum area of 10 feet by 1 story of aluminum-framed systems.

C. Repair or remove work if test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

E. Aluminum-framed assemblies will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports.

3.3 ENTRANCE DOOR HARDWARE SETS

See Section 080671

END OF SECTION 084113

SECTION 084413

GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes conventionally glazed aluminum curtain walls installed as stick assemblies.

1.3 PERFORMANCE REQUIREMENTS

A. General Performance: Comply with performance requirements specified, as determined by testing of manufacturer's standard glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:

a. Thermal stresses transferring to building structure.
b. Glass breakage.
c. Noise or vibration created by wind and thermal and structural movements.
d. Loosening or weakening of fasteners, attachments, and other components.
e. Failure of operating units.

B. Delegated Design: Design glazed aluminum curtain walls, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

C. Wind Loads: As indicated on Drawings..

D. Structural-Test Performance: Test according to ASTM E 330 as follows:

1. When tested at **150** percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main framing members exceeding **0.2** percent of span.
2. Test Durations: **10** seconds.

E. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to L/360 of clear span or 1/8 inch (3.2 mm), whichever is smaller.
3. Cantilever Deflection: Where framing members overhang an anchor point, limit deflection to two times the length of cantilevered member, divided by 175.

F. Water Penetration under Static Pressure: No evidence of water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than **15 lbf/sq. ft. (720 Pa)**.

G. Energy Performance: Glazed aluminum curtain wall shall have certified and labeled energy performance ratings in accordance with NFRC.

H. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than **0.38 Btu/sq. ft. x h x deg F** as determined according to NFRC 100.

1. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than **0.35** as determined according to NFRC 200.
2. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of **0.30 cfm/sq. ft.** of fixed wall area as determined according to ASTM E 283 at a minimum static-air-pressure differential of **6.24 lbf/sq. ft.**.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:

a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.

C. Samples: For each type of exposed finish required.

D. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Energy Performance Certificates: For glazed aluminum curtain walls, accessories, and components, from manufacturer.

1. Basis for Certification: NFRC-certified energy performance values for each glazed aluminum curtain wall.

C. Product test reports.

D. Field quality-control reports.

E. Warranties: Sample of special warranties.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.

B. Testing Agency Qualifications: Qualified according to ASTM E 699 for testing indicated.

C. Product Options: Information on Drawings and in Specifications establishes requirements for aesthetic effects and performance characteristics of assemblies. Aesthetic effects are indicated by dimensions, arrangements, alignment, and profiles of components and assemblies as they relate to sightlines, to one another, and to adjoining construction.

D. Energy Performance Standards: Comply with NFRC for minimum standards of energy performance, materials, components, accessories, and fabrication. Comply with more stringent requirements if indicated.

1. Provide NFRC-certified glazed aluminum curtain walls with an attached label.

1.8 WARRANTY

A. Special Assembly Warranty: Standard form in which Installer agrees to repair or replace components of glazed aluminum curtain walls that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Warranty Period: 20 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide systems as manufactured by one of the following:

1. EFCO Corporation.
2. Kawneer North America; an Alcoa company.
3. Oldcastle Building Systems
4. YKK AP America Inc.
5. Or equal as approved by Professional.

2.2 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.

1. Sheet and Plate: ASTM B 209 (ASTM B 209M).
2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221 (ASTM B 221M).
3. Extruded Structural Pipe and Tubes: ASTM B 429.
4. Structural Profiles: ASTM B 308/B 308M.
5. Welding Rods and Bare Electrodes: AWS A5.10/A5.10M.

B. Steel Reinforcement: With manufacturer's standard zinc-rich, corrosion-resistant primer complying with SSPC-PS Guide No. 12.00; applied immediately after surface preparation and pretreatment. Select surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

1. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
3. Hot-Rolled Sheet and Strip: ASTM A 1011/A 1011M.

2.3 FRAMING

A. Framing Members: Manufacturer's standard extruded- or formed-aluminum framing members of thickness required and steel reinforced as required to support imposed loads.

1. Construction: Thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Front.

B. Structural Sealant Glazed Curtainwall Components: Two Side SSG – framing shall be thermally improved. Intermediate horizontal mullions shall be structural silicone glazed with no exposed exterior aluminum. Vertical members and jambs shall have a nominal face dimension of 2-1/2”. See elevations.

C. Brackets and Reinforcements: Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

D. Fasteners and Accessories: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.
2. Reinforce members as required to receive fastener threads.
3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system , fabricated from 300 series stainless steel.

E. Anchors: Three-way adjustable anchors with minimum adjustment of **1 inch** that accommodate fabrication and installation tolerances in material and finish compatible with adjoining materials and recommended by manufacturer.

1. Concrete and Masonry Inserts: Hot-dip galvanized cast-iron, malleable-iron, or steel inserts complying with ASTM A 123/A 123M or ASTM A 153/A 153M requirements.

F. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

G. Framing Sealants: Manufacturer's standard sealants.

2.4 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers.

C. Glazing Sealants: As recommended by manufacturer.

1. Sealants used inside the weatherproofing system shall have a VOC content of **250** g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.5 SHADOW BOX PANELS

A. Aluminum wrapped insulation panels installed in curtainwall framing behind transparent glass.
1. Panel Material: 0.125: Thick aluminum sheet.
2. Insulation: 2-inch extruded polystyrene.
3. Fasteners: Aluminum, nonmagnetic stainless steel or other materials must be non-corrosive and compatible with aluminum members, trim hardware, anchors, and other components.
4. Sealant: For sealants required within system, provide permanently elastic, non-shrinking, and non-migrating type recommended by sealant manufacturer for joint size and movement.
5. Fabrication: Fabricate components that, when assembled, have the following characteristics:
    a. Fabricate aluminum shapes before finishing.
    b. Profiles that are sharp, straight, and free of defects or deformations.
    c. Accurately fitted joints.
    d. Fasteners, anchors, and connection devices that are concealed from view to the greatest extent possible.
    e. Provide drainage of condensation to exterior.
6. Finishes
    a. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.

b. High-Performance Organic Finish: Three-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

2.6 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.7 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.
2. Accurately fitted joints with ends coped or mitered.
3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from exterior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Fabricate components that, when assembled, have the following characteristics:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Factory-Assembled Frame Units:

1. Rigidly secure nonmovement joints.
2. Seal joints watertight unless otherwise indicated.
3. Install glazing to comply with requirements in Section 088000 "Glazing."

F. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.8 ALUMINUM FINISHES

A. Color Anodic Finish: AAMA 611, AA-M12C22A42/A44, Class I, 0.018 mm or thicker.

1. Color: Dark Bronze.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape or installing nonconductive spacers as recommended by manufacturer for this purpose.
2. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

D. Install components plumb and true in alignment with established lines and grades.

E. Install glazing as specified in Section 088000 "Glazing."

F. Shadow Box Installation.

1. Install shadow box panels plumb, level, and true to line, within manufacturer’s prescribed tolerances, and complying with installation instructions.
2. Provide support and anchor in place.
3. Provide separation of aluminum materials from sources of corrosion or electrolytic action contact points.

3.2 ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6 mm in 12 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6 mm in 12 m).
3. Alignment:

a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.7 m); 1/2 inch (12.7 mm) over total length.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of representative areas of glazed aluminum curtain walls shall take place as installation proceeds to determine compliance of installed assemblies with specified requirements.

1. Air Infiltration: Areas shall be tested for air leakage of 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article, but not more than 0.50 cfm/sq. ft. (2.25 L/s per sq. m), of fixed wall area when tested according to ASTM E 783 at a minimum static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).

   a. Test Area: One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall.
   b. Perform a minimum of **two** tests in areas as directed by Architect.

2. Water Penetration: Areas shall be tested according to ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 6.24 lbf/sq. ft. (300 Pa), and shall not evidence water penetration.

   a. Test Area: One bay wide, but not less than 30 feet (9.1 m), by one story of glazed aluminum curtain wall.
   b. Perform a minimum of **two** tests in areas as directed by Architect.

3. Water Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to AAMA 501.2 and shall not evidence water penetration.

   a. Test Area: A minimum area of 75 feet (23 m) by one story of glazed aluminum curtain wall.

C. Glazed aluminum curtain walls will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

END OF SECTION 084413

SECTION 087100

DOOR HARDWARE

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.3 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware.
3. Automatic operators.
4. Cylinders specified for doors in other sections.

C. Codes and References: Comply with the version adopted by the Authority Having Jurisdiction.

1. ANSI A117.1 - Accessible and Usable Buildings and Facilities.
2. ICC/IBC - International Building Code.
3. NFPA 70 - National Electrical Code.
4. NFPA 80 - Fire Doors and Windows.
5. NFPA 101 - Life Safety Code.
6. NFPA 105 - Installation of Smoke Door Assemblies.
7. UL/ULC and CSA C22.2 - Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
8. State Building Codes, Local Amendments.

D. Standards: All hardware specified herein shall comply with the following industry standards as applicable. Any undated reference to a standard shall be interpreted as referring to the latest edition of that standard:

1. ANSI/BHMA Certified Product Standards - A156 Series.

2. UL10C - Positive Pressure Fire Tests of Door Assemblies.
3. ANSI/UL 294 - Access Control System Units.
4. UL 305 - Panic Hardware.
5. ANSI/UL 437- Key Locks.

1.4 SUBMITTALS

A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.

B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing, fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will be rejected and subject to resubmission.
3. Content: Include the following information:

    a. Type, style, function, size, label, hand, and finish of each door hardware item.
    b. Manufacturer of each item.
    c. Fastenings and other pertinent information.
    d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
    e. Explanation of abbreviations, symbols, and codes contained in schedule.
    f. Mounting locations for door hardware.
    g. Door and frame sizes and materials.
    h. Warranty information for each product.

4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.

C. Shop Drawings: Details of electrified access control hardware indicating the following:

1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:

    a. Elevation diagram of each unique access controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
    b. Complete (risers, point-to-point) access control system block wiring diagrams.

c. Wiring instructions for each electronic component scheduled herein.

2. Electrical Coordination: Coordinate with related sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Keying Schedule: After a keying meeting with the Client Agency has taken place prepare a separate keying schedule detailing final instructions. Submit the keying schedule in electronic format. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Client Agency must approve submitted keying schedule prior to the ordering of permanent cylinders/cores.

E. Informational Submittals:

1. Product Test Reports: Indicating compliance with cycle testing requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified independent testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Procedures.

B. Project Record Documents: Provide record documentation of as-built door hardware sets in digital format (.pdf, .docx, .xlsx, .csv) and as required in Division 01, Project Record Documents.

1.6 QUALITY ASSURANCE

A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.

B. Certified Products: Where specified, products must maintain a current listing in the Builders Hardware Manufacturers Association (BHMA) Certified Products Directory (CPD).

C. Installer Qualifications: A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.

D. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Client Agency concerning both standard and electromechanical door hardware and keying.

E. Source Limitations: Obtain each type and variety of door hardware specified in this section from a single source unless otherwise indicated.

1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.

F. Each unit to bear third party permanent label indicating compliance with the referenced testing standards.

G. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control storage and software.
4. Installation of permanent keys, cylinder cores and software.
5. Address and requirements for delivery of keys.

H. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.

1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.
2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
3. Review sequence of operation narratives for each unique access controlled opening.
4. Review and finalize construction schedule and verify availability of materials.
5. Review the required inspecting, testing, commissioning, and demonstration procedures

I. At completion of installation, provide written documentation that components were applied according to manufacturer's instructions and recommendations and according to approved schedule.

1.7 DELIVERY, STORAGE AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Client Agency via registered mail or overnight package service. Instructions for delivery to the Client Agency shall be established at the "Keying Conference".

1.8 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.9 WARRANTY

A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Client Agency of other rights Client Agency may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or workmanship within specified warranty period after final acceptance by the Client Agency. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
2. Faulty operation of the hardware.
3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
4. Electrical component defects and failures within the systems operation.

C. Warranty Period: Unless otherwise indicated, warranty shall be one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Hardware shall not have any visible manufacturer names on exposed materials, except cylinders, when the door is in a closed position.

2.2 BUTT HINGES

A. Hinges: ANSI/BHMA A156.1 butt hinges with number of hinge knuckles and other options as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity:

a. Two Hinges: For doors with heights up to 60 inches.

b. Three Hinges: For doors with heights 61 to 90 inches.
c. Four Hinges: For doors with heights 91 to 120 inches.
d. For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.

2. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:

a. Widths up to 3'0": 4-1/2" standard or heavy weight as specified.
b. Sizes from 3'1" to 4'0": 5" standard or heavy weight as specified.

3. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:

a. Exterior Doors: Heavy weight, non-ferrous, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate standard weight.
b. Interior Doors: Standard weight, steel, ball bearing or oil impregnated bearing hinges unless Hardware Sets indicate heavy weight.

4. Hinge Options: Comply with the following:

a. Non-removable Pins: With the exception of electric through wire hinges, provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for all out-swinging lockable doors.

5. Manufacturers:

a. Hager Companies (HA) - BB Series, 5-knuckle.
b. Ives (IV) - 5BB Series, 5-knuckle.
c. McKinney (MK) - TA/T4A Series, 5-knuckle.
d. Best / Dormakaba (BE)
e. Or equal as approved by Professional.

2.3 CONTINUOUS HINGES

A. Continuous Geared Hinges: ANSI/BHMA A156.26 Grade 1-600 continuous geared hinge. with minimum 0.120-inch thick extruded 6063-T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Factory trim hinges to suit door height and prepare for electrical cut-outs.

1. Manufacturers:.

a. Hager Companies (HA).
b. Ives (IV).
c. Pemko (PE).
d. Best / Dormakaba (BE).
e. Or equal as approved by Professional.

2.4 POWER TRANSFER DEVICES

A. Electrified Quick Connect Transfer Hinges: Provide electrified transfer hinges with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to

accommodate the electrified functions specified in the Door Hardware Sets with a 1-year warranty. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Hager Companies (HA) - ETW-QC (# wires) Option.
    b. Ives (IV) - Connect.
    c. McKinney (MK) - QC (# wires) Option.
    d. Best / Dormakaba (BE)
    e. Or equal as approved by Professional.

B. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

1. Manufacturers:

    a. Pemko (PE) - EL-CEPT Series.
    b. Securitron (SU) - EL-CEPT Series.
    c. Von Duprin (VD) - EPT-10 Series.
    d. Best / Dormakaba (BE) – EPT-12C.
    e. Or equal as approved by Professional.

C. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to twelve (12) wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

1. Provide one each of the following tools as part of the base bid contract:

    a. McKinney (MK) - Electrical Connecting Kit: QC-R001.
    b. McKinney (MK) - Connector Hand Tool: QC-R003.

2. Manufacturers:

    a. Hager Companies (HA) - Quick Connect.
    b. McKinney (MK) - QC-C Series.
    c. Schlage (SC) - Connect.
    d. Best / Dormakaba (BE) WH Series.
    e. Or equal as approved by Professional.

2.5 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: Provide products conforming to ANSI/BHMA A156.3 and A156.16, Grade 1.

1. Flush bolts to be furnished with top rod of sufficient length to allow bolt retraction device location approximately six feet from the floor.
2. Furnish dust proof strikes for bottom bolts.
3. Surface bolts to be minimum 8” in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable.
4. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
5. Manufacturers:

    a. Ives (IV).
    b. Rockwood (RO).
    c. Trimco (TC).
    d. ABH (AB)
    e. Or equal as approved by Professional.

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 door pushes and pull units of type and design specified in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Pulls shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
5. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets. When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.
6. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Ives (IV).
    c. Rockwood (RO).
    d. ABH (AB).
    e. Or equal as approved by Professional.

2.6 CYLINDERS AND KEYING

A. General: All cylinders and cores to be manufactured by Best.

1. All cylinders and cores to be keyed into the Client Agency’s existing Best key system.

B. Cylinder Types: Original manufacturer cylinders able to supply the following cylinder formats and types:

1. Threaded mortise cylinders with rings and cams to suit hardware application.
2. Rim cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored or cylindrical lock cylinders with tailpieces as required to suit locks.
4. Tubular deadlocks and other auxiliary locks.
5. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
6. Keyway: Match Facility Standard.

C. Small Format Interchangeable Cores: Provide small format interchangeable cores (SFIC) as specified, core insert, removable by use of a special key; usable with other manufacturers' cylinders.

D. Keying System: Each type of lock and cylinders to be factory keyed.

1. Supplier shall coordinate a "Keying Conference" to define and document keying system instructions and requirements.
2. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Client Agency.
3. Existing System: Field verify and key cylinders to match Client Agencies existing system.

E. Key Quantity: Provide the following minimum number of keys:

1. Change Keys per Cylinder: Three (3).
2. Master Keys (per Master Key Level/Group): Five (5).
3. Construction Keys (where required): Ten (10).
4. Construction Control Keys (where required): Two (2).
5. Permanent Control Keys (where required): Two (2).

F. Construction Keying: Provide temporary keyed construction cores.

G. Key Registration List (Bitting List):

1. Provide keying transcript list to Client Agencies representative in the proper format for importing into key control software.
2. Provide transcript list in writing or electronic file as directed by the Client Agency.

H. Proprietary Cores:

1. Utilize Best Lock Core J1 core system consistent with existing lock coring system. This only applies to the lockset cores. Non-proprietary locksets need to be compatible with cores but are not proprietary.

    a. The above item has been approved by the Department as a Proprietary item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

2.7 MORTISE LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): Provide ANSI/BHMA A156.13, Series 1000, Operational Grade 1 Certified Products Directory (CPD) listed mortise locksets. Listed manufacturers shall meet all functions and features as specified herein.

1. Manufacturers:

    a. ASSA ABLOY ACCENTRA (YA) - 8800FL Series.
    b. Corbin Russwin Hardware (RU) - ML2000 Series.
    c. Dormakaba BEST (BE) - 45H Series.
    d. Schlage (SC) – L9000 Series.
    e. Or equal as approved by Professional.

2. Locksets shall be compatible with proprietary cores listed above.

2.8 DEADLOCKS AND LATCHES

A. Mortise Deadlocks, Small Case: ANSI/BHMA A156.36, Grade 1, small case mortise type deadlocks constructed of heavy gauge wrought corrosion resistant steel. Steel or stainless steel bolts with a 1" throw and hardened steel roller pins. Deadlocks to be products of the same source manufacturer and keyway as other specified locksets.

1. Manufacturers:

    a. Dormakaba BEST (BE) - 48H Series.
    b. Corbin Russwin Hardware (RU) - DL4000 Series.
    c. Sargent Manufacturing (SA) - 4870 Series.
    d. Schlage (SC) – L400 Series.
    e. Or equal as approved by Professional.

B. Narrow Case Deadlocks and Deadlatches: ANSI/BHMA 156.13 Series 1000 Grade 1 narrow case deadlocks and deadlatches for swinging or sliding door applications. All functions shall be manufactured in a single sized case formed from 12 gauge minimum, corrosion resistant steel (option for fully stainless steel case and components). Provide minimum 2 7/8" throw laminated stainless steel bolt. Bottom rail deadlocks to have 3/8” diameter bolts.

1. Manufacturers:

    a. Adams Rite Manufacturing (AD) - MS1850S / MS1950 Series.
    b. Or equal as approved by Professional.

2.9 LOCK AND LATCH STRIKES

A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
4. Double-lipped strikes: For locks at double acting doors. Furnish with retractable stop for rescue hardware applications.

B. Standards: Comply with the following:

1. Strikes for Mortise Locks and Latches: BHMA A156.13.
2. Strikes for Bored Locks and Latches: BHMA A156.2.
3. Strikes for Auxiliary Deadlocks: BHMA A156.36.
4. Dustproof Strikes: BHMA A156.16.

2.10 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. Exit devices shall have a five-year warranty.
2. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
3. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer’s catalog and template book for specific requirements.
4. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
5. Devices must fit flat against the door face with no gap that permits unauthorized dogging of the push bar. The addition of filler strips is required in any case where the door light extends behind the device as in a full glass configuration.
6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.

    a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
    b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.

7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2” wide stiles.
9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.

B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 Certified Products Directory (CPD) listed exit devices. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide exit devices with functions and features as follows:

    a. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
    b. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.

c. No catch points: addition of applied deflectors or other added components are not allowed.
d. No visible plastic.
e. Heavy duty end caps with flush and overlapping options made of stainless steel, brass, or bronze with architectural finishes.
f. Constructed of all stainless steel.
g. Stainless steel pullman type latch with deadlock feature.
h. Narrow or wide style exterior trim as specified in the hardware sets.
i. Center case adjustability on concealed vertical rod exit devices; single operation with hex key individually adjusts top or bottom latches. No retainer screws or clips required to maintain adjustment.
j. Ten-year limited warranty for mechanical features.

2. Manufacturers:

a. Corbin Russwin Hardware (RU) - PED4000 / PED5000 Series.
b. Sargent Manufacturing (SA) - PE80 Series.
c. Von Duprin (VD) - 35A/98 XP Series.
d. Best / Dormakaba (BE) – Apex 2000 Series.
e. Or equal as approved by Professional.

2.11 SURFACE DOOR CLOSERS

A. All door closers specified herein shall meet or exceed the following criteria:

1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers.
2. Standards: Closers to comply with UL-10C for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the Americans with Disabilities Act, provide units complying with ANSI ICC/A117.1.
4. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
5. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates as required for proper installation. Provide through-bolt and security type fasteners as specified in the hardware sets.

B. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 Certified Products Directory (CPD) listed surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.

1. Heavy duty surface mounted door closers shall have a 30-year warranty.

2. Manufacturers:

a. ASSA ABLOY ACCENTRA (YA) - 4400 Series.
b. Corbin Russwin Hardware (RU) - DC6000 Series.
c. Sargent Manufacturing (SA) - 351 Series.
d. Best / Dormakaba – HD8000 Series.
e. LCN (LC) – 4050 Series.
f. Or equal as approved by Professional.

2.12 OVERHEAD CONCEALED DOOR CLOSERS

A. Door Closers, Overhead Concealed Double Acting (Heavy Duty): Center pivot, double acting ANSI/BHMA 156.4 Grade 1 Certified Products Directory (CPD) listed overhead concealed door closers. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide overhead concealed doors closers with functions and features as follows:

a. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies and A117.1 Accessibility Code.
b. Cast iron body construction with 1-1/4" dual pistons.
c. Fully concealed body in the frame head and track assembly in the door.
d. Adjustable spring strength, hydraulic back check, and two closing speed adjustments for sweep and latch.
e. Fifteen-year limited warranty.

2. Manufacturers:

a. dormakaba (DO) - RTS88 Series.
b. LCN Closers (LC) - 6030 Series.
c. Norton Rixson (NO) - 73 Series.
d. Or equal as approved by Professional.

2.13 ELECTROMECHANICAL DOOR OPERATORS

A. Electromechanical Door Operators (High Traffic): Provide ANSI/BHMA A156.19 Certified Products Directory (CPD) listed low energy operators that are UL325/991 and UL10C certified and comply with requirements for the Americans with Disabilities Act (ADA). Operators shall accommodate openings up to 250 pounds and 48” wide. Provide accessories such as custom templates, special mounting brackets, spacers and drop plates as needed for proper installation. Operators shall accommodate openings up to 200 pounds and 48” wide. Listed manufacturers shall meet all functions and features as specified herein.

1. Provide operators with features as follows:

a. Non-handed with push and pull side mounting.
b. Activation by push button, hands-free or radio frequency devices.
c. Adjustable opening force and closing power.
d. Two-year limited warranty.
e. Wi-Fi interface where the operator is a secure, password protected WiFi hot spot with no connection to building’s IT required.
    1) Simple setup with no app required.
    2) View status and make adjustments without removing the cover.

3) Built-in logic to support single use restroom applications with no external relay boards, logic modules, position switches required.

f. Mounting backplate to simplify and speed up installation.

g. Integration with access control systems.

2. Operators shall have the following functionality:

a. Adjustable Hold Open: Amount of time a door will stay in the full open position after an activation.

b. Blow Open for Smoke Ventilation: Door opens when signal is received from alarm system allowing air or smoke to flow through opening. Door will stay open until signal from alarm system is stopped.

c. Emergency Interface Relay: Door closes and ignores any activation input until signal is discontinued.

d. Infinite Hold Open: Door will hold open at set position until power is turned off.

e. Latch Assist: At closed position, after an activation, the door is pulled in. After the door has closed, the door is pulled in to assist with latch release/engagement.

f. Obstruction Detection: Door closes if it hits an obstruction while opening; door will reverse to open position if it hits an obstruction while closing. Door will stop once it hits an obstruction and will rest against the obstruction until removed.

g. Open Delay: Delays operator opening for locking hardware.

h. Outside Wall Switch Disable: When contact is closed, outside wall switch is disabled.

i. Power Assist: Senses the door is being opened manually and applies small amount of power to assist the user in opening the door with force less than 5 lbs. The door opens only as far as it is moved manually, then closes once released.

j. Power Close: Additional force to assist door closing between 7° and 2°.

k. Presence Detector Input: Input for external sensor to detect presence at door open or close position only.

l. Push & Go: As the door is manually opened, the operator "senses" movement and opens door to the full-open position.

m. Selector Mode Switch: Off disables the signal inputs unless Blow Open is activated, on activates the signal inputs, hold open activates the unit (unless Blow Closed is activated) to the hold open position.

n. Vestibule Delay: When the wall switch is pressed, first door in vestibule will open. Second door will open once vestibule door delay has expired. Delay is adjustable.

o. Executive Mode Feature: When the door receives an activation signal it opens and remains open until either a second signal is received, or the door is manually moved in closing direction.

3. Manufacturers:

a. ASSA ABLOY Entrance Systems (BE) - SW200 Series.

b. Horton Automatics (HO) - S4100LE Series.

c. Norton Rixson (NO) - 6300 Series.

d. Or equal as approved by Professional.

2.14 DOOR STOPS AND HOLDERS

A. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will

impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.

1. Manufacturers:

    a. Hiawatha, Inc. (HI).
    b. Ives (IV).
    c. Rockwood (RO).
    d. ABH (AB).
    e. Or equal as approved by Professional.

B. Overhead Door Stops and Holders: ANSI/BHMA A156.8, Grade 1 Certified Products Directory (CPD) listed overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.

1. Manufacturers:

    a. Norton Rixson (NO).
    b. Rockwood (RO).
    c. Sargent Manufacturing (SA).
    d. Dorma (DO).
    e. ABH (AB).
    f. Or equal as approved by Professional.

2.15 ARCHITECTURAL SEALS

A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.

B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.

1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.

1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and NFPA 252, Standard Methods of Fire Tests of Door Assemblies.

D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated.

E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.

F. Manufacturers:

1. National Guard Products (NG).
2. Pemko (PE).
3. Reese Enterprises, Inc. (RE).
4. Or equal as approved by Professional.

2.16 ELECTRONIC ACCESSORIES

A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1" diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.

1. Manufacturers:

a. Alarm Controls (AK) - CP1-1026 Series.
b. Sargent Manufacturing (SA) - 3280 Series.
c. Securitron (SU) - DPS Series.
d. RCI/Dormakaba (RC).
e. Or equal as approved by Professional.

B. Intelligent Switching Power Supplies: Provide the least number of power supplies at the appropriate amperage level sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Power supplies shall meet all functions and features as specified herein.

a. UL listed dual voltage 12 or 24 VDC field selectable continuous output.
b. Dedicated fast charger to prolong battery life with low battery cutoff to protect batteries from deep discharge.
c. Enhanced surge immunity for input/output protection
d. Separate, dedicated battery charging circuit to keep locks cooler.
e. Dual-color LED visual notification to prevent applying incorrect voltages to the power supply.
f. Instant auto-switch to battery on AC loss.
g. Expandable up to 16 outputs in the standard enclosure
h. Integrated fire alarm interface to allow main output shutdown or disconnect on a per output basis when using an R8 output module.
i. Network ready and remotely manage locks and connected devices when using an M8 managed output module on network models.
j. Lifetime replacement, no-fault, no questions asked warranty.

2. Manufacturers:

a. Life Safety Power (LP).
b. Securitron (SU) - AQL Series.
c. Best / Dormakaba (BE) DKPS / RPSMLR2.
d. Or equal as approved by Professional.

2.17 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.18 FINISHES

A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.

B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware

C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine scheduled openings, with Installer present, for compliance with requirements for installation tolerances, labeled fire door assembly construction, wall and floor construction, and other conditions affecting performance.

B. Notify architect of any discrepancies or conflicts between the door schedule, door types, drawings and scheduled hardware. Proceed only after such discrepancies or conflicts have been resolved in writing.

3.2 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.

B. Wood Doors: Comply with ANSI/DHI A115-W series.

3.3 INSTALLATION

A. Install each item of mechanical and electromechanical hardware and access control equipment to comply with manufacturer's written instructions and according to specifications.

1. Installers are to be trained and certified by the manufacturer on the proper installation and adjustment of fire, life safety, and security products including: hanging devices; locking devices; closing devices; and seals.

B. Mounting Heights: Mount door hardware units at heights indicated in following applicable publications, unless specifically indicated or required to comply with governing regulations:

1. Standard Steel Doors and Frames: DHI's "Recommended Locations for Architectural Hardware for Standard Steel Doors and Frames."
2. DHI TDH-007-20: Installation Guide for Doors and Hardware.
3. Where indicated to comply with accessibility requirements, comply with ANSI A117.1 "Accessibility Guidelines for Buildings and Facilities."
4. Provide blocking in drywall partitions where wall stops or other wall mounted hardware is located.

C. Retrofitting: Install door hardware to comply with manufacturer's published templates and written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work specified in Division 9 Sections. Do not install surface-mounted items until finishes have been completed on substrates involved.

D. Push Plates and Door Pulls: When through-bolt fasteners are in the same location as a push plate, countersink the fasteners flush with the door face allowing the push plate to sit flat against the door.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Division 7 Section "Joint Sealants."

F. Storage: Provide a secure lock up for hardware delivered to the project but not yet installed. Control the handling and installation of hardware items so that the completion of the work will not be delayed by hardware losses before and after installation.

3.4 FIELD QUALITY CONTROL

A. Field Inspection (Punch Report): Reference Division 01 Sections “Closeout Procedures”. Produce project punch report for each installed door opening indicating compliance with approved submittals and verification hardware is properly installed, operating and adjusted. Include list of items to be completed and corrected, indicating the reasons or deficiencies causing the Work to be incomplete or rejected.

1. Organization of List: Include separate Door Opening and Deficiencies and Corrective Action Lists organized by Mark, Opening Remarks and Comments, and related Opening Images and Video Recordings.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.6 CLEANING AND PROTECTION

A. Protect all hardware stored on construction site in a covered and dry place. Protect exposed hardware installed on doors during the construction phase. Install any and all hardware at the latest possible time frame.

B. Clean adjacent surfaces soiled by door hardware installation.

C. Clean operating items as necessary to restore proper finish. Provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of Client Agency occupancy.

3.7 DEMONSTRATION

A. Instruct Client Agencies maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.8 DOOR HARDWARE SETS

A. The hardware sets represent the design intent and direction of the Client Agencies and architect. They are a guideline only and should not be considered a detailed hardware schedule. Discrepancies, conflicting hardware and missing items should be brought to the attention of the architect with corrections made prior to the bidding process. Omitted items not included in a hardware set should be scheduled with the appropriate additional hardware required for proper application and functionality.

1. Quantities listed are for each pair of doors, or for each single door.
2. The supplier is responsible for handing and sizing all products.
3. Where multiple options for a piece of hardware are given in a single line item, the supplier shall provide the appropriate application for the opening.
4. At existing openings with new hardware the supplier shall field inspect existing conditions prior to the submittal stage to verify the specified hardware will work as required. Provide alternate solutions and proposals as needed.

B. Refer to Section 080671, Door Hardware Sets, for hardware sets.

END OF SECTION 087100

SECTION 08 8000

GLAZING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Glass products.
2. Insulating glass.
3. Glazing tapes.
4. Miscellaneous glazing materials.

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters in accordance with ASTM C1036.

C. IBC: International Building Code.

D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances to achieve proper safety margins for glazing retention under each design load case, load case combination, and service condition.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass ; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

D. Delegated Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by qualified professional engineer responsible for their preparation.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer manufacturers of fabricated glass units .

1.7 QUALITY ASSURANCE

A. Fabricated-Glass Manufacturer Qualifications: A qualified manufacturer of fabricated glass units who is approved and certified by primary glass manufacturer.

B. Installer Qualifications: A qualified glazing contractor for this Project who is certified under the North American Contractor Certification Program (NACC) for Architectural Glass & Metal (AG&M) contractors.

1.8 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each glass product, tape sealant, gasket, glazing accessory, and glass-framing member for adhesion to and compatibility with elastomeric glazing sealants.

1. Testing is not required if data are submitted based on previous testing of current sealant products and glazing materials matching those submitted.
2. Use ASTM C1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to glass, tape sealants, gaskets, and glazing channel substrates.
3. Test no fewer than eight Samples of each type of material, including joint substrates, shims, sealant backings, secondary seals, and miscellaneous materials.
4. Schedule enough time for testing and analyzing results to prevent delaying the Work.
5. For materials failing tests, submit sealant manufacturer's written instructions for corrective measures including use of specially formulated primers.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials in accordance with manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.10 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain glass from single source from single manufacturer.

B. Source Limitations for Glazing Accessories: For each product and installation method, obtain from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design glazing.

C. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined in accordance with the IBC and ASTM E1300:

1. Design Wind Pressures: As indicated on Drawings .
   a. Wind Design Data: As indicated on Drawings.
   b. Basic Wind Speed: 124 mph. .
   c. Importance Factor: 1.0 .
   d. Exposure Category: C .
2. Design Snow Loads: As indicated on Drawings.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
4. Thermal Loads: Design glazing to resist thermal stress breakage induced by differential temperature conditions and limited air circulation within individual glass lites and insulated glazing units.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

E. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick .

2. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
3. U-Factors: Center-of-glazing values, in accordance with NFRC 100 and based on most current non-beta version of LBL's WINDOW computer program, expressed as Btu/sq. ft. x h x deg F.
4. SHGC and Visible Transmittance: Center-of-glazing values, in accordance with NFRC 200 and based on most current non-beta version of LBL's WINDOW computer program.
5. Visible Reflectance: Center-of-glazing values, in accordance with NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. NGA Publications: "Glazing Manual."
2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "North American Glazing Guidelines for Sealed Insulating Glass Units for Commercial and Residential Use."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction . Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of the IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass thickness that complies with performance requirements and is not less than thickness indicated.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Fully Tempered Float Glass: ASTM C1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion horizontally oriented upon installation.

B. Heat-Strengthened Float Glass: ASTM C1048, Kind HS (heat strengthened), Type I, Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion horizontally oriented upon installation.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified in accordance with ASTM E2190.

1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
2. Perimeter Spacer: Aluminum with bronze, color anodic finish.
   a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1) Guardian Glass, LLC. (Basis-of-Design)
      2) Saint-Gobain Glass Corp.
      3) Vitro Architectural Glass.
      4) Or equal as approved by Professional.
3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C1281 and AAMA 800 for products indicated below:

1. AAMA 804.3 tape, where indicated.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, recommended in writing by manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.

C. Setting Blocks:

1. Silicone with Shore A durometer hardness of 85, plus or minus 5.
2. Type recommended in writing by sealant or glass manufacturer.

D. Spacers:

1. Neoprene blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
2. Type recommended in writing by sealant or glass manufacturer.

E. Edge Blocks:

1. Silicone with Shore A durometer hardness per manufacturer's written instructions.
2. Type recommended in writing by sealant or glass manufacturer.

F. Cylindrical Glazing Sealant Backing: ASTM C1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.8 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   a. Temperature Change: 120 deg F , ambient; 180 deg F , material surfaces .

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep systems.
3. Minimum required face and edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

B. Examine glazing units to locate exterior and interior surfaces. Label or mark units as needed so that exterior and interior surfaces are readily identifiable. Do not use materials that leave visible marks in the completed Work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.

1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
2. Provide 1/8-inch- minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and in accordance with requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended in writing by gasket manufacturer.

3.4 GASKET GLAZING (DRY)

A. Cut compression gaskets to lengths recommended by gasket manufacturer to fit openings exactly, with allowance for stretch during installation.

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket. Install dense compression gaskets and pressure-glazing stops, applying pressure uniformly to compression gaskets. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended in writing by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.5 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.6 CLEANING AND PROTECTION

A. Immediately after installation, remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

3.7 MONOLITHIC GLASS (GL-1)

A. Clear Glass: Fully tempered float glass.

1. Minimum Thickness: 6 mm unless noted otherwise or as needed to comply with Performance Compliance Article.

3.8 INSULATING GLASS SCHEDULE

A. Low-E-Coated, Clear Insulating Vision Glass (IG-1):

1. Basis-of-Design Product: Guardian Glass LLC SunGuard SNX 70+ on Clear or equal as approved by Professional.
2. Overall Unit Thickness: 1-1/16 inch .
3. Minimum Thickness of Each Glass Lite: 5/16 inch (8 mm).
4. Outboard Lite: Clear float glass.
5. Coating Sputtered on Surface #2: Guardian SunGuard SNX 70+.
6. Heat Treatment: Fully tempered.
7. Interspace: Argon filled 12 mm (1/2” wide, hermetically sealed).
8. Inboard Lite: Clear float glass.
9. Heat Treatment: Fully tempered.
10. Glass Unit Performance Characteristics
    a. Winter Nighttime U-Factor: 0.24 maximum.
    b. Summer Daytime U-Factor: 0.21 maximum.
    c. Visible Light Transmittance: 65 percent minimum.
    d. SHGC: 0.27 maximum.

B. Low-E Coated Spandrel Insulating Glass (IG-1S):

1. Basis-of-Design Product: Guardian Glass Vision-SNX 70+ on Clear with Warm Gray Spandrel or equal as approved by Professional.
2. Overall Unit Thickness: 1-1/16 inch .
3. Minimum Thickness of Each Glass Lite: 5/16 inch (8 mm).
4. Outboard Lite: Clear float glass.
5. Coating Sputtered on Surface #2: Guardian SunGuard SNX 70+.
6. Heat Treatment: Fully tempered.
7. Interspace: Argon filled 12 mm (1/2” wide, hermetically sealed).
8. Inboard Lite: Clear float glass.
9. Spandrel Coating on Surface #4: Warm Gray Spandrel or color to be selected by architect from fabricators full range of color options.
10. Heat Treatment: Fully tempered.
11. Glass Unit Performance Characteristics
    a. Winter Nighttime U-Factor: 0.24 maximum.
    b. Summer Daytime U-Factor: 0.21 maximum.
    c. Visible Light Transmittance: 0 percent minimum.
    d. SHGC: 0.21 maximum.

END OF SECTION 08 8000

SECTION 08 87 00

WINDOW FILM

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. Architectural Window Film

1.3 PERFORMANCE REQUIREMENTS

A. Flammability: Surface burning characteristics when tested in accordance ASTM E 84, demonstrating film applied to glass rated Class A for Interior Use.

1.4 SUBMITTALS

A. Product Data: Manufacturer's current technical literature on each product to be used, including:
   1. Manufacturer's Data Sheets.
   2. Preparation instructions and recommendations.
   3. Storage and handling requirements and recommendations.
   4. Installation methods.

B. Verification Samples: For each film specified, two samples representing actual film color and pattern.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: All primary products specified in this section will be supplied by a single manufacturer with a minimum of ten years experience.
   1. Provide documentation that the adhesive used on the specified films is a Pressure Sensitive Adhesive (PSA).

B. Installer Qualifications: All products listed in this section are to be installed by a single installer with a minimum of five years demonstrated experience in installing products of the same type and scope as specified.
   1. Provide documentation that the installer is authorized by the Manufacturer to perform Work specified in this section.
   2. Provide a commercial building reference list of 5 properties where the installer has applied window film. This list will include the following information:
      a. Name of building.
      b. The name and telephone number of a management contact.
      c. Type of glass.
      d. Type of film and/or film attachment system.
      e. Amount of film and/or film attachment system installed.
      f. Date of completion.

C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1. Finish 20 square foot areas designated by Architect.
2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
3. Refinish mock-up area as required to produce acceptable work.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Follow Manufacturer's instructions for storage and handling.

B. Store products in manufacturer's unopened packaging until ready for installation.

C. Store and dispose of hazardous materials, and materials contaminated by hazardous materials, in accordance with requirements of local authorities having jurisdiction.

1.7 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 WARRANTY

A. At project closeout, provide to Client Agency an executed current copy of the manufacturer's standard limited warranty against manufacturing defect, outlining its terms, conditions, and exclusions from coverage.

B. Product shall be free from defects in material and manufacture for a period of 10 years from the date of installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, available manufacturers include but are not limited to the following:

1. 3M.
2. Decorative Films, LLC.
3. LLumar; Eastman Performance Films, LLC.
4. Or equal as approved by Professional.

2.2 WINDOW FILM (WF-1) see Drawings for locations

A. Basis-of Design: Solyx, SXJ-0582 Matte Dual Dot Gradient, or equal as approved by Professional.

B. Properties:
1. Base Material: Polyester.
2. Type: Dual direction fade; variable privacy.
3. Color: As indicated on schedule.
4. Adhesive Type: Pressure Sensitive, self-adhesive.
5. Thickness: Nominal 4 mils minimum.

C. Optical Performance:
1. Decorative / Privacy Glazing Film applied to 6 mm thick clear glass (ASTM E 903, ASTM E 308):
   a. UV Rating: Level 1, 0-24 percent.

PART 3 EXECUTION

3.1 EXAMINATION

A. Film Examination:
1. Do not proceed with installation until glass surfaces have been properly prepared and deviations from manufacturer's recommended tolerances are corrected. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result under the project conditions.
2. Commencement of installation constitutes acceptance of conditions.

3.2 PREPARATION

A. Clean surfaces thoroughly prior to installation.

B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

C. Refer to Manufacturer's installation instructions for methods of preparation for Impact Protection Adhesive or Impact Protection Profile film attachment systems.

3.3 INSTALLATION

A. Film Installation, General:
1. Install in accordance with manufacturer's instructions.
2. Cut film edges neatly and square. Use new blade tips after 3 to 4 cuts.

3.4 CLEANING AND PROTECTION

A. Remove left over material and debris from Work area. Use necessary means to protect film before, during, and after installation.

B. Touch-up, repair or replace damaged products before Substantial Completion.

C. After application of film, wash film using common window cleaning solutions, including ammonia solutions, 30 days after application. Do not use abrasive type cleaning agents and bristle brushes to avoid scratching film. Use synthetic sponges or soft cloths.

END OF SECTION 08 87 00

SECTION 092116
GYPSUM BOARD ASSEMBLIES

PART 1 GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SECTION INCLUDES

A. Performance criteria for gypsum board assemblies.

B. Acoustic insulation.

C. Cementitious backing board.

D. Gypsum wallboard.

E. Joint treatment and accessories.

1.03 RELATED REQUIREMENTS

A. Section 054000 - Cold-Formed Metal Framing: Structural steel stud framing.

B. Section 061000 - Rough Carpentry: Wood blocking product and execution requirements.

C. Section 092216 - Non-Structural Metal Framing.

1.04 REFERENCE STANDARDS

A. ANSI A108.11 - American National Standard Specifications for Interior Installation of Cementitious Backer Units; 2023.

B. ANSI A118.9 - American National Standard Specifications for Test Methods and Specifications for Cementitious Backer Units; 2023.

C. ASTM C475/C475M - Standard Specification for Joint Compound and Joint Tape for Finishing Gypsum Board; 2017 (Reapproved 2022).

D. ASTM C665 - Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing; 2024.

E. ASTM C840 - Standard Specification for Application and Finishing of Gypsum Board; 2024.

F. ASTM C954 - Standard Specification for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 in. (0.84 mm) to 0.112 in. (2.84 mm) in Thickness; 2022.

G. ASTM C1002 - Standard Specification for Steel Self-Piercing Tapping Screws for Application of Gypsum Panel Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2022.

H. ASTM C1047 - Standard Specification for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2019.

I. ASTM C1288 - Standard Specification for Fiber-Cement Interior Substrate Sheets; 2023.

J. ASTM C1325 - Standard Specification for Fiber-Mat Reinforced Cementitious Backer Units; 2022, with Editorial Revision (2023).

K. ASTM C1396/C1396M - Standard Specification for Gypsum Board; 2024.

L. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2021.

M. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2024.

N. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2024.

O. GA-216 - Application and Finishing of Gypsum Panel Products; 2024.

P. ICC (IBC) - International Building Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

Q. UL (FRD) - Fire Resistance Directory; Current Edition.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of gypsum board assemblies with size, location, and installation of service utilities.

B. Sequencing: Install service utilities in an orderly and expeditious manner.

1.06 SUBMITTALS

A. See Section 013000 - Administrative Requirements for submittal procedures.

B. Product Data:
   1. Provide data on gypsum board, accessories, and joint finishing system.

1.07 QUALITY ASSURANCE

A. Installer Qualifications: Company specializing in performing work of the type specified and with at least three years of documented experience.

B. Documents at Project Site: Maintain at the project site a copy of manufacturer's instructions.

1.08 DELIVERY, STORAGE, AND HANDLING

A. Store gypsum products and accessories indoors and keep above freezing. Elevate boards above floor, on nonwicking supports, in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.01 GYPSUM BOARD ASSEMBLIES

A. Provide completed assemblies complying with ASTM C840 and GA-216.

B. Fire-Resistance-Rated Assemblies: Provide completed assemblies complying with applicable code.

2.02 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:
   1. American Gypsum Company: .
   2. CertainTeed Corporation: .
   3. Georgia-Pacific Gypsum: .
   4. Gold Bond Building Products, LLC provided by National Gypsum Company: .
   5. PABCO Gypsum:
   6. USG Corporation: .
   7. Or equal as approved by Professional.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Use for vertical surfaces and ceilings, unless otherwise indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
      a. Mold-resistant board is required whenever board is being installed before the building is enclosed and conditioned.
      b. Mold resistant board is required in kitchens and toilet rooms.
   3. Thickness:
      a. Vertical Surfaces: 5/8 inch.
      b. Ceilings: 1/2 inch.

C. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

D. Abuse Resistant Wallboard:
   1. Application: High-traffic areas indicated.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. Type: Fire-resistance-rated Type X, UL or WH listed.
   4. Thickness: 5/8 inch.
   5. Edges: Tapered.

E. Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.
   3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

F. Backing Board For Wet Areas:
   1. Application: Surfaces behind tile in wet areas, including kitchens.
   2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
   3. ANSI Cement-Based Board: Non-gypsum-based; aggregated Portland cement panels with glass fiber mesh embedded in front and back surfaces complying with ANSI A118.9 or ASTM C1325.
      a. Thickness: 5/8 inch.

G. Backing Board For Non-Wet Areas: Water-resistant gypsum backing board as defined in ASTM C1396/C1396M; sizes to minimum joints in place; ends square cut.
   1. Application: Vertical surfaces behind thinset tile, except in wet areas.
   2. Type: Regular and Type X, in locations indicated.
   3. Type X Thickness: 5/8 inch.
   4. Regular Board Thickness: 5/8 inch.
   5. Edges: Tapered.

H. Ceiling Board: Special sag resistant gypsum ceiling board as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.
   1. Application: Ceilings, unless otherwise indicated.
   2. Thickness: 1/2 inch.
   3. Edges: Tapered.

2.03 GYPSUM BOARD ACCESSORIES

A. Acoustic Insulation: ASTM C665; preformed mineral-fiber, friction fit type, unfaced; thickness 2 inches.

B. Finishing Accessories: ASTM C1047, rigid plastic, unless noted otherwise.
   1. Types: As detailed or required for finished appearance.
   2. Special Shapes: In addition to conventional corner bead and control joints, provide U-bead at exposed panel edges.

C. Beads, Joint Accessories, and Other Trim: ASTM C1047, rigid plastic, unless noted otherwise.
   1. Corner Beads: Low profile, for 90 degree outside corners.
   2. L-Trim with Tear-Away Strip: Sized to fit 5/8-inch thick gypsum wallboard.
   3. Expansion Joints:
      a. Type: V-shaped PVC with tear away fins.

D. Decorative Metal Trim:
   1. Material: Extruded aluminum alloy 6063-T5 temper.
   2. Finish: Anodized, clear.
   3. Type: As indicated on drawings.
      a. Products:
         1) Gordon Inc: www.gordon-inc.com/#sle.
         2) Pittcon Industries: www.pittconindustries.com/#sle.
         3) Tamlyn: www.tamlyn.com/#sle.

4) Fry Reglet: www.fryreglet.com.

E. Joint Materials: ASTM C475/C475M and as recommended by gypsum board manufacturer for project conditions.
   1. Paper Tape: 2 inch wide, creased paper tape for joints and corners, except as otherwise indicated.
   2. Joint Compound: Drying type, vinyl-based, ready-mixed.

F. Screws for Fastening of Gypsum Panel Products to Cold-Formed Steel Studs Less than 0.033 inches in Thickness and Wood Members: ASTM C1002; self-piercing tapping screws, corrosion-resistant.

G. Screws for Fastening of Gypsum Panel Products to Steel Members from 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws, corrosion-resistant.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that project conditions are appropriate for work of this section to commence.

3.02 ACOUSTIC ACCESSORIES INSTALLATION

A. Acoustic Insulation: Place tightly within spaces, around cut openings, behind and around electrical and mechanical items within partitions, and tight to items passing through partitions.

B. Acoustic Sealant: Install in accordance with manufacturer's instructions.

3.03 BOARD INSTALLATION

A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.

B. Fire-Resistance-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.

C. Cementitious Backing Board: Install over steel framing members and plywood substrate where indicated, in accordance with ANSI A108.11 and manufacturer's instructions.

3.04 INSTALLATION OF TRIM AND ACCESSORIES

A. Control Joints: Place control joints consistent with lines of building spaces and as indicated.

B. Corner Beads: Install at external corners, using longest practical lengths.

C. Edge Trim: Install at locations where gypsum board abuts dissimilar materials.

D. Decorative Trim: Install at locations shown on drawings and in accordance with manufacturer's instructions.

3.05 JOINT TREATMENT

A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
   1. Level 4: Walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
   2. Level 2: In utility areas, behind cabinetry, and on backing board to receive tile finish.
   3. Level 1: Fire-resistance-rated wall areas above finished ceilings, whether or not accessible in the completed construction.

B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
   1. Feather coats of joint compound so that camber is maximum 1/32 inch.

C. Fill and finish joints and corners of cementitious backing board as recommended by manufacturer.

3.06 TOLERANCES

A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

3.07 PROTECTION

A. Protect installed gypsum board assemblies from subsequent construction operations.

END OF SECTION

SECTION 092216

NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 119 by an independent testing agency.

2.2 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
2. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.

B. Manufacturers:
1. Products: Subject to compliance with requirements, available manufacturers include the following:
   a. ClarkDietrich Building Systems.
   b. CEMCO.

c. Marino Ware.
d. Steel Network, Inc, The
e. Telling Industries.
f. Or equal as approved by Professional.

C. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:

a. Minimum Base-Metal Thickness: 0.031 inch (20 gauge drywall).
b. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Blazeframe Industries; Bare Slotted Track (BST/BST 2).
2) ClarkDietrich Building Systems; SLP-TRK Slotted Deflection Track.
3) MBA Building Supplies; FlatSteel Deflection Track or Slotted Deflecto Track.
4) Metal-Lite; [The System].
5) Steel Network, Inc. (The); VertiClip SLD or VertiTrack VTD.
6) Telling Industries; Vertical Slip Track or Vertical Slip Track II.
7) Or equal as approved by Professional.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Minimum Base-Metal Thickness: 0.027 inch.

F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.

1. Depth: 1-1/2 inches.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base-Metal Thickness: 0.033 inch.
2. Depth: As indicated on Drawings.

H. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.0179 inch, and depth required to fit insulation thickness indicated.

I. Column/Beam Connectors: Low profile metal connectors for the attachment of gypsum wallboard to steel columns.
1. ASTM A1003 Grade 50, Type H.
2. Minimum yield strength: 50 ksi.
3. Minimum tensile strength: 65 ksi.
4. Minimum thickness: 33 mil (20 gauge, 0.0346 inch).
5. ASTM G90 hot dipped galvanized coating.

6. Products: Subject to compliance with requirements, provide one of the following or approved equal:
    a. CEMCO, Grip Clip.
    b. Grabber Construction Products, Column and Beam Drywall Clip.
    c. Steel Network, Inc., The: Grip Clip.
    d. SteelSmart System.
    e. Or equal as approved by Professional.

2.3 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Hanger Attachments to Concrete:

1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.

    a. Type: Postinstalled, chemical anchor or Postinstalled, expansion anchor.

2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch (4.12 mm) in diameter.

D. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-tee members that interlock.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:

    a. Armstrong World Industries, Inc; Drywall Grid Systems.
    b. Chicago Metallic Corporation; Drywall Grid System.
    c. USG Corporation; Drywall Suspension System.
    d. Or equal as approved by Professional.

2. Structural Classification:

    a. Main Beam shall be heavy duty per ASTM C 635.
    b. Classification can require wires to be closer together for additional loading when used to support double layer gypsum, verticals, slopes, domes, half barrels, circles, soffits, canopies, and step conditions, which call for loading or unusual designs and shapes in drywall construction. Using cross tees in the construction of circles, barrels, etc. is common in order to hold the radius.
    c. Deflection of fastening suspension system supporting light fixtures, ceiling grilles, access doors, verticals, and horizontal loads shall have a maximum deflection of 1/360 of the span.

2.4 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide the following:

1. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch (3.2 mm) thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.
1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated.

3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

C. Install studs so flanges within framing system point in same direction.

D. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.

    a. Install two studs at each jamb unless otherwise indicated.
    b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
    c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.

E. Direct Furring:

1. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Shaped Furring Members:

1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced **24 inches** o.c. unless noted otherwise.
2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches (610 mm) o.c.
3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than 12 inches (305 mm) from corner and cut insulation to fit.

G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components as required by manufacturer and referenced installation standards for assembly types.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.

    a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

    a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 09 29 53

PARTITION GAP CLOSURE

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SECTION INCLUDES:

A. This section includes drywall accessories or noise control components at intersections between fire rated GWB partitions and window mullions.

1.03 REFERENCES:

A. GENERAL
    1. Comply with applicable requirements of the following, except where more stringent requirements are indicated by building codes.
B. American Architectural Manufacturers Association (AAMA):
    1. AAMA 2604 – Specification for Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels
C. American Society for Testing and Materials (ASTM)
    1. ASTM D2247 Standard Practice for Testing Water Resistance of Coatings in 100% Relative Humidity
    2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials
    3. ASTM E1399/E1399M-97 Standard Test Method for Cyclic Movement and Measuring the Minimum and Maximum Joint Widths of Architectural Joint Systems
    4. ASTM E90-2016 Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
D. Underwriters Laboratory (UL).
E. National Association of Architectural Metal Manufacturers (NAAMM)
    1. Metal Finishes Manual for Architectural and Metal Products

1.04 DESIGN/PERFORMANCE REQUIREMENTS:

A. All components of the Extruded Aluminum Partition Gap Closure shall be provided by one (1) Manufacturer to ensure single source responsibility and quality control.
B. Partition Gap Closure shall meet specified performance requirements listed in ASTM E1399/E1399M-97 for the joint width minimum and maximum dimension verification as well as the cyclic movement performance for Class IV – Combined movement which encompasses Seismic, Thermal and Wind Sway, movement at a cycling rate greater than or equal to 10 cycles per minute.
C. Sound Transmission Class (STC) for (Against the Mullion / Against the Glass) Extruded Aluminum Partition Gap Closure per ASTM E90-2016.
D. All materials are Class A rated per ASTM E84.
E. Partition Gap Closure passes the requirements of UL 2079 for a duration of two hours.

1.05 SUBMITTALS:

A. Product Data: Submit Manufacturer’s:
    1. Product Specifications
    2. Detail Drawings
    3. Installation Instructions

B. Samples:
    1. Submit samples consisting of 12” long Extruded Aluminum Partition Gap Closure and finish as specified, as well as accessories.

1.06 QUALITY ASSURANCE:

A. Source Limitations:
    1. All components of (Against the Mullion / Against the Glass) Extruded Aluminum Partition Gap Closures shall be provided by a single Manufacturer to ensure responsibility and quality control.
B. Manufacturer Qualifications:
    1. Manufacturer must have manufacturing and delivery capacity required for the project and shall have successfully completed at least ten (10) projects within the past five (5) years, utilizing systems, materials, and techniques as herein specified.
C. Installer Qualifications:
    1. Installers shall have a minimum of five (5) years of experience installing systems of similar type and scope as those specified in this section.

1.07 PRODUCT DELIVERY, STORAGE AND HANDLING:

A. All materials shall be protected during fabrication, shipment, and installation to prevent damage to the finished work from other trades.
B. To avoid lasting deformation of the Extruded Aluminum Partition Gap Closure components when exposed to temperature and humidity extremes, store this material at or near room temperature. Allow a minimum of 48 hours for the product to adjust to internal room temperature and humidity conditions before Extruded Aluminum Partition Gap Closure.
C. Store Extruded Aluminum Partition Gap Closures inside a well-ventilated area, away from uncured concrete and masonry, and protected from the weather, moisture, soiling, abrasion, extreme temperatures, and humidity.
D. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommend by Manufacturer for optimum results. Do not install products under environmental conditions outside Manufacturer’s recommendations.
E. Exercise care in loading, unloading, storing, and installing units to preclude bending, warping, twisting and other surface damage.

1.08 WARRANTY:

A. Standard Warranty:
    1. Furnish Manufacturer’s Standard Warranty of one (1) year for workmanship and for finish against defects in materials and/or workmanship.
B. Extended Workmanship Warranty:
    1. Furnish Manufacturer's Standard Workmanship Warranty (must be requested at time of quotation) may be extended up to a maximum of twenty (20) years from date of material shipment, when installed in accordance with Manufacturer’s recommendations.
C. Extended Finish Warranty:
    1. Furnish Manufacturer’s Standard Finish Warranty (must be requested at time of quotation) may be extended up to a maximum of twenty (20) years from date of material shipment, when installed in accordance with Manufacturer’s recommendations.

PART 2 - PRODUCTS

2.01 MANUFACTURERS:

A. Products: Subject to compliance with requirements, provide the following Fire-Rated Extruded Aluminum Partition Gap Closures:

1. Gordon, Inc., Mullion Mate Pro FR.
2. Mull-It-Over, Classic 1 HR.
3. Shannon Corporation, Mullion Mate.
4. Or equal as approved by Professional.

B. The listed Manufacturer shall not be construed as closing specifications to other prospective Manufacturers, but rather as establishing a level of quality in a metal system. Other systems may be submitted for approval, as provided for in the specifications at least ten (10) working days prior to submission of bids. Companies desiring to submit a proposal shall submit all descriptive information of the system proposed including photographs and Shop Drawings of at least ten (10) projects within the past five (5) years, utilizing systems, materials, and techniques as herein specified.

2.02 MATERIALS:

A. Provide metals free from surface blemishes where exposed to view in finished Extruded Aluminum Partition Gap Closures. Surfaces exhibiting pitting, seam marks, roller marks, stains, discolorations, or other imperfections on finished Extruded Aluminum Partition Gap Closures are not acceptable. All metal shall be of the highest commercial grade available.
B. Extruded Aluminum Partition Gap Closures are factory-assembled, and spring-loaded to provide a tight fit for vertical junctures of partitions and window walls.
C. Materials:
    1. Aluminum extrusions: 6063-T5 or T6 temper alloy.
    2. Aluminum sheet, 3000 series alloy.

2.03 FABRICATION:

A. Provide Extruded Aluminum Partition Gap Closures in lengths and size to fit specified openings.
    1. Single-Piece construction available in lengths up to sixteen (16) feet. Spliced conditions are available in lengths up to thirty (30) feet.
B. Provide End Caps in ten (10) foot lengths and widths to fit specified wall conditions.
    1. End Caps –
        a. Provide width to match wall condition.
C. Provide corner trim in ten (10) foot lengths for field cutting.
D. Intumescent/Insulation Materials Assembly
    1. Refer to Manufacturer's Installation Instructions for correct placement of Intumescent/Insulation Materials.

2.04 FINISHES:

A. Comply with the National Association of Architectural Metal Manufacturers (NAAMM) "Metal Finishes Manual for Architectural and Metal Products" for recommendations relative to applying and designating finishes.
B. All material shall be in a finish as follows:
    1. Factory Anodized
        a. Custom color anodized to match window mullion finish.

PART 3 - EXECUTION

3.01 EXAMINATION:

A. Examination of Surfaces: Installer must examine conditions under which work is to be performed and must notify Contractor in writing of unsatisfactory conditions.
B. Verify that field measurements and block-out dimensions are as shown on Shop Drawings.

3.02 PREPARATION:

A. Clean surfaces thoroughly prior to installation.
B. Prepare surfaces using the methods recommended by the Manufacturer to achieve the best result for the project conditions.
C. To avoid lasting deformation of the Extruded Aluminum Partition Gap Closures components when exposed to temperature and humidity extremes, store this material at or near room temperature. Allow a minimum of 48 hours for the product to adjust to internal room temperature and humidity conditions before installing the Partition Gap Closures.

3.03 INSTALLATION:

A. Extruded Aluminum Partition Gap Closures shall be inspected before installation to be free from dents, scratches, and other defects.
B. Install Extruded Aluminum Partition Gap Closures in accordance with Manufacturer's written Installation Instructions and Details.
C. Space Enclosure: Do not install any work until space is enclosed and weatherproofed, wet-work in space is completed and nominally dry, work above ceilings is complete, and temperature and humidity shall be continuously maintained at values near those of final occupancy.

3.04 CLEANING:

A. Follow Manufacturer's cleaning instructions for specified finish.

3.05 PROTECTION:

A. Procedures: Advise the Contractor of procedures required to protect the finished work from damage during the remainder of the construction period.

END OF SECTION

SECTION 093013

TILING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Glazed wall tile.
3. Thresholds.
4. Waterproof membranes.
5. Crack isolation membranes.
6. Setting material.
7. Grout materials.
8. Tile backing panels.
9. Metal edge strips.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Porcelain tile.
2. Glazed wall tile.
3. Thresholds.
4. Waterproof membranes.
5. Crack isolation membranes.
6. Setting material.
7. Grout materials.
8. Tile backing panels.
9. Metal edge strips.

B. Shop Drawings: Show locations, plans, and elevations, of each type of tile and tile pattern. Show widths, details, and locations of movement joints in tile substrates and finished tile surfaces. Show thresholds.

C. Samples:

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.

2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 36 inches square, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.
3. Full-size units of each type of trim and accessory for each color and finish required.
4. Stone thresholds in 6-inch lengths.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:

1. Installer is a Five-Star member of the National Tile Contractors Association or a Trowel of Excellence member of the Tile Contractors' Association of America.
2. Installer employs only Ceramic Tile Education Foundation Certified Installers or installers recognized by the U.S. Department of Labor as Journeyman Tile Layers for Project.

PART 2 - PRODUCTS

2.1 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

2.2 MANUFACTURERS

A. Tile Products: Subject to compliance with requirements, provide products by listed manufacturer or one of the following:

1. Daltile
2. American Olean
3. Crossville
4. Or equal as approved by Professional.

B. Tile Setting and Grouting Materials: Subject to compliance with requirements, provide products by listed manufacturer one of the following:

1. Custom Building Products
2. Mapei Corporation
3. Laticrete International, Inc.
4. Or equal as approved by Professional.

C. Cementitious Patching and Underlayment Compounds: Subject to compliance with requirements, provide products by listed manufacturer or one of the following:

1. Custom Building Products
2. Mapei Corporation
3. Laticrete International, Inc.
4. Or equal as approved by Professional.

2.3 TILE

A. Porcelain Floor Tile (CT-1):

1. Certification: Tile certified by the Porcelain Tile Certification Agency.
2. Basis-of-Design Manufacturer: Daltile
3. Type: Portfolio
4. Color: PF06 Iron Grey
5. Finish: Matte
6. Size: 12” x 24”
7. Thickness: 5/16”
8. Physical Properties: Chemical resistant when tested with indicated chemicals in accordance with ASTM C650.
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Precoat with temporary protective coating.
11. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
    a. Base: Surface bullnose with cove base, 6”x12”
    b. External Base Corners: Surface bullnose, 1”x6”
    c. Internal Corners: Field-butted square corners.
    d. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide reduction in thickness from 1/2 to 1/4 inch across nominal 4-inch dimension.

B. Glazed Ceramic Wall Tile (CT-2):

1. Certification: Tile certified by the Porcelain Tile Certification Agency.
2. Basis-of-Design Manufacturer: Daltile
3. Type: Color Wheel Linear
4. Color: 0190 Arctic White
5. Finish: Glossy
6. Size: 8” x 24”
7. Thickness: 5/16”
8. Physical Properties: Chemical resistant when tested with indicated chemicals in accordance with ASTM C650.
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Precoat with temporary protective coating.

C. Glazed Ceramic Wall Tile (CT-3):

1. Certification: Tile certified by the Porcelain Tile Certification Agency.
2. Basis-of-Design Manufacturer: Daltile
3. Type: Luminique
4. Color: K189 Navy

5. Finish: Glossy
6. Size: 12” x 24”
7. Thickness: 5/16”
8. Physical Properties: Chemical resistant when tested with indicated chemicals in accordance with ASTM C650.
9. Grout Color: As selected by Architect from manufacturer's full range.
10. Precoat with temporary protective coating.
11. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide shapes as follows, selected from manufacturer's standard shapes:
    a. External Corners: Jolly, ½” x 12”
    b. Internal Corners: Field-butted square corners.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325, Type A.
1. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following:

    a. C-Cure; C-Cure Board 990.
    b. Custom Building Products; Wonderboard.
    c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
    d. USG Corporation; DUROCK Cement Board.

2. Thickness: 5/8 inch.

2.5 WATERPROOF MEMBRANES

A. General: Manufacturer's standard product that complies with ANSI A118.10 and is recommended by manufacturer for application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Waterproof Membrane, Sheet: Polyethylene sheet faced on one or both sides with polyester fabric.

C. Waterproof Membrane, Fluid Applied: Liquid-latex rubber or elastomeric polymer.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. ARDEX Americas.
    b. Bostik; Arkema.
    c. Laticrete International, Inc.
    d. MAPEI Corporation.
    e. Sika Corporation.
    f. Or equal as approved by Professional.

2.6 SETTING MATERIALS

A. Portland Cement Mortar (Thickset) Installation Materials: ANSI A108.02.

1. Cleavage Membrane: Installer's option of material that complies with ANSI A108.02, paragraph 3.8.
2. Reinforcing Wire Fabric: Galvanized, welded-wire fabric, 2 by 2 inches by 0.062-inch diameter; comply with ASTM A1064/A1064M except for minimum wire size.
3. Latex Additive: Manufacturer's standard acrylic resin or styrene-butadiene-rubber water emulsion, serving as replacement for part or all of gaging water, of type specifically recommended by latex-additive manufacturer for use with field-mixed portland cement and aggregate mortar bed.

B. Modified Dry-Set Mortar (Thinset): ANSI A118.4.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. ARDEX Americas.
   b. Bostik; Arkema.
   c. Laticrete International, Inc.
   d. MAPEI Corporation.
   e. Parex USA, Inc.
   f. Summitville Tiles, Inc.
   g. Or equal as approved by Professional.
2. Provide prepackaged, dry-mortar mix to which only water must be added at Project site.
3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to other requirements in ANSI A118.1.

2.7 GROUT MATERIALS

A. Sand-Portland Cement Grout: ANSI A108.10, consisting of white or gray cement and white or colored aggregate as required to produce color indicated.

B. High Performance Tile Grout: ANSI A118.7.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Ardex Americas.
   b. Bostik; Arkema.
   c. Laticrete International, Inc.
   d. MAPEI Corporation.
   e. Summitville Tiles, Inc.
   f. Or equal as approved by Professional.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting and adhesive materials for installations indicated.

B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D4397, 4.0 mils thick.

C. Metal Flooring Transitions: Profile designed specifically for flooring applications; height to match tile and setting-bed thickness.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
    a. Custom Building Products.
    b. Profilitec Corp.
    c. Progress Profiles America Inc.
    d. Schluter Systems L.P.
    e. Or equal as approved by Professional.
2. Description: Profiles as indicated on Drawings.
3. Material and Finish: As indicated on Drawings, or if not indicated, metallic; brushed chrome anodized aluminum exposed-edge material.

D. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic, designed specifically for flooring applications; stainless-steel, ASTM A 666, 300 Series exposed-edge material.

E. Temporary Protective Coating: Formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products and easily removable after grouting is completed without damaging grout or tile.

F. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

G. Grout Sealer: Grout manufacturer's standard product for sealing grout joints that does not change color or appearance of grout.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.
2. Verify that concrete substrates for tile floors installed with thinset mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds or other coatings, that are incompatible with tile-setting materials.

B. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thinset mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

C. Where indicated, prepare substrates to receive waterproof membrane by applying a reinforced mortar bed that complies with ANSI A108.1 and is sloped 1/4 inch per foot toward drains.

D. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

E. Substrate Flatness:

1. For tile shorter than 15 inches, confirm that structure or substrate is limited to variation of 1/4 inch in 10 ft. from the required plane, and no more than 1/16 inch in 12 inches when measured from tile surface high points.
2. For large format tile, tile with at least one edge 15 inches or longer, confirm that structure or substrate is limited to 1/8 inch in 10 ft. from the required plane, and no more than 1/16 inch in 24 inches when measured from tile surface high points.

F. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION OF CERAMIC TILE SYSTEM

A. Install tile backing panels and treat joints in accordance with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

B. Install waterproof membrane to comply with ANSI A108.13 and manufacturer's written instructions to produce waterproof membrane of uniform thickness that is bonded securely to substrate.

1. Allow waterproof membrane to cure and verify by testing that it is watertight before installing tile or setting materials over it.

C. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness that is bonded securely to substrate.

1. Allow crack isolation membrane to cure before installing tile or setting materials over it.

D. Install tile in accordance with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of ANSI A108 series that are referenced in TCNA installation methods and specified in tile installation schedules, and apply to types of setting and grouting materials used.

E. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

F. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

G. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

H. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

I. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

J. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

K. Movement Joints: Provide movement joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated on Drawings. Form joints during installation of setting materials, mortar beds, and tile. Keep joints free of dirt, debris, and setting materials prior to filling with sealants. Do not saw-cut joints after installing tiles.

1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

L. Thresholds: Install stone and solid surface thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in modified dry-set mortar (thinset).
2. Do not extend waterproof membrane or crack isolation membrane under thresholds set in standard dry-set mortar. Fill joints between such thresholds and adjoining tile set on waterproof membrane or crack isolation membrane with elastomeric sealant.

M. Metal Flooring Transitions: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

N. Metal Edge Strips: Install at locations indicated, where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile, where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.

O. Grout Sealer: Apply grout sealer to cementitious grout joints in tile floors in accordance with manufacturer's written instructions. As soon as sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Wood or Metal Studs or Furring:

1. TCNA W244: Thinset on cementitious backer unit.
   a. Latex Portland cement mortar ANSI A118.4.
   b. Polymer modified tile grout ANSI 118.7.
   c. Joint Width: 1/8 inch.
   d. Movement Joints: Types located on Drawings.

B. Interior Wall Installations, Masonry

1. TCNA W202: Thinset on masonry units.
   a. Latex Portland cement mortar ANSI A118.4.
   b. Polymer modified tile grout ANSI 118.7.
   c. Joint Width: 1/8 inch.
   d. Movement Joints: Types located on Drawings.

C. Interior Floor Installations, Concrete:

1. TCNA F122: Thinset mortar over waterproof membrane (For use in toilet rooms).
   a. Latex Portland cement mortar" ANSI A118.4.
   b. Polymer modified tile grout: ANSI 118.7.
   c. Liquid applied waterproofing.
   d. Joint Width: 1/8 inch.
   e. Movement Joints: Types located on Drawings.

END OF SECTION 093013

SECTION 095113

ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Acoustical panels.
2. Metal suspension system.
3. Metal edge moldings and trim.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, and coordinated with each other, using input from installers of the items involved.

B. Product test reports.

C. Research reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: Class A in accordance with ASTM E1264.
2. Smoke-Developed Index: 50 or less.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by listed manufacturer or one of the following:

1. Armstrong World Industries
2. USG Ceiling Solutions
3. CertainTeed Saint-Gobain
4. Or equal as approved by Professional.

2.3 ACOUSTICAL PANELS

A. Mineral Fiber Acoustical Panels (APC-1):

1. Basis-of-Design Manufacturer: Armstrong World Industries
2. Type: Ultima 2082
3. Color: White
4. Edge Detail: Beveled Tegular
5. Thickness: 1”
6. Size: 24” x 24”
7. NRC: 0.85
8. CAC: 35
9. Light Reflectance: 0.85
10. Grid: 9/16”
11. Sag Resistance: Equivalent to Armstrong “HumiGuard Plus”

B. Mineral Fiber Acoustical Panels (APC-2):

1. Basis-of-Design Manufacturer: Armstrong World Industries
2. Type: Dune 1773
3. Color: White
4. Edge Detail: Square
5. Thickness: 5/8”
6. Size: 24” x 48”
7. NRC: 0.50
8. CAC: 30
9. Light Reflectance: 0.81
10. Grid: 15/16”
11. Sag Resistance: Equivalent to Armstrong “HumiGuard Plus”

C. Scrubbable Mineral Fiber w/ Water Repellent Membrane Acoustical Panels (APC-3):

1. Basis-of-Design Manufacturer: Armstrong World Industries
2. Type: Ultima Health Zone High NRC 1448
3. Color: White
4. Edge Detail: Square
5. Thickness: 7/8”
6. Size: 24” x 48”
7. NRC: 0.80
8. CAC: 35

9. Light Reflectance: 0.86
10. Grid: 15/16”
11. Sag Resistance: Equivalent to Armstrong “HumiGuard Plus”

D. Scrubbable Mineral Fiber w/ Water Repellent Membrane Acoustical Panels (APC-4):

1. Basis-of-Design Manufacturer: Armstrong World Industries
2. Type: Ultima Health Zone High NRC 1445
3. Color: White
4. Edge Detail: Square
5. Thickness: 7/8”
6. Size: 24” x 24”
7. NRC: 0.80
8. CAC: 35
9. Light Reflectance: 0.86
10. Grid: 15/16”
11. Sag Resistance: Equivalent to Armstrong “HumiGuard Plus”

2.4 METAL SUSPENSION SYSTEM

A. Basis-of-Design Manufacturer: Use products from same manufacturer as ceiling system used.

B. Metal Suspension-System Standard: Manufacturer's standard, direct-hung, metal suspension system and accessories in accordance with ASTM C635/C635M. Size as indicated with panel types.

C. Wide-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 15/16-inch- wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material:
   a. Typical Locations: Cold-rolled steel or aluminum.
   b. Wet Areas: Aluminum.
   c. Areas Indicated for Scrubbable Panels: Aluminum.
5. Cap Finish: Painted white.

D. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrolytically zinc coated, or hot-dip galvanized, G30 coating designation; with prefinished 9/16-inch- wide metal caps on flanges.

1. Structural Classification: Heavy-duty system.
2. End Condition of Cross Runners: butt-edge type.
3. Face Design: Flat, flush.
4. Cap Material: Cold-rolled steel or aluminum.
5. Cap Finish: Painted white.

2.5 ACCESSORIES

A. Attachment Devices: Size for five times the design load indicated in ASTM C635/C635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

1. Corrosion Protection: Carbon-steel components zinc plated to comply with ASTM B 633, Class Fe/Zn 5 (0.005 mm) for Class SC 1 service condition; unless otherwise indicated.
2. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594; for ceilings located in wet areas as follows:
   a. Shower Areas and Dishwashing Areas: Alloy 304 or 316.

B. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

1. Zinc-Coated Carbon-Steel Wire: ASTM A 641, Class 1 zinc coating, soft temper; unless otherwise indicated.
2. Nickel-Copper-Alloy Wire: ASTM B 164, nickel-copper-alloy UNS No. N04400; for ceilings located in wet areas including dishwashing areas.
3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch diameter wire.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Basis-of-Design Manufacturer: Use products from same manufacturer as ceiling system used.

B. Extruded Aluminum Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. For lay-in panels with reveal edge details, provide stepped edge molding that forms reveal of same depth and width as that formed between edge of panel and flange at exposed suspension member.
2. For curved penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Special Accessories for Acoustical Ceilings: Provide factory-prepared units as described below to accommodate installation conditions indicated, finished to match appearance of exposed suspension system members.

1. Accessory for Bullnose Concrete Masonry: Snap-over molding to trim outside corners, fitting over 1-inch radius masonry units.
   a. Basis-of-Design Product: Bullnose Corner Cover No. 7866; Armstrong.
2. Drywall Transition Clip: For transition from 5/8 inch gypsum board to acoustical ceiling; eliminates need for drywall bead.
   a. Basis-of-Design Product: DW58; Armstrong.
3. Expansion Joints: Special moldings and trim to accommodate building expansion joints in ceiling assemblies as indicated.
4. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches on center on all cross tees.
   a. Locations: Provide hold-down clips for acoustical ceilings located in toilet rooms.

PART 3 - EXECUTION

3.1 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders unless otherwise indicated.

B. Layout openings for penetrations centered on the penetrating items.

3.2 INSTALLATION

A. Install acoustical panel ceilings in accordance with ASTM C636/C636M and manufacturer's written instructions.

B. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Do not use exposed fasteners, including pop rivets, on moldings and trim.
3. Arrange directionally patterned acoustical panels as follows:
   a. As indicated on reflected ceiling plans.

END OF SECTION 095113

SECTION 09 6513

RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Thermoset-rubber base.
2. Resilient stair treads and landing tiles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.5 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F , in spaces to receive resilient products during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F .

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by listed manufacturer or one of the following:

1. Roppe
2. Flexco
3. Johnsonite
4. Or equal as approved by Professional.

2.3 THERMOSET-RUBBER BASE (RB)

1. Rubber Wall Base: ASTM F 1861.
2. Type (Material Requirement): TS (rubber, vulcanized thermoset).
3. Group (Manufacturing Method): I (solid).
4. Style: Cove with top-set toe.
5. Minimum Nominal Thickness: 1/8 inch.
6. Height: 4 inches.
7. Lengths: Cut to size from coils; use of 4 foot or other single lengths is not permitted.
8. Exterior Corners: Job-formed.
9. Interior Corners: Job-formed.
10. Color: To be selected by Architect by manufacturer’s full range

2.4 RESILIENT STAIR ACCESSORIES (RTR)

A. Rubber Stair Treads: Products of style suitable for use indicated and complying with FS RR-T-650, Composition A, Type 2 design (designed) products complying with the following requirements.

1. Type: Combination tread and riser.
2. Type 2 Design: Hammered pattern with minimum 2 inch wide contrasting nosing strip in color selected by Architect.
3. Thickness: 1/4 inch tapering to 3/16 inch at back edge.
4. Size: Lengths and depths to fit each stair tread in one piece or, for treads exceeding maximum lengths manufactured, obtain Architect’s approval for joint locations.

B. Rubber Tiles for Stair Landings: Homogeneous rubber tile, solid color.

1. Wearing Surface: Molded pattern matching stair treads.
2. Thickness: 0.125 inch.
3. Size: Not less than 18 by 18 inches.

2.5 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum horizontal surfaces thoroughly.
3. Damp-mop horizontal surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 6513

SECTION 09 6516

RESILIENT SHEET FLOORING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section Includes:

1. Vinyl sheet flooring.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color, texture, and pattern specified, in manufacturer's standard size, but not less than 6-by-9-inch sections.

1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 68 deg F or more than 80 deg F, in spaces to receive resilient sheet flooring during the following periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F .

C. Close spaces to traffic during resilient sheet flooring installation.

D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.

E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by listed manufacturer or approved equal from one of the following:

1. Altro
2. Polyflor
3. Gerflor
4. Or equal as approved by Professional.

2.3 COMMERCIAL KITCHEN SAFETY VINYL SHEET FLOORING (SV)

A. Basis-of-Design Manufacturer: Altro

1. Material: Stronghold 30
2. Color: Cannon K30911
3. Roll Width: 6’-7”
4. Roll Length: 66’
5. Thickness: 2.5mm
6. ASTM D2047, .92 Dry, .88 Wet
7. Roll Weight: 275 lbs.

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

1. Verify adhesives have a VOC content of 50 g/L or less.

C. Seamless-Installation Accessories:

1. Heat-Welding Bead: Manufacturer's solid-strand product for heat welding seams.
   a. Colors: Match flooring.

D. Integral-Flash-Cove-Base Accessories:

1. Cove Former: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
2. Cap Strip: Metal, vinyl, or rubber cap provided or approved by resilient sheet flooring manufacturer.

E. Metal Edge Strips:

1. Aluminum extruded, smooth, stainless steel with lip to extend over flooring.

F. Caulking:

1. Colors: Match flooring.
2. For use where flooring abuts edges, skirtings, wall surfaces or where the flooring is cut around pipes and door frames.

G. Stainless Steel Deflector Plate:

1. For use under stove equipment not fitted with such

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 200 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

D. Do not install resilient sheet flooring until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

H. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to fuse sections permanently into a seamless flooring installation. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

I. Integral-Flash-Cove Base: Cove resilient sheet flooring 6 inches up vertical surfaces. Support flooring at horizontal and vertical junction with cove strip. Butt at top against cap strip.

1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient sheet flooring.

B. Perform the following operations immediately after completing resilient sheet flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 09 6516

SECTION 096519

RESILIENT TILE FLOORING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Resilient floor tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and pattern specified.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are competent in techniques required by manufacturer for floor tile installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Testing Requirements:

1. Slip Resistance ASTM D2047: ADA Compliant
2. Static Load Limit ASTM F970: 1500 psi
3. Residual Indentation F1914: passes , 8%
4. Flexibility ASTM F137: Passes
5. Resistance to Heat ASTM F1514: Passes
6. Resistance to Light ASTM F1515: Passes
7. Resistance to Chemicals ASTM F925: Passes

8. Radiant Flux ASTM E648: / 0.45 W/sq. cm., Class I
9. Smoke Density ASTM E662: Passes, <450

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by listed manufacturer or one of the following:

1. Patcraft
2. Shaw Contract
3. Interface
4. Tarkett
5. Or equal as approved by Professional.

2.3 RESILIENT TILE

A. Resilient Vinyl Tile (LVT-1)

1. Basis-of-Design Manufacturer: Patcraft
2. Product: Paint Palette I840V
3. Color: Gesso 00510
4. Size: 12” x 24”
5. Thickness: 2.5mm
6. Wear Layer: 20 mil
7. Finish: Equivalent to Patcraft “ExoGuard+”

B. Resilient Vinyl Tile (LVT-2)

1. Basis-of-Design Manufacturer: Patcraft
2. Product: Paint Palette I840V
3. Color: Indigo 00480
4. Size: 12” x 24”
5. Thickness: 2.5mm
6. Wear Layer: 20 mil
7. Finish: Equivalent to Patcraft “ExoGuard+”

C. Resilient Vinyl Tile (LVT-3)

1. Basis-of-Design Manufacturer: Patcraft
2. Product: Paint Palette I840V
3. Color: Sumi 00580
4. Size: 12” x 24”
5. Thickness: 2.5mm
6. Wear Layer: 20 mil
7. Finish: Equivalent to Patcraft “ExoGuard+”

D. Resilient Vinyl Tile (LVT-4)

1. Basis-of-Design Manufacturer: Patcraft
2. Product: Treeline 20mil I707V
3. Color: Camel 00713
4. Size: 7” x 48”
5. Thickness: 2.5mm

6. Wear Layer: 20 mil
7. Finish: Equivalent to Patcraft “ExoGuard”

2.4 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland-cement-based or blended hydraulic-cement-based formulation provided or approved by floor tile manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by floor tile and adhesive manufacturers to suit floor tile and substrate conditions indicated.

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by floor tile manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by floor tile manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
    a. Anhydrous Calcium Chloride Test: ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
    b. Relative Humidity Test: Using in-situ probes, ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install floor tiles until materials are the same temperature as space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient floor tile and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient floor tile.

3.2 FLOOR TILE INSTALLATION

A. Comply with manufacturer's written instructions for installing floor tile.

B. Lay out floor tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay tiles in pattern indicated on Drawings.

C. Match floor tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles in pattern of colors and sizes indicated.

D. Scribe, cut, and fit floor tiles to butt neatly and tightly to vertical surfaces and permanent fixtures including built-in furniture, cabinets, pipes, outlets, and door frames.

E. Extend floor tiles into toe spaces, door reveals, closets, and similar openings. Extend floor tiles to center of door openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on floor tiles as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install floor tiles on covers for telephone and electrical ducts, building expansion-joint covers, and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of tile installed on covers and adjoining tiles. Tightly adhere tile edges to substrates that abut covers and to cover perimeters.

H. Adhere floor tiles to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

END OF SECTION 096519

SECTION 096813

TILE CARPETING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Modular carpet tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For carpet tile installation, plans showing the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Carpet tile type, color, and dye lot.
3. Type of subfloor.
4. Type of installation.
5. Pattern of installation.
6. Pattern type, location, and direction.
7. Pile direction.
8. Type, color, and location of insets and borders.
9. Type, color, and location of edge, transition, and other accessory strips.
10. Transition details to other flooring materials.

C. Samples: For each exposed product and for each color and texture required.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

B. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: Certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

1.7 WARRANTY

A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Performance Characteristics:

1. Appearance Retention Rating: Severe traffic, 3.5 minimum according to ASTM D7330.
2. Critical Radiant Flux Classification: Not less than 0.45 W/sq. cm according to NFPA 253.
3. Dry Breaking Strength: Not less than 100 lbf according to ASTM D2646.
4. Tuft Bind: Not less than 6.2 lbf according to ASTM D1335.
5. Delamination: Not less than 3.5 lbf/in. according to ASTM D3936.
6. Dimensional Tolerance: Within 1/32 inch of specified size dimensions, as determined by physical measurement.
7. Dimensional Stability: 0.2 percent or less according to ISO 2551 (Aachen Test).
8. Colorfastness to Crocking: Not less than 4, wet and dry, according to AATCC 165.
9. Colorfastness to Light: Not less than 4 after 60 AFU (AATCC fading units) according to AATCC 16, Option E.

B. Testing Requirements:

1. Pill Test CPSC FF 1 70: Pass
2. Radiant Panel ASTM E648: Class I
3. NBS smoke ASTM E662 NF: <450
4. Static AATCC 134: <3.5 kv
5. Coefficient of Friction: 0.6 (Meets ADA requirements)
6. Wear Rating: ASTM D5252 Heavy

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by listed manufacturer or one of the following:

1. Patcraft
2. Shaw Contract
3. Interface
4. Tarkett

5. Or equal as approved by Professional.

2.3 CARPET TILE

A. Carpet Tile (CPT-1):

1. Basis-of-Design Manufacturer: Patcraft
2. Style: Unhemmed I0637
3. Color: Sheer 00120
4. Construction: Multi-level pattern loop
5. Fiber: Post-industrial recycled nylon
6. Dye Methold: 100% solution dyed
7. Size: 18” x 36”
8. Gauge: 1/10 inches
9. Stitches: 10 per inch
10. Finished Pile Thickness: 0.145 inches
11. Total Thickness: 0.308 inches
12. Average Density: 5959 oz/yd³
13. Tufted Yarn Weight: 24 oz/yd²
14. Primary Backing: Non-woven synthetic
15. Secondary Backing: Equivalent to Patcraft “Ecoworx Tile”

B. Carpet Tile (CPT-2):

1. Basis-of-Design Manufacturer: Patcraft
2. Style: Running Stitch I0635
3. Color: Sheer 00120
4. Construction: Multi-level pattern loop
5. Fiber: Post-industrial recycled nylon
6. Dye Methold: 100% solution dyed
7. Wear Rating: ASTM D5252 Heavy
8. Size: 18” x 36”
9. Gauge: 1/10 inches
10. Stitches: 9.33 per inch
11. Finished Pile Thickness: 0.127 inches
12. Total Thickness: 0.308 inches
13. Average Density: 7087 oz/yd³
14. Tufted Yarn Weight: 25 oz/yd²
15. Primary Backing: Non-woven synthetic
16. Secondary Backing: Equivalent to Patcraft “Ecoworx Tile”

2.4 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that comply with flammability requirements for installed carpet tile, and are recommended by carpet tile manufacturer for releasable installation.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Concrete Slabs:

1. Moisture Testing: Perform tests so that each test area does not exceed 1000 sq. ft. , and perform no fewer than three tests in each installation area and with test areas evenly spaced in installation areas.
   a. Anhydrous Calcium Chloride Test: ASTM F1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
   b. Relative Humidity Test: Using in situ probes, ASTM F2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level measurement.
   c. Perform additional moisture tests recommended in writing by adhesive and carpet tile manufacturers. Proceed with installation only after substrates pass testing.

3.2 PREPARATION

A. General: Comply with the Carpet and Rug Institute's CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider, and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Concrete Substrates: Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by adhesive and carpet tile manufacturers.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with the Carpet and Rug Institute's CRI 104, Section 10, "Carpet Tile," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye-lot integrity. Do not mix dye lots in same area.

D. Maintain pile-direction patterns indicated on Drawings.

E. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

F. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

G. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on carpet tile as marked on subfloor. Use nonpermanent, nonstaining marking device.

H. Install pattern parallel to walls and borders.

I. Access Flooring: Stagger joints of carpet tiles so carpet tile grid is offset from access flooring panel grid. Do not fill seams of access flooring panels with carpet adhesive; keep seams free of adhesive.

J. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 096813

SECTION 09 7200

WALL COVERINGS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Vinyl wall covering.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.

B. Samples: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36 inches long in size.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet-work in spaces is complete and dry, work above ceilings is complete, and HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by listed manufacturer or from one of the following:

1. Momentum
2. Versad
3. Lanark
4. Eykon
5. D.L. Couch
6. Or equal as approved by Professional.

2.2 DIGITAL IMAGE VINYL WALL COVERING (WC-1)

A. Material Composition: Digital image shall be printed on no less than 52 inch/54 inch vinyl wall covering substrate using UV piezo drop on demand technology or Ecosol with environmentally friendly ink systems. Printing produced in CMYK or RGB. Images shall be dried and fully cured prior to shipping.

B. Manufacturers: Subject to compliance with requirements, provide products by listed manufacturer or from one of the following:

1. Momentum Digital Creations, custom graphic
2. DesignTex Digital Studio, custom graphic
3. Takeform Amplify, custom graphic
4. Or equal as approved by Professional.

C. Provide 6 (six) hours of art coordination with the digital wall covering manufacturer.

2.3 VINYL WALL COVERING (WC-2)

A. All materials shall be mercury and cadmium free. Material shall have antimicrobial inhibitors throughout the vinyl substrate and shall conform to CFFA-W-101-D, CCC-408-D, C, B, A by using the test methods as outlined by FedSpec CCC-T-191B, except as otherwise specified.

A. Manufacturers: Subject to compliance with requirements, provide products by listed manufacturer or from one of the following:

1. Momentum
2. Versa
3. Lanark
4. Eykon
5. Or equal as approved by Professional.

B. Basis-of-Design Manufacturer: Versa
1. Pattern: Alegre

2. Color: Jazz A203-357
3. Type: II
4. Weight: 20 oz.
5. Width: 52/54”
6. Content: 100% vinyl
7. Backing: Osnaburg
8. Flame Resistance: ASTM E84 Class A

2.4 VINYL WALL COVERING (WC-3)

C. All materials shall be mercury and cadmium free. Material shall have antimicrobial inhibitors throughout the vinyl substrate and shall conform to CFFA-W-101-D, CCC-408-D, C, B, A by using the test methods as outlined by FedSpec CCC-T-191B, except as otherwise specified.

B. Manufacturers: Subject to compliance with requirements, provide products by listed manufacturer or from one of the following:

1. Momentum
2. Versa
3. Lanark
4. Eykon
5. Or equal as approved by Professional.

D. Basis-of-Design Manufacturer: Lanark
1. Pattern: French Crown
2. Color: Fountain Blue LLN-FC-08
3. Type: II
4. Weight: 20 oz.
5. Width: 52/54”
6. Content: 100% vinyl
7. Backing: Non-woven, 50% post-consumer recycled content
8. Flame Resistance: ASTM E84 Class A

2.4 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.

B. Primer/Sealer: Mildew resistant, complying with requirements in Section 09 9123 "Interior Painting" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended in writing by wall-covering manufacturer.

1. Verify adhesives have a VOC content of 50 g/L or less.

PART 3 - EXECUTION

3.3 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation surfaces being true in plane and vertical and horizontal alignment, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, and mildew.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.

1. Gypsum Board: Apply primer/sealer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.

D. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

E. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.5 INSTALLATION OF WALL LINER

A. Install wall liner, without gaps or overlaps. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.

3.6 INSTALLATION OF WALL COVERING

A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.

B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.

C. Install strips in same order as cut from roll.

1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.

D. Install wall covering without lifted or curling edges and without visible shrinkage.

E. Match pattern 72 inches above the finish floor.

F. Install seams vertical and plumb at least 6 inches from outside corners and 3 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.

G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.

H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.7 CLEANING

A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.

B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 7200

SECTION 098400
DIRECT-ATTACHED ACOUSTICAL INTERIOR PANELS
(CEMENTITIOUS WOOD FIBER CEILINGS)

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Cementitious wood fiber plank acoustical ceiling system

1.3 REFERENCES

A. American Society for Testing and Materials (ASTM)
B. ASTM C 423 Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method
C. ASTM E 84 Standard Test Method for Surface Burning Characteristics of Building Materials
D. ASTM E2768-11(2018) Standard Test Method for Extended Duration Surface Burning Characteristics of Building Materials
E. ASTM E 580 Installation of Metal Suspension Systems in Areas Requiring Moderate Seismic Restraint
F. ASTM C636 / C636M - 19 Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-In Panels
G. ASTM C 754 Installation of Steel Framing Members to Receive Screw-Attached Gypsum Board
H. ASTM E 1264 Classification for Acoustical Ceiling Products
I. ASTM D 3273 Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber
J. International Building Code
K. ASHRAE Standard 62.1-2004, "Ventilation for Acceptable Indoor Air Quality"
L. NFPA 70 National Electrical Code
M. ASCE 7 American Society of Civil Engineers, Minimum Design Loads for Buildings and Other Structures
N. International Code Council-Evaluation Services - AC 156 Acceptance Criteria for Seismic Qualification Testing of Non-structural Components
O. International Well Building Standard
P. Mindful Materials
Q. Living Building Challenge
R. U.S. Department of Agriculture BioPreferred program (USDA BioPreffered).

B.

1.4 SYSTEM DESCRIPTION

Direct attached acoustical ceiling systems manufactured from domestic cementitious wood fiber.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer’s technical data for each type of Direct-Attach ceilings or walls required.

B. Samples: Minimum 6 inch x 6 inch samples of specified Direct-Attached interior panels.

C. Shop Drawings: Layout and details of Direct-Attached interior panels show locations of items that are to be coordinated with the installation as required.

D. Certifications: UL certifications that products comply with specified requirements, including laboratory reports showing compliance with specified tests and standards. Acoustical performance, products must be tested to the A, D-20, C-20, or C-40 method.

E. Country of Origin: Submittals must be accompanied by letter, label or certification indicating the manufacturing country of origin. Comply with Made in USA requirements as applicable for the project.

F. If the material supplied by the acoustical subcontractor does not have an Underwriter's Laboratory classification of acoustical performance as specified in Section 2.2, subcontractor shall be required to send material from every production run appearing on the job, finished as intended to be installed, to an independent or NVLAP approved laboratory for testing, at the architect's or Client Agencies discretion. All products not conforming to manufacturer's current published values must be removed, disposed of and replaced with complying product at the expense of the Contractor performing the work.

1.6 QUALITY ASSURANCE

A. Single-Source Responsibility: Provide acoustical panel units and grid components by a single manufacturer.

B. Fire Performance Characteristics: Identify acoustical ceiling components with appropriate UL markings.

1. Surface Burning Characteristics: Tested per ASTM E 84 and complying with ASTM E 1264 Classification.

C. As with other architectural features located at the ceiling, may obstruct or skew the planned fire sprinkler water distribution pattern through possibly delay or accelerate the activation of the sprinkler or fire detection systems by channeling heat from a fire either toward or away from the device. Designers and installers are advised to consult a fire protection engineer, NFPA 13, or their local codes for guidance where automatic fire detection and suppression systems are present.

D. Coordination of Work: Coordinate acoustical ceiling work with installers of related work including, but not limited to building insulation, gypsum board, light fixtures, mechanical systems, electrical systems, and sprinklers.

1.7 DELIVERY, STORAGE & HANDLING

A. Deliver acoustical ceiling units to project site in original, unopened packages and store them in a fully enclosed space where they will be protected against damage from moisture, direct sunlight, surface contamination, and other causes.

B. Provide labels indicating brand name, style, size and thickness.

C. Before installing acoustical ceiling units, permit them to reach room temperature and a stabilized moisture content.

D. Handle acoustical ceiling units carefully to avoid chipping edges or damaged units in any way.

C.

1.8 PROJECT/SITE CONDITIONS

A. Environmental Requirements:

B. Do not install ceiling panels until building is closed in and HVAC system is operational.

C. Locate materials onsite at least 72 hours before beginning installation to allow materials to reach temperature and moisture content equilibrium.

D. Maintain the following conditions in areas where acoustical materials are to be installed 72 hours before, during and after installation:

1. Relative Humidity: 25 - 85%.

2. Uniform Temperature: 32 - 120 degrees F (0 - 49 degrees C).

1.9 WARRANTY

A. Direct-Attached Ceiling and Wall Panels: Submit a written warranty executed by the manufacturer, agreeing to repair or replace panels that fail within the warranty period. Failures include, but are not limited to the following:

1. Defects in materials or factory workmanship.

B. Direct-Attach Ceiling and Wall Panels warranty - Thirty (30) years from date of substantial completion.

C. The Warranty shall not deprive the Client Agencies of other rights the Client Agency may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under the requirements of the Contract Documents.

PART 2 PRODUCTS
2

2.1 Manufacturer
A. Basis of Design Direct-Attached Wall or Ceiling Panels:
1. Subject to compliance with requirements provide Tectum Panels manufactured by Armstrong World Industries, Inc. or one of the following:
2. Acoustical Surfaces, Inc.
3. ASI Architectural
4. Timberwool
5. USG
6. Or equal as approved by Professional.

2.2 DIRECT-ATTACH CEILING PANELS

A. Acoustical Panels Type AP-1:
1. Surface Texture: Coarse
2. Composition: Aspen wood fibers bonded with inorganic hydraulic cement
3. Finish: Surface appearance shall be consistent from panel to panel
4. Color: Natural or White.
5. Size: 23 ¾” x 48”.
6. Thickness: 1-1/2”
7. Edge Profile: Long edge/short edge – Bevel/Bevel.
8. UL Classified Noise Reduction Coefficient (NRC): ASTM C 423; 1-1/2” thick panels mounting method: C-40(0.90); Classified with UL label.
9. UL Classified Flame Spread: ASTM E 1264; Class A. Product must be able to meet this criteria after being painted six times.
10. Dimensional Stability/Mold Resistance: HumiGuard Plus and no significant mold growth when tested by ASTM D3273.
11. USDA Certified Biobased Product, 98%
12. Basis of Design Product: Tectum Direct-Attach: 8175T15PC1-C-20 as manufactured by Armstrong World Industries, or equal approved by Professional.

2.3 SUSPENSION SYSTEMS
A. Accessories: Manufacturer’s standard painted head fasteners.
B. Attachment Component for Direct Attached to Heavy gauge metal steel
1. 1-5/8" drill point screws item 8188L16

PART 3 - EXECUTION

3.1 EXAMINATION

A. Do not proceed with installation until all wet work such as concrete, terrazzo, plastering and painting has been completed and thoroughly dried out, unless expressly permitted by manufacturer’s printed recommendations.

3.2 PREPARATION

A. Measure each wall area and establish layout of wall units. Coordinate panel layout with mechanical and electrical fixtures.

B. Coordination: Furnish layouts for preset inserts, clips, and other ceiling anchors whose installation is specified in other sections.

3.3 INSTALLATION

A. Install Panels in accordance manufacturer’s installation instructions.

3.4 ADJUSTING AND CLEANING

A. Replace damaged and broken Direct-Attached Panels.

B. Clean exposed surfaces of acoustical ceilings, including trim, edge moldings, and suspension members. Comply with manufacturer’s instructions for cleaning and touch up of minor finish damage. Remove any Direct-Attached Ceiling Panels that cannot be successfully cleaned and or repaired. Replace with new product to eliminate evidence of damage.

END OF SECTION

SECTION 098436

SOUND ABSORBING CEILING UNITS

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SECTION INCLUDES

A. Pendant LED Lighting with Acoustic Housing.

B. Unlit Acoustic Baffles.

1.3 DEFINITIONS:

A. NRC: Noise Reduction Coefficient.

B. PET: Polyethylene Terephthalate; the commercial name for polyester.

C. SAA: Sound Absorption Average.

D. Sabin: A sound measurement of the ability of one square foot of any surface texture in a room to absorb sound reflections.

1.4 SUBMITTALS

A. Product Data: Manufacturer's technical data sheets, specifications, performance data and installation instructions for all products referenced in the scope of work defined in this section.

B. Shop Drawings: Submit shop drawings required to depict the requirements for fabrication and installation. Include the following drawings as applicable:
   1. Reflected ceiling plan to coordinate lighting with HVAC and any other items mounted in the ceiling.
   2. Details such as sections, elevations, or isometric views of individual parts including location and appropriate detailing methods for transitions, terminations, penetrations, installation tolerances, and relationships to adjacent work.
   3. Where the installation is required to comply with specific design criteria, include all details required to perform proper analysis.Manufacturer’s standard fixture schedule coordinated with project requirements and the fixture schedule on the drawings. Selection Samples: Provide 3 by 4 inch samples depicting the manufacturer’s full range of options for selection of color and finish.

D. Verification Samples: Provide samples to verify specified finishes, profiles and accessories.

E. Warranty: Manufacturer’s sample warranty document, outlining its terms, conditions, limitations, and duration.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: Primary products in this section to be provided by a manufacturer with no less than three years of experience producing the products specified in this section at a facility in the United States.

B. Installer's Qualifications: All work specified in this section is to be completed by a firm with demonstrated experience installing systems similar in scope and complexity to those specified.

C. Mock-Up: Arrange for the construction of a mock-up of the products specified in this section. Example must include one light fixture and accessory for each type specified, including the selected color and finish. Client Agency and Architect will verify acceptance of products and workmanship.
   1. Accepted mockups may be incorporated into the work.
   2. Provide mockups as indicated on the drawings.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver, store and handle materials and products in accordance with the manufacturer's instructions and recommendations and industry standards.

B. Store all materials in the manufacturer’s original packaging until ready for installation. Protect all products from damage or exposure to adverse environmental conditions, including weather, humidity, and dust.

C. Coordinate pallet sizes, weights, and delivery schedule with manufacturer.

1.7 PROJECT CONDITIONS

A. Begin installation only after spaces are enclosed and weather-tight, and after all wet work and overhead work has been completed.

B. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's recommended limits.

1.8 COORIDNATION AND SCHEDULING

A. Coordinate locations of lighting fixtures with walls, ceilings, ceiling mounted components, fire partitions, and cabinets.

1.9 WARRANTY

A. Manufacturer’s Warranty: Manufacturer agrees to replace products that fail within the specified warranty period.
   1. Lit Products: 5 years from date of Substantial Completion.
   2. Unlit Products: One year from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Manufacturer: Focal Point LLC. Subject to compliance with requirements, provide the listed product or one of the following:
   1. Acoufelt.
   2. Armstrong
   3. MPS Acoustics
   4. Or equal as approved by Professional.

2.2 PERFORMANCE REQUIREMENTS

A. System Certifications:
   1. UL/cUL and ETL certification marks for Canada/USA.

B. Safety Standards:

1. UL/cUL 1598; Pass, Standard for Luminaires in Non-Hazardous Locations.
2. UL/cUL 294; Pass, Standard for Emergency Lighting and Power Equipment.
3. UL/cUL 8750; Pass, Standard for Light Emitting Diode (LED) Equipment for use in Lighting Products.

C. Fire Performance Characteristics: Provide products with manufacturer's standard PET acoustic housing complying with the following:
1. Flame-Spread and Smoke-Developed Indexes: 0 and 300, respectively, when tested in accordance with ASTM E84.

D. LED Performance:
1. LED Board: Provide manufacturer's standard LED Board with no hum or flicker.

E. Electrical Power: Provide fixtures capable of being powered by the following power sources with flicker free performance:

F. Dimming: Provide Class 2 Drivers ETL and UL approved with 10% dimming capacity.

2.3 LINEAR LED LIGHTING WITH ACOUSTIC BAFFLE HOUSING

A. Basis of Design Product: Seem 1 Acoustic, by Focal Point Lights.

B. Physical Requirements:
1. Length: As indicated on drawings.
2. Height: 12 inches.
3. Width: 2.27 inches.

C. Installation Method: Suspended, see drawings.

D. Installation Method: Direct attached to grid or strut, see drawings.

E. Lighting Configuration: Direct and Indirect.

F. Lens: Provide frosted acrylic lens that provides even, uninterrupted illumination without pixels or shadows regardless of length.

G. Noise Reduction Coefficient: Apparent value from total coverage area when tested from 200 Hz to 2500 Hz in accordance with ASTM C423.
1. NRC Rating: 0.70 for baffles 12 inches tall at 24-inch spacing.

2.4 UNLIT ACOUSTIC BAFFLE.

A. Basis of Design Product: Seem 1 Acoustic Unlit, by Focal Point.

B. Physical Requirements:
1. Length: See drawings.
2. Height: 12 inches.
3. Width: 2.27 inches.

C. Installation Method: Suspended.

D. Installation Method: Direct attached to grid or strut.

E. Noise Reduction Coefficient: Apparent value from total coverage area when tested from 200 Hz to 2500 Hz in accordance with ASTM C423.
1. NRC Rating: 0.70 for baffles 12 inches tall at 24-inch spacing.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin work until adjacent substrates have been properly prepared to receive work specified in this section.

B. Verify that locations of concealed reinforcements have been clearly marked for the installer.

C. Locate reinforcement points and clearly mark their locations if not already done.

3.2 PREPARATION

A. Clean surfaces prior to installation.

B. Protect all adjacent surfaces from possible damage during installation of units.

C. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 INSTALLATION

A. Install in accordance with manufacturer's current installation instructions, industry recognized best practices, and all code bodies having jurisdiction; do not install damaged products.

B. Test for proper operation and adjust until satisfactory results are obtained.

C. Adjust fixture suspension heights to match RCP and submittal drawings.

D. Protect finishes from damage during installation using manufacturer's recommendations.

3.4 CLEANING AND PROTECTION

A. Remove dust and debris with a clean soft lint-free cloth or vacuum.

B. Damaged products must be repaired or replaced prior to substantial completion.

C. Protect installed products until completion of work specified in this section.

END OF SECTION

SECTION 09 9133

PAINTING AND COATING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes surface preparation and field painting of the following:
   1. Exposed exterior items and surfaces.
   2. Exposed interior items and surfaces.
   3. Repainting and surface preparation at areas of remodeling. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.
   1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
   1. Prefinished items include the following factory-finished components:
      a. Architectural woodwork and casework, unless otherwise indicated**.**
      b. Acoustical wall panels.
      c. Toilet compartments.
      d. New metal lockers.
      e. Elevator entrance doors and frames.
      f. Elevator equipment.
      g. Finished mechanical and electrical equipment, unless otherwise indicated.
      h. Light fixtures.
      i. Distribution cabinets, except when in corridors or other normally occupied rooms.
   2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
      a. Foundation spaces.
      b. Furred areas.
      c. Ceiling plenums.
      d. Utility tunnels.
      e. Pipe spaces.
      f. Duct shafts.
      g. Elevator shafts.
   3. Finished metal surfaces include the following:

a. Anodized aluminum.
b. Stainless steel, except exposed metal flashing indicated for field-painted finish.
c. Chromium plate.
d. Copper.
e. Bronze and brass.

4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.
   e. Sprinkler heads.
5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other code-required labels or equipment name, identification, performance rating, or nomenclature plates.

1.3 DEFINITIONS

A. General: Standard coating terms defined in ASTM D 16 apply to this Section.
   1. Flat: Lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
   2. Eggshell: Low-sheen finish with a gloss range between 5 and 20 when measured at a 60-degree meter.
   3. Satin: Low-sheen finish with a gloss range between 15 and 35 when measured at a 60-degree meter.
   4. Semigloss: Medium-sheen finish with a gloss range between 30 and 65 when measured at a 60-degree meter.
   5. Full Gloss: High-sheen finish with a gloss range more than 65 when measured at a 60-degree meter.

1.4 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.
   1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.
   2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.

B. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
   1. Provide stepped Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.
   2. Provide a list of materials and applications for each coat of each Sample. Label each Sample for location and application.

C. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and Client Agent, and other information specified.

1.5 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to that indicated for this Project with a record of successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type and color of coating and substrate required on the Project. Comply with procedures specified in PDCA P5. Duplicate finish of approved prepared samples.
   1. Architect will select one room or surface to represent surfaces and conditions for each type of coating and substrate to be painted.
      a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
      b. Small Areas and Items: The Architect will designate an item or area as required.
   2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
      a. After finishes are accepted, the Architect will use the room or surface to evaluate coating systems of a similar nature.
   3. Final approval of colors will be from job-applied samples.

1.6 REGULATORY REQUIREMENTS

A. Comply with the applicable provisions of all codes, standards and specifications referenced in this section.
   1. Chemical Components of Field-Applied Interior Paints and Coatings: Provide products that comply with the limits for VOC content of the Ozone Transport Commission (OTC) effective January 1st, 2005.

1.7 PRODUCT HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label, and the following information:
   1. Product name or title of material.
   2. Product description (generic classification or binder type).
   3. Manufacturer's stock number and date of manufacture.
   4. Contents by volume, for pigment and vehicle constituents.
   5. Thinning instructions.
   6. Application instructions.
   7. Color name and number.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.
   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.8 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.
   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Product: Subject to compliance with requirements, provide one of the products listed or equal as approved by Professional.

B. Manufacturers Names: : One or more of the following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:
   1. Benjamin Moore (BMoore).
   2. Sherwin Williams (S/W).
   3. Pittsburgh Paints (PPG).
   4. Duron, Inc. (Duron).
   5. Minwax Company (Minwax).
   6. Or equal as approved by Professional.

2.2 PAINT MATERIALS, GENERAL

A. Material Compatibility: Provide block fillers, primers, undercoats, and finish-coat materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.

B. Provide systems indicated. Where substrates are required to be finished, but no system is specified for that particular substrate, employ finish system most closely related to that scope of work but modified with appropriate primers. In the case of components on walls, use system for adjacent wall or trim as determined by Architect. In the case of components on or suspended from ceilings or decks, use semigloss paint system.

C. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
   1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

D. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction**.** and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base:
   1. Flat Paints and Coatings: 50 g/L.
   2. Nonflat Paints and Coatings: 150 g/L.
   3. Dry-Fog Coatings: 400 g/L.
   4. Primers, Sealers, and Undercoaters: 200 g/L.
   5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.

6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
7. Pretreatment Wash Primers: 420 g/L.
8. Floor Coatings: 100 g/L.
9. Shellacs, Clear: 730 g/L.
10. Shellacs, Pigmented: 550 g/L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
   1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
   2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
   1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.2 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
   2. Mask surfaces and construction adjacent to paint application areas to prevent paint from spilling or spattering other areas.

B. Preparing Previously Painted Surfaces: Remove existing paint from surfaces indicated using scrapers or chemical paint stripper as follows:
   1. Strip loose, chipped, alligatored or otherwise deteriorated paint using methods that will not damage existing surfaces.
   2. Remove paint to sound substrate. Sound, well-adhered paint may remain on surface.
   3. Rub steel surfaces to remove rust bloom, and solvent clean prior to priming.
   4. Allow surfaces to dry and sand smooth.
   5. Clean surfaces so they are free of dust and dirt.
   6. Fill cracks, gouges and nail holes with suitable filler prior to application of first coat.
   7. Complete surface preparation to produce a smooth, uniform substrate suitable for application of primer and finish coats specified.
   8. Apply test patch to confirm adhesion and compatibility. Check adhesion after 7 days.

C. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.
   1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

D. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
   1. Provide barrier coats over incompatible primers or remove and reprime.
   2. Cementitious Materials: Prepare concrete and masonry surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
      a. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's written instructions.
   3. Precast Concrete Surfaces: Finish patched or repaired areas to provide a uniform texture and surface. Grind down any ridges or other protrusions flush with surrounding surfaces; remove all grinding sludge and dust.
      a. After surfaces are prepared and dry, apply a full coat of surface primer specified in Part 2 for precast concrete surfaces, over entire surface. Allow to dry before application of textured paint finish.
   4. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.
      a. When transparent finish is required, backprime with spar varnish.
   5. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council's (SSPC) recommendations.
      a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
      b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
      c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.
   6. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
   7. Previously Painted Surfaces: If in sound condition, clean the surface of all foreign material. Smooth, hard or glossy coatings and surfaces should be dulled by abrading the surface. Apply a test area, allowing paint to dry one week before testing adhesion. If adhesion is poor, additional abrasion of the surface and/or removal of the previous coating may be necessary. Retest surface for adhesion. If paint is peeling or badly weathered, clean surface to sound substrate and treat as a new surface as above. Recognize that any surface preparation short of total removal of the old coating may compromise the service length of the system.

E. Materials Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
   1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
   2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
   3. Use only thinners approved by paint manufacturer and only within recommended limits.

F. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
   1. Paint colors, surface treatments, and finishes are indicated in the schedules.
   2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
   3. Provide finish coats that are compatible with primers used.
   4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
   5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
   6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
   7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
   8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
   9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
   1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
   2. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
   3. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
   1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
   2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
   3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.
      a. For electrostatic painting, use spray equipment designed to negatively charge the paint particles, with a connection of spray gun to a generator.
   4. Use rollers, not spray equipment, for application on sound-absorbing concrete masonry units.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer. Use application rate to achieve finished dry film thickness (DFT) as indicated for each coat.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.

F. Mechanical items to be painted include, but are not limited to, the following:
   1. Cabinet heater enclosures.
   2. Piping, pipe hangers, and supports.
   3. Heat exchangers.
   4. Tanks.
   5. Ductwork.
   6. Insulation.
   7. Supports.
   8. Motors and mechanical equipment.
   9. Accessory items.

G. Electrical items to be painted include, but are not limited to, the following:
   1. Conduit and fittings.
   2. Switchgear.
   3. Panelboards.

H. Block Fillers: : Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
   1. Provide a smooth, uniform finish, appearance, and coverage. Spotting, laps, roller marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
   2. Spray application will not be permitted unless combined with back rolling or squeegeeing. Do not thin filler. Apply sufficient material to allow back rolling or squeegeeing to fill surface.
   3. Where two filler coats are scheduled, allow first coat to fully dry before application of second. Back roll or squeegee both coats.
   4. Do not use squeegee for scored unit masonry; backroll in manner that prevents buildup of block filler in score joints.
   5. Extend block filler coats the full extent of exposed surfaces. Protect adjacent surfaces.

I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been field prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
   1. Provide satin finish for final coats.

L. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING AND PROTECTION

A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.
   1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

B. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

C. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.
   1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.5 EXTERIOR PAINT SCHEDULE

A. General: Provide the finish systems scheduled for each material type indicated, applied at spreading rate recommended by manufacturer to achieve the total dry film thickness (DFT) listed.
   1. Provide 2 finish coats over the listed base coats (primer, filler, bond coat) except as otherwise indicated.

B. Exterior Concrete, Stucco, and Masonry (Other than Concrete Masonry Units):
   1. Elastomeric Finish:
      a. Primer: One coat masonry sealer
         1) BM: Acrulic Masonry Sealer (N066)Primer: Alkali-resistant, exterior, acrylic-latex primer or surface conditioner.
         2) Duron: Maxflex Step #1 Alkali Resistant Surface Conditioner, 80-135(11)(55); DFT as recommended by manufacturer.
         3)SW: Loxon XP, A24W400 series.
      b. First and Second Coats: : High build elastomeric – smooth water based finish.
         1) Duron: Maxflex High Build Elastomeric Finish; 10 mils DFT.
         2) SW: : Loxon XP, A24W400 series.
         3) PPG Paints: : PERMA-CRETE® HB 100% Acrylic Topcoat 4-22 series
         4) BM: : Super Spec Elastomeric Low Luster (055)

C. Exterior Ferrous Metal – :
   1. Semi-gloss, Urethane Finish:
      a. Primer: Provide primer over bare metal and over shop-applied primers.
         1) Carboline: Carboguard 60 Epoxy Coating 4.0 mils DFT
         2) Duron: Dura Clad High Build Epoxy Mastic 93 Series; 5.0 mils DFT.
         3) SW: Recoatable Epoxy 646
      b. First and Second Coats: Gloss urethane finish.
         1) Carboline: Carbothane 134HG; 2.0 mils DFT
         2) Duron: High Solids Acrylic Aliphatic Urethane, 33 Series; 4.0 mils DFT.
         3) SW: Hi-Solids Urethane coating, semi-gloss
         4) BM: Ultra Spec HP DTM Acrylic Semi Gloss (HP29)

3.6 INTERIOR PAINT SCHEDULE

A. General: Provide the finish systems scheduled for each material type indicated, applied at spreading rate recommended by manufacturer to achieve the total dry film thickness (DFT) listed.
   1. Provide 2 finish coats over the listed base coats (primer, filler, bond coat) except as otherwise indicated.

B. Interior Concrete Masonry Units (CMU):
   1. Eggshell Low Luster, Acrylic-Enamel Finish: : .
      a. Block Filler: : Two Coats acrylic latex high build block filler.
         1) Duron: Block Kote Latex Block Filler, 08-126.
         2) S/W: : PrepRite Block Filler
         3) PPG Paints: : SPEEDHIDE Int / Ext Masonry Hi Fill Latex Block Filler 6-15XI
         4) BM: : Coronado Super Kote 5000 Block Filler (958-11)
      b. First and Second Finish Coats: : Eggshell latex Low-luster acrylic-latex interior finish.enamel.
         1) Duron: Plastic Kote Interior Acrylic Latex Eggshell Enamel, 20 series; 1.6 mils DFT.
         2) S/W: : ProMar 200 Zero VOC Latex Eggshell
         3) PPG Paints: : SPEEDHIDE® Zero VOC Int Latex Eggshell 6-45310 series
         4) BM: : Ultra Spec 500 Int. Eggshell (N538)

C. Gypsum Board Ceilings and Soffits:
   1. Flat Acrylic Finish: Provide the following unless otherwise indicated.
      a. Primer: Latex-based, interior primer.
         1) Duron: Interior Acrylic Latex Drywall Primer, 04-124; 1.6 mils DFT.
         1) S/W: Promar 200 Primer
      b. First and Second Coats: Flat, acrylic-latex-based, interior paint.
         1) Duron: Plastic Kote Interior Flat Acrylic Latex, 17 series; 1.5 mils DFT.
         1) S/W: ProMar 200 Latex Flat

D. Gypsum Board Walls:
   1. Eggshell, Acrylic-Enamel Finish: Provide the following unless otherwise indicated.
      a. Primer: Latex-based, interior primer.
         1) Duron: Acrylic Enamel Undercoater, 04-123; 1.6 mils DFT
         2) S/W: Promar 200 Primer
      b. First and Second Coats: Low-luster, scrubbable acrylic-latex, interior enamel.
         1) Duron: Plastic Kote Interior Acrylic Latex Eggshell Enamel, 20 series; 1.6 mils DFT.
         2) S/W: ProMar 200 LatexEggshell

E. Gypsum Board, Moisture Conditions:
   1. Water-Reducible Epoxy Coating System: Provide the following for **gypsum board surfaces located in toilet rooms.**
         1) Primer: Latex-based, interior primer.Carboline Sanitile 120
         2) Duron: Acrylic Enamel Undercoater, 04-123; 1.6 mils DFT
         3) S/W: ProMar 200 Primer
      b. First and Second Coats: Semi-gloss epoxy finish.
         1) Carboline Sanitile 255 Semi Gloss Epoxy 2.0 mils DFT
         2) Duron: Acrylic Epoxy Semi-Gloss, 901 Series; 1.5 mils DFT.
         3) S/W: ProIndustrial Pre-Catalyzed Epoxy, semi-gloss.

F. Painted Interior Woodwork:
1. Semigloss, Acrylic lkyd-Enamel Finish:
a. Primer: Alkyd or latex-based, interior enamel undercoater.
1) SW: : Multi-Purpose Zero VOC Primer
2) PPG: SPEEDHIDE® Zero VOC Int Latex Sealer 6-4900
3) BM: Ultra Spec 500 Int. :atex Promer (N534)
4) Duron: Wall Kote Interior Alkyd Enamel Undercoater 04-024; 2.2 mils DFT.
b. First and Second Coats: Semigloss, Acrylicalkyd, interior enamel.
1) SW: ProMar 200 Zero VOC, semi-gloss
2) PPG: : SPEEDHIDE Zero VOC Latex Semi-Gloss 6-4510 series
3) BM: Ultra Spec 500 Int. Latex Gloss (T546)
4) Duron: Everlast Interior Alkyd/Oil Semi-Gloss Enamel, 43 Series; 2.1 mils DFT.

G. Stained Interior Woodwork:
1. Polyurethane, Satin-Varnish Finish:
a. Stain Coat:
1) Minwax 250 interior wood stain.Alkyd-based, interior wood stain.
2) PPG: Olympic Interior Stains 41533 series
3) Duron: Interior Penetrating Oil Wood Stain, 28-188 with tints.
b. Sealer Coat: Polyurethane reduced as recommended by manufacturer for use as sanding sealer.
c. First and Second Finish Coats: Polyurethane varnish.
1) Duron: Permathane Interior Polyurethane Satin, 15-011; 1.1 mils DFT.
2) SW: : Wood Classics WB Polyurethane, satin.
3) BM: Stays Clear Polyurethane Low Lustre W423

H. Components at Ceiling Level: Apply the following coating system to exposed structure and other elements in exposed high areas.
1. Dry Fall, Flat Finish:
1) Primer: Carboline Sanitile 120 Primer
2) Duron: Dura Clad White Alkyd Primer, 33-010.
1) SW: Kem Bond HSHP Universal Metal Primer (HP1320)
3) PPG: : Pitt-Tech Primer / Finish DTM Industrial Enamel 90-712
4) BM: : Super Spec HP Alkyd metal Primer (P06)
b. First and Second Coats: Alkyd flat dry fall finish.Carboline Galoseal Finish
1) Duron: Dura Clad White Alkyd Dry Fog, 93-83X; 3.8 mils DFT.
2) SS/W: : Waterbased Acrylic Dryfall Eggshell, B42W82
3) PPG: : SPEEDHIDE SUPER TECH WB 100% Acrylic Dry-Fog Semi- Gloss Latex 6-724XI
4) BM: : Super Kote 5000 Dry Fall Acrylic Flat (105N110)

I. Interior Ferrous Metal: Apply the following coating system to interior ferrous metal not scheduled to receive another coating.
1. Semigloss, DTM Acrylic-Enamel Finish:
a. Primer: Metal primer.
1) S/W: : DTM Primer
2) PPG: : Pitt-Tech Primer / Finish DTM Industrial Enamel 90-712
3) BM: HP Universal Metal Primer (HP1320)
b. First and Second Coats: Semigloss, alkyd, interior enamel.
1) S/W: : DTM Acrylic Coating, semi-gloss
2) PPG: Pitt-Tech® Plus Int/Ext Semi-Gloss DTM Industrial Enamel 90-1210 series.
3) BM: Ultra Spec HP DTM Acrylic Semi Gloss (HP29)

END OF SECTION 09 9133

SECTION 101419

DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Dimensional characters.
   a. Cutout dimensional characters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
3. Show message list, typestyles, graphic elements, and layout for each sign at least **half size**.

C. Samples: For each exposed product and for each color and texture specified.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Signs and supporting elements shall withstand the effects of gravity and other loads within limits and under conditions indicated.

2.2 DIMENSIONAL CHARACTERS

A. Cutout Characters: Characters with uniform faces; square-cut, smooth edges; precisely formed lines and profiles; and as follows:

1. Character Material: Sheet or plate aluminum .
2. Character Height: As indicated on Drawings.
3. Character Font: Arial.
4. Thickness: 0.25 inch..
5. Finishes:
    a. Interior - Integral Aluminum Finish: Clear anodized.
    b. Exterior – Baked enamel or powder coat finish: Manufacturer’s standard in color as selected by Architect from manufacturer’s full range.
6. Mounting - Exterior: Concealed painted aluminum back bar or bracket assembly for mounting on expanded metal screen. Coordinate with screen manufacturer for angled clips for through bolt mounting to screen.
7. Mounting – Interior: Concealed studs.

2.3 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signs, noncorrosive and compatible with each material joined, and complying with the following:

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. Sign Mounting Fasteners:
    a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material, screwed into back of sign assembly, or screwed into tapped lugs cast integrally into back of cast sign material, unless otherwise indicated..

B. Adhesive: As recommended by sign manufacturer.

2.4 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Mill joints to a tight, hairline fit.
2. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
3. Internally brace dimensional characters for stability, to meet structural performance loading without oil-canning or other surface deformation, and for securing fasteners.
4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Aluminum Brackets: Factory finish brackets to match sign.

PART 3 - EXECUTION

3.1 INSTALLATION OF DIMENSIONAL CHARACTERS

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
2. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
3. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101419

SECTION 101423

PANEL SIGNAGE

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Panel signs.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For panel signs.

1. Include fabrication and installation details and attachments to other work.
2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

C. Samples: For each exposed product and for each color and texture specified.

D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.4 INFORMATIONAL SUBMITTALS

A. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities and ICC A117.1 for signs.

2.2 SIGNS

A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Laminated-Sheet Sign:
   a. 1/8 inch acrylic sheet with finish specified in "Surface Finish and Applied Graphics" Subparagraph below and as follows.
   b. Raised graphics, white on face and sides.
      1) Font: Source Sans Semibold Pro.

2. Sign-Panel Perimeter: Finish edges smooth.

   a. Edge Condition, Square cut.
   b. Corner Condition in Elevation: Square.

3. Provide matching 1/8 inch backer panel for installation on opposite side of glass where signs will be mounted on glass.

4. Mounting: Surface mounted to wall or glass with adhesive or two-face tape.
5. Surface Finish and Applied Graphics:
   a. Painted Finish and Graphics: Manufacturer's standard, factory-applied acrylic polyurethane, in color SW 7076 for backing and border, and manufacturer’s standard white for graphics.
   b. Overcoat: Manufacturer's standard baked-on clear coating.

2.3 PANEL-SIGN MATERIALS

A. Acrylic Sheet: ASTM D 4802, Type UVF (UV filtering).

2.4 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:

B. Adhesive: As recommended by sign manufacturer.

C. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
2. Install signs so they do not protrude or obstruct according to the accessibility standard.
3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

B. Mounting Methods:

1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
2. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101423

SECTION 10 22 39
FOLDING PANEL PARTITION

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:
   1. Manually operated, paired panel operable partitions.
B. Related Sections include the following:
   1. Division 05 Sections for primary structural support, including pre-punching of support members by structural steel supplier per operable partition supplier's template.
   2. Division 06 Sections for wood framing & supports, and all blocking at head and jambs as required.
   3. Division 09 Sections for wall and ceiling framing at head and jambs.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified in writing by the operable partition manufacturer, as qualified to install the manufacturer's partition systems for work similar in material, design, and extent to that indicated for this Project.
B. Acoustical Performance: Test operable partitions in an independent acoustical laboratory in accordance with ASTM E90 test procedure and classified in accordance with ASTM E413 to attain no less than the STC rating specified. Provide a complete and unedited written test report by the testing laboratory upon request.
C. Preparation of the opening shall conform to the criteria set forth per ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
D. The operable wall must be manufactured by a certified ISO-9001-2015 company or an equivalent quality control system.
E. Indoor Air Quality: Operable partition, movable wall manufacturer’s non-wood products must meet the SCS Indoor Advantage™ Gold Certification or equivalent. This approval guarantees conformance to indoor air concentrations meeting Indoor Advantage Gold Indoor Air Quality Certified to SCS-105 v4.2-2023 Conforms to ANSI/BIFMA M7.1 and X7.1 and the CDPH/EHLB Standard Method (CA 01350) v1.2-2017 conducted in an independent third-party air quality testing laboratory.

1.4 REFERENCE STANDARDS

A. ASTM International
   1. ASTM E557 Standard Practice for Architectural Application and Installation of Operable Partitions.
   2. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements.
   3. ASTM C1036 - Standard Specification for Flat Glass.
   4. ASTM C1048 - Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass.
   5. ASTM E84 - Surface Burning Characteristics of Building Materials.
   6. ASTM E413 - Classification for Rating Sound Insulation
B. Health Product Declaration Collaborative
   1. Health Product Declaration Open Standard v2.1
C. International Standards Organization
   1. ISO 14021 - Environmental Labels and Declarations - Self-Declared Environmental Claims (Type II Environmental Labeling).
   2. ISO 14025:2011-10, Environmental Labels and Declarations - Type III Environmental Declarations - Principles and Procedures.
   3. ISO 14040:2009-11, Environmental Management - Life Cycle Assessment - Principles and Framework.

4. ISO 14044:2006-10, Environmental Management - Life Cycle Assessment - Requirements and Guidelines.
5. ISO 21930 – Sustainability in Buildings and Civil Engineering Works — Core Rules for Environmental Product Declarations of Construction Products and Services.

D. Other Standards
1. ADA – Americans with Disabilities Act.
2. ANSI Z97.1 - Safety Glazing Materials Used in Buildings.
3. CPSC 16 CFR 1201 - Safety Standard for Architectural Glazing Materials.
4. NEMA LD3 - High Pressure Decorative Laminates.

1.5 SUBMITTALS

A. Product Data: Material descriptions, construction details, finishes, installation details, and operating instructions for each type of operable partition, component, and accessory specified.
B. Shop Drawings: Show location and extent of operable partitions. Include plans, elevations, sections, details, attachments to other construction, and accessories. Indicate dimensions, weights, conditions at openings, and at storage areas, and required installation, storage, and operating clearances. Indicate location and installation requirements for hardware and track, including floor tolerances required and direction of travel. Indicate blocking to be provided by others.
C. Setting Drawings: Show imbedded items and cutouts required in other work, including support beam punching template.
D. Samples: Color samples demonstrating full range of finishes available by architect. Verification samples will be available in same thickness and material indicated for the work.
E. Reports: Provide a complete and unedited written sound test report indicating test specimen matches product as submitted.
F. Create spaces that are healthy for occupants.
1. Furnish products and materials with Health Product Declaration (HPD), Manufacturer Inventory, or other material health disclosure documentation. Products without an HPD or other disclosure documentation are not acceptable.
G. Furnish materials that generate the least amount of pollution.
1. Furnish products and materials that have third party verified environmental product declarations (EPD's). Consider products and materials that have optimized environmental performance (reduced life cycle impacts). Products without an EPD or other disclosure documentation are not acceptable.
H. Buy American: Folding door to be manufactured in the United States in compliance with applicable U.S. Federal Trade Commission (FTC) and U.S. Customs Service and Border Protections regulations and be labeled "Made in America".

1.6 DELIVERY, STORAGE, AND HANDLING

A. Clearly mark packages and panels with numbering systems used on Shop Drawings. Do not use permanent markings on panels.
B. Protect panels during delivery, storage, and handling to comply with manufacturer's direction and as required to prevent damage.

1.7 WARRANTY

A. Provide written warranty by manufacturer of operable partitions agreeing to repair or replace any components with manufacturing defects.
B. Warranty period: Eight (8) years.

PART 2 – PRODUCTS

2.1 MANUFACTURERS, PRODUCTS, AND OPERATION

A. Basis of Design Manufacturer: Subject to compliance with requirements, provide product by Modernfold, Inc. or one of the following:
1. Hufcor, Inc.
2. Moderco.
3. Or equal as approved by Professional.
B. Basis of Design Products: Subject to compliance with the requirements, provide the following product or approved equal:

1. Acousti-Seal Legacy – Paired Panel (932) manually operated paired panel operable partition.

2.2 OPERATION

A. Series of paired flat panels hinged together in pairs, manually operated, top supported with operable floor seals.
B. Final Closure:
    1. Horizontally expanding panel edge with removable crank

2.3 PANEL CONSTRUCTION

A. Nominal 3-inch (76mm) thick panels in manufacturer's standard 48-inch (1220mm) widths. All panel horizontal and vertical framing members fabricated from minimum 16-gage formed steel with overlapped and welded corners for rigidity. Top channel is reinforced to support suspension system components. Frame is designed so that full vertical edges of panels are of formed steel and provide concealed protection of the edges of the panel skin.
B. Panel skin shall be:
    1. Roll-formed steel wrapping around panel edge. Panel skins shall be lock formed and welded directly to the frame for unitized construction. Acoustical ratings of panels with this construction minimum:
        a. 50 STC
C. Hinges for Panels, Closure Panels, Pass Doors, and Pocket Doors shall be:
    1. Full leaf butt hinges, attached directly to the panel frame with welded hinge anchor plates within panel to further support hinge mounting to frame. Lifetime warranty on hinges. Hinges mounted into panel edge or vertical astragal are not acceptable.
D. Panel Trim: No vertical trim required or allowed on edges of panels; minimal groove appearance at panel joints.
E. Panel Weights:
    1. 50 STC - 8 lbs./square foot

2.4 PANEL FINISH

A. Panel finish shall be:
    1. Reinforced vinyl with woven backing weighing not less than 20 ounces (567 grams) per lineal yard.
B. Panel Trim: Exposed panel trim of one consistent color:
    1. To Be Selected by Architect from full range.

2.5 SOUND SEALS

A. Vertical Interlocking Sound Seals between panels: Roll-formed steel astragals, with reversible tongue and groove configuration in each panel edge for universal panel operation. Rigid plastic or aluminum astragals or astragals in only one panel edge are not acceptable.
B. Horizontal Top Seals: Continuous contact extruded vinyl bulb shape with pairs of non-contacting vinyl fingers to prevent distortion without the need for mechanically operated parts.
C. Horizontal bottom floor seals shall be:
    1. Manually activated seals providing nominal 2-inch (51 mm) operating clearance with an operating range of +1/2-inch (13 mm) to –1-1/2-inch (38 mm). Seal shall be operable from panel edge or face. Extended seal shall exert nominal 120 pounds (54 kg) downward force to the floor throughout operating range.

2.6 SUSPENSION SYSTEM

A. #17 Suspension System
    1. Suspension Tracks: Minimum 11-gauge, 0.12-inch (3.04mm) roll-formed steel track, suitable for either direct mounting to a wood header or supported by adjustable steel hanger brackets, supporting the load-bearing surface of the track, connected to structural support by pairs of 0.38-inch (10mm) diameter threaded rods. Aluminum track is not acceptable.
        a. Exposed track soffit: Steel, integral to track, and pre-painted off-white.
    2. Carriers: One all-steel trolley with steel tired ball bearing wheels per panel (except hinged panels). Non-steel tires are not acceptable.
    3. Warranty period: Ten (10) years.

2.7 OPTIONS

A. Pocket Doors:
    1. Pocket door (matching construction and finish)

PART 3 – EXECUTION

3.1 INSTALLATION

A. General: Comply with ASTM E557, operable partition manufacturer's written installation instructions, Drawings and approved Shop Drawings.
B. Install operable partitions and accessories after other finishing operations, including painting have been completed.
C. Match operable partitions by installing panels from marked packages in numbered sequence indicated on Shop Drawings.
D. Broken, cracked, chipped, deformed or unmatched panels are not acceptable.

3.2 CLEANING AND PROTECTION

A. Clean partition surfaces upon completing installation of operable partitions to remove dust, dirt, adhesives, and other foreign materials according to manufacturer’s written instructions.
B. Provide final protection and maintain conditions in a manner acceptable to the manufacturer and Installer that ensure operable partitions are without damage or deterioration at time of Substantial Completion.

3.3 ADJUSTING

A. Adjust operable partitions to operate smoothly, easily, and quietly, free from binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and other moving parts.

3.4 EXAMINATION

A. Examine flooring, structural support, and opening, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of operable partitions. Proceed with installation only after unsatisfactory conditions have been corrected.

3.5 DEMONSTRATION

A. Demonstrate proper operation and maintenance procedures to Client Agencies representative.
B. Provide Operation and Maintenance Manual to Client Agencies representative.

END OF SECTION

SECTION 102600

WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Corner guards.

B. Related Requirements:

1. Section 087100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for kick, mop, and push plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For each exposed product and for each color and texture specified, 12 inches long.

1.4 INFORMATIONAL SUBMITTALS

A. Product certificates.

B. Material certificates.

C. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of wall- and door-protection units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products as manufactured by one of the following:

1. Construction Specialties (Acrovyn)
2. Inpro Corporation
3. Koroseal
4. Or equal as approved by the Professional.

2.3 CORNER GUARDS

A. Surface-Mounted, Opaque-Plastic Corner Guards (CG): Fabricated as one piece from PVC-free plastic or opaque polycarbonate sheet; with formed edges; fabricated with 90- or 135-degree turn to match wall condition.

1. Mounting: Mechanically fastened.
2. Color and Texture: As selected by Architect from manufacturer's full range.
3. Size: 1 ½ inch x 1 ½”.
4. Length: 8 feet.

2.4 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Polycarbonate Plastic Sheet: ASTM D 6098, S-PC01, Class 1 or Class 2, abrasion resistant; with a minimum impact-resistance rating of 15 ft.-lbf/in. of notch when tested according to ASTM D 256, Test Method A.

C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

D. Adhesive: As recommended by protection product manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer's written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Mounting Heights: Install wall and door protection in locations and at mounting heights indicated in specifications. Mount bottom at top of base.

C. Accessories: Provide splices, mounting hardware, anchors, trim, joint moldings, and other accessories required for a complete installation.

1. Provide anchoring devices and suitable locations to withstand imposed loads.
2. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches apart.
3. Adjust caps as required to ensure tight seams.

END OF SECTION 102600

SECTION 102800

TOILET AND BATH ACCESSORIES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes the following:

1. Toilet and bath accessories.

1.3 SUBMITTALS

A. Product Data: Include construction details, material descriptions and thicknesses, dimensions, profiles, fastening and mounting methods, specified options, and finishes for each type of accessory specified.

B. Samples: For each accessory item to verify design, operation, and finish requirements.

1. Approved full-size Samples will be returned and may be used in the Work.

C. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required. Use designations indicated in the Toilet and Bath Accessory Schedule and room designations indicated on Drawings in product schedule.

1.4 QUALITY CONTROL

A. Source Limitations: Provide products of same manufacturer for each type of accessory unit and for units exposed to view in same areas, unless otherwise approved by Professional.

1.5 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by disabled persons, proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.6 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Client Agency of other rights Client Agency may have under other provisions of the Contract Documents and

shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Manufacturer's Mirror Warranty: Written warranty, executed by mirror manufacturer agreeing to replace mirrors that develop visible silver spoilage defects within minimum warranty period indicated.

1. Minimum Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering accessories that may be incorporated into the Work include, but are not limited to, the following:

1. Toilet and Bath Accessories (Refer to Schedule in Part 3 of this Specification):

a. American Specialties, Inc.
b. Bobrick Washroom Equipment, Inc.
c. Bradley Corporation.
d. Georgia Pacific.
e. Or Equal as approved by the Professional.

2.2 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, with No. 4 finish (satin), in 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Sheet Steel: ASTM A 366/A 366M, cold rolled, commercial quality, 0.0359-inch minimum nominal thickness; surface preparation and metal pretreatment as required for applied finish.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, G60.

D. Chromium Plating: ASTM B 456, Service Condition Number SC 2 (moderate service), nickel plus chromium electrodeposited on base metal.

E. Mirror Glass: ASTM C 1036, Type I, Class 1, Quality q2, nominal 6.0 mm thick, with silvering, electroplated copper coating, and protective organic coating complying with FS DD-M-411.

F. Galvanized Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

G. Fasteners: Screws, bolts, and other devices of same material as accessory unit, tamper and theft resistant when exposed, and of galvanized steel when concealed.

2.3 FABRICATION

A. Recessed Toilet Accessories: Unless otherwise indicated, fabricate units of all-welded construction, without mitered corners. Hang doors and access panels with full-length, stainless-steel hinge. Provide anchorage that is fully concealed when unit is closed.

B. Framed Glass-Mirror Units: Fabricate frames for glass-mirror units to accommodate glass edge protection material. Provide mirror backing and support system that permits rigid, tamper-resistant glass installation and prevents moisture accumulation.

1. Provide galvanized steel backing sheet, not less than 0.034 inch and full mirror size, with nonabsorptive filler material. Corrugated cardboard is not an acceptable filler material.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Secure mirrors to walls in concealed, tamper-resistant manner with special hangers, toggle bolts, or screws. Set units level, plumb, and square at locations indicated, according to manufacturer's written instructions for substrate indicated.

C. Install grab bars to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation and verify that mechanisms function properly. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

3.3 TOILET AND BATH ACCESSORY SCHEDULE

A. Soap Dispenser, surface mounted manual.

1. American Specialties, Model 0347.
2. Bobrick,Model B-2111.
3. Bradley, Model 6562.
4. Georgia Pacific, Pacific Blue Ultra 53057.

B. Toilet Tissue Dispenser; surface mounted, 2-roll.

1. American Specialties, Model 74022-HBSM.
2. Bobrick, Model B-3588.
3. Bradley, Model 5126.
4. Geoargia Pacific, Compact.

C. Paper Towel Dispenser; surface mounted manual, 8 inch roll.

1. Bobrick, Model B-72860.
2. Georgia Pacific, Model 54338A
3. Kimberly Clark, Model 9765l
4. San Jamar, Classic Element

D. Surface Mounted Sanitary Napkin Disposal

1. American Specialties, Model 0852
2. Bobrick, Model B-270
3. Bradley, Model 4017-10

E. Channel Frame Mirror, 24” x 36”

1. American Specialties, Model 0620
2. Bobrick, Model B-165
3. Bradley, Model 780

F. Grab Bar with Concealed Mounting (sizes and locations as indicated on drawings – 3 for each toilet)

1. American Specialties, Model 3800
2. Bobrick, Model B-6806
3. Bradley, Model 812

G. Waste Receptacle; surface mounted, 12 gallon.

1. American Specialties, Model 0826.
2. Bobrick; Model B-9279.
3. Bradley; Model 3565.

H. Underlavatory Guard: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings. Antimicrobial, molded plastic, white.

1. Plumberex, Pro-Extreme
2. Truebro by IPS Corporation, Lav Guard 2.
3. Zurn, Z8946-2-NT

J. Mop Receptor/Shelf

1. American Specialties, Model 1308-3
2. Bobrick, Model B-239 x 34
3. Bradley, Model 9933
4. Or equal as approved by Professional.

END OF SECTION

SECTION 10 4313

DEFIBRILLATOR CABINETS

PART 1 - GENERAL

1.0 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.1 SUMMARY

A. Section Includes:

1. Custom fabricated automated external defibrillator (AED) cabinets.
2. Automated external defibrillators (AED's).

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for AED cabinets.

1. Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.
2. Automated External Defibrillator

B. Shop Drawings: For AED cabinets. Include plans, elevations, sections, details, and attachments to other work.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance Data: For AED cabinets and AED's.

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Pre-installation Conference: Conduct conference at Project site.

1. Review methods and procedures related to AED cabinets including, but not limited to, the following:
    a. Schedules and coordination requirements.

1.5 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of AED cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Stainless-Steel Sheet: ASTM A 666, Type 304.

C. Tempered Float Glass: ASTM C 1048, Kind KT, Condition A, Type I, Quality q3, 1/8 inch, Class I (clear).

2.2 AED CABINET

A. Cabinet Type: Suitable for mounting AED with emergency telephone and alarm; match existing AED cabinets;

1. Basis of Design Product: Heartsmart AED Wall Cabinet or a comparable product by one of the following:

    a. J. L. Industries, Inc., a division of Activar Construction Products Group;.
    b. Larsen's Manufacturing Company;. B. Cabinet
    c. Potter Roemer LLC; Model HSSS7063-D-LAWA
    d. Or equal as approved by the Professional.

C. Cabinet Interior Size: 14 inches wide by 22 inches high by 6 inches deep, as required to incorporate AED and specified features. All cabinet components and equipment shall be accessible, removable and replaceable with the cabinet door in a 90 degree position. D. Cabinet Material: Stainless-steel sheet.

E. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim.

F. Cabinet Trim Material: Stainless-steel sheet.

G. Door Material: Stainless-steel sheet.

H. Door Style: Provide limited visibility window to match existing.

I. Door Glazing: Tempered float glass.

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide manufacturer's standard.
2. Provide continuous hinge, of same material and finish as trim, permitting door to open 180 degrees.

K. Accessories:
   1. Identification: Manufacturer's standard.

L. Finishes:
   1. Manufacturer's standard baked-enamel paint for the interior of cabinet.
   2. Stainless Steel: No. 4.

M. Cabinet Interior Features:
   1. Emergency Phone Box.
   2. Cable Access Box
   3. Raceway

N. Alarm:
   1. Circuitry Board.
   2. Alarm Circuitry
   3. Alarm Key Switch and Key:
   4. Control for Visual Alarm, Audio Alarm and Relay Closures: O. Power Requirements for Alarm Board, Siren and LED:

2.3 AUTOMATED EXTERNAL DEFIBRILLATOR (AEDS)

A. Provide the following:
   1. Philips Heartstart FRX Defibrillator
   2. Physio Control LIFEPAK CR2
   3. Defibtech Lifeline VIEW
   4. Or equal as approved by the Professional.

2.4 FABRICATION

A. AED Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Provide factory-drilled mounting holes.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install AED cabinets in locations and at mounting heights, at heights acceptable to the Los Angeles Fire Department.

B. AED Cabinets: Fasten cabinets to structure, square and plumb.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as cabinets are installed unless otherwise indicated in manufacturer's written installation instructions. B. Adjust cabinet doors to operate easily without binding.

C. On completion of cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by AED cabinet and mounting bracket manufacturers.

E. Replace AED cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 44 13

SECTION 10 4413

FIRE PROTECTION CABINETS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Fire-protection cabinets for the following:
   a. Portable fire extinguisher.

B. Related Requirements:

1. Section 10 4416 "Fire Extinguishers" for portable, hand-carried fire extinguishers accommodated by fire-protection cabinets

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
2. Show location of knockouts for hose valves.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION

A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain fire-protection cabinets, accessories, and fire extinguishers from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

2.3 FIRE-PROTECTION CABINET (FEC as indicated on Code Sheet))

A. Cabinet Type: Suitable for fire extinguisher .

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Babcock-Davis.
b. JL Industries; Activar Construction Products Group, Inc.
c. Larsen's Manufacturing Co.
d. Potter Roemer LLC; a Division of Morris Group International.
e. Or equal as approved by the Professional.

B. Cabinet Construction: Nonrated.

1. Size: To accommodate extinguishers specified in Section 104416 "Fire Extinguishers."

C. Cabinet Material: Cold rolled steel sheet.

1. Shelf: Same metal and finish as cabinet.

D. Semi-Recessed Cabinet:

1. Exposed Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface, with exposed trim face and wall return at outer edge (backbend).

E. Rough Opening Depth: 6 inches.

F. Cabinet Trim Material: Steel sheet.

G. Door Material: Steel sheet.

H. Door Style: Vertical duo panel with frame .

I. Door Glazing: Tempered float glass (clear) .

J. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.

1. Provide door pull and friction latch.
2. Provide continuous hinge, of same material and finish as trim, , permitting door to open 180 degrees.

K. Accessories:

1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
2. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect .
   a. Identify fire extinguisher in fire-protection cabinet with the words " FIRE EXTINGUISHER ."
      1) Location: Applied to cabinet door .
      2) Application Process: Decals .
      3) Lettering Color: Black .
      4) Orientation: Vertical .

L. Materials:

1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
   a. Finish: Baked enamel or powder coat.
   b. Color: Selected by Architect from manufacturer’s full range.
2. Tempered Float Glass: ASTM C1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear) .

2.4 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Miter corners and grind smooth.
3. Provide factory-drilled mounting holes.
4. Prepare doors and frames to receive locks.
5. Install door locks at factory.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames and grind smooth.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.5 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's AMP 500, "Metal Finishes Manual for Architectural and Metal Products," for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where recessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare recesses for recessed fire-protection cabinets as required by type and size of cabinet and trim style.

3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at height indicated below:

1. Fire-Protection Cabinet Mounting Height: 48 inches above finished floor to top of fire extinguisher.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification:

1. Apply decals at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 4413

SECTION 10 4416

FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

B. Related Requirements:

1. Section 10 4413 "Fire Protection Cabinets."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

1.4 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

1. Provide fire extinguishers approved, listed, and labeled by FM Global.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire-protection cabinet (FEC) and mounting bracket (FE) indicated.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. Guardian Fire Equipment, Inc.
b. JL Industries; Activar Construction Products Group, Inc.
c. Kidde; Carrier Global Corporation.
d. Larsen's Manufacturing Company.
e. Potter Roemer LLC; a Division of Morris Group International.
f. Or equal as approved by the Professional.

2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.

B. Multipurpose Dry-Chemical Type in Steel Container (FE and FEC - except kitchens provide Class K) : UL-rated 2-A:10-B:C, 5-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-steel container.

C. Class K Wet Chemical Type in stainless steel container: (FE in kitchens): UL rated WC-100-1, 1.6 gallon capacity potassium acetate in stainless steel container.

2.3 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

1. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.

B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by Architect.

1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
   a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.

1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

1. Mounting Height: Top of fire extinguisher to be at 48 inches above finished floor.

END OF SECTION 10 4416

SECTION 10 5113

METAL LOCKERS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Knocked-down lockers.
2. Locker room benches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.

B. Shop Drawings: For metal lockers.

1. Include plans, elevations, sections, and attachment details.
2. Show locker trim and accessories.
3. Include locker identification system and numbering sequence.

C. Samples: For each color specified, in manufacturer's standard size.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.

1.8 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
   b. Faulty operation of latches and other door hardware.
2. Damage from deliberate destruction and vandalism is excluded.
3. Warranty Period for Knocked-Down Metal Lockers: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain metal lockers and accessories from single source from single locker manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: For lockers indicated to be accessible, comply with applicable provisions in ICC A117.1 .

2.3 KNOCKED-DOWN LOCKERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide ASI Storage Solutions; Traditional Collection or comparable product by one of the following:

1. Hadrian Inc.; Zurn Industries, LLC.
2. Lockers MFG.
3. Olympus Lockers & Storage Products, Inc.
4. Penco Products, Inc.
5. Republic Storage Systems, LLC.
6. Or equal as approved by the Professional.

A. Lockers:

1. Style: Double tier.
2. Size: 15 inches x 15 inches x 72 inches.

B. Doors: One piece; fabricated from 0.060-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Doors less than 12 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
2. Doors for box lockers less than 15 inches wide may be fabricated from 0.048-inch nominal-thickness steel sheet.
3. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
4. Stiffeners: Manufacturer's standard full-height stiffener fabricated from 0.048-inch nominal-thickness steel sheet; welded to inner face of doors.
5. Sound-Dampening Panels: Manufacturer's standard, designed to stiffen doors and reduce sound levels when doors are closed, of die-formed metal with full perimeter flange and sound-dampening material; welded to inner face of doors.
6. Door Style: Vented panel as follows:
    a. Louvered Vents: No fewer than three louver openings at top and bottom for double-tier lockers.

C. Body: Assembled by riveting or bolting body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

1. Tops, Bottoms, and Intermediate Dividers: 0.024-inch nominal thickness, with single bend at sides.
2. Backs and Sides: 0.024-inch nominal thickness, with full-height, double-flanged connections.
3. Shelves: 0.024-inch nominal thickness, with double bend at front and single bend at sides and back.

D. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral, full-height door strikes on vertical main frames.

1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.
2. Frame Vents: Fabricate face frames with vents.

E. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Knuckle Hinges: Steel, full loop, five or seven knuckles, tight pin; minimum 2 inches high. Provide no fewer than three hinges for each door more than 42 inches high.

F. Recessed Door Handle and Latch: Stainless steel cup with integral door pull, recessed so locking device does not protrude beyond door face; pry and vandal resistant.

1. Single-Point Latching: Nonmoving latch hook with steel padlock loop that projects through recessed cup and is finished to match metal locker body.
    a. Latch Hook: Equip each door with one latch hook, fabricated from 0.105-inch nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

G. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum plates, with numbers and letters at least 3/8 inch high.

H. Hooks: Manufacturer's standard ball-pointed hooks, aluminum or steel; zinc plated.

I. Continuous Zee Base: Fabricated from manufacturer's standard thickness, but not less than 0.060-inch nominal-thickness steel sheet.

1. Height: 4 inches .

J. Continuous Sloping Tops: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.

1. Closures: Vertical -end type.

K. Filler Panels: Fabricated from manufacturer's standard thickness, but not less than 0.036-inch nominal-thickness steel sheet.

L. Materials:

1. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B, suitable for exposed applications.
2. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B; with A60 zinc-iron, alloy (galvannealed) coating designation.

M. Finish: Baked enamel or powder coat.

1. Color: As selected by Architect from manufacturer's full range .

2.4 LOCKS

A. Combination Padlock: Provided by Client Agency.

2.5 BENCHES

A. Accessible Locker Room Benches: Butcher block seat with metal pedestal legs.

1. Butcher Block Seats: 1.25” thick face-glued hardwood strips with 0.625” radius comfort edges and rounded corners with two coats catalyzed clear lacquer top and sides with one clear coat bottom.
2. Seat Height: 17-1/2″ high.
3. Seat size: 42 inches x 20 inches.
4. Pedestal: Powder-coated steel, quantity of four.
5. Anchor pedestals to floor following manufacturer’s instructions.
6. Position bench backed to wall with required transfer clearance at end.

2.6 FABRICATION

A. Fabricate metal lockers square, rigid, without warp, and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.

1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments.

C. Equipment: Provide each locker with an identification plate and the following equipment:

1. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.

D. Knocked-Down Construction: Fabricate metal lockers by preassembling at plant prior to shipping, using manufacturer's nuts, bolts, screws, or rivets.

E. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.
2. Where hooks, coat rods, or additional shelves are provided, locate no higher than 48 inches above the floor.

F. Continuous Zee Base: Fabricated in lengths as long as practical to enclose base and base ends; finished to match lockers.

G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

H. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

2.7 ACCESSORIES

A. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

B. Anchors: Material, type, and size required for secure anchorage to each substrate.

1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls for corrosion resistance.
2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and floors or support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install lockers level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.
2. Anchor single rows of metal lockers to walls near top of lockers and to floor.

B. Knocked-Down Lockers: Assemble with manufacturer's standard fasteners, with no exposed fasteners on door faces or face frames.

C. Equipment:

1. Attach hooks with at least two fasteners.
2. Attach door locks on doors using security-type fasteners.
3. Identification Plates: Identify metal lockers with identification indicated on Drawings.
    a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.
    b. Attach plates to upper shelf of each open-front metal locker, centered, with a least two aluminum rivets.

D. Trim: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach recess trim to recessed metal lockers with concealed clips.
2. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.
3. Attach sloping-top units to metal lockers, with closures at exposed ends.

3.3 ADJUSTING

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

3.4 PROTECTION

A. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 5113

SECTION 114000

FOODSERVICE EQUIPMENT

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract including General and Supplementary Conditions and Division 1 Specification Sections apply to this Section.

1.3 SUMMARY

A. Provide all material, labor, equipment and services required to execute and complete all items of work relating to the food service equipment, both existing and new, all as required to make the resulting facility a fully functional and reliable operating unit in accordance with this Specification. All food service equipment shall be furnished as specified, delivered prepaid, unloaded and uncrated, assembled with all components and accessories connected within the equipment, set-in-place in proper location as indicated on the drawings, leveled and fastened to the wall, ceiling or floor as required, left ready for final utility connections. The work shall include:

1. To prevent extended warehousing of all food service equipment, no pre-ordering of equipment is permitted; schedule ordering of the equipment so that warehousing of the equipment shall not be required for longer than 60 days prior to delivery to the site for installation.
2. All food service equipment shall have a manufacturer extended warranty covering parts and labor for a period of two years which shall take effect only after acceptance and beneficial use by the District. All labor shall be performed by a factory authorized and qualified representative.
3. A “complete and thorough” demonstration and start-up for each item of equipment must be conducted by a qualified manufacturer representative in the use, sanitation and maintenance of the equipment.

B. Furnishing scheduled items of custom fabricated food service equipment as specified utilizing a food service equipment fabricator listed with the National Sanitation Foundation (NSF) for custom equipment fabrication.

C. Delivery of food service equipment in factory fabricated containers designed to protect equipment and finish until final installation. Delivery of food service equipment shall be coordinated with the construction schedule. If necessary, delivery of the food service equipment shall be by means other than common carrier to expedite delivery and to maintain project schedule.

D. Warehousing of the food service equipment in a bonded warehouse and re-delivery of the food service equipment from the storage facility to the project site or arrangement for secured storage at the project site to assure availability of the food service equipment to maintain project schedule.

E. Field installation of the food service equipment including buy out equipment at the project site including on site receiving and unloading, uncrating from packing containers, conveyance of the food service equipment from the receiving area to the installation location, erection and assembly of the food service equipment including field welding and polishing of sub assemblies and installation of fixtures and components and setting in place in final location.

F. Removal and disposal of discontinued items of food service equipment not to be reused including costs for transport and scrapping. This shall include pump-down and reclaim of refrigerant and fire system propellant and disposal costs of all refrigeration systems as required. Utility disconnection and termination of utility services shall be provided by the Plumbing, Electrical and Mechanical (HVAC) Trades.

G. Removal and disposal of discontinued items of food service equipment not to be reused including costs for transport and scrapping. This shall include pump-down and reclaim of refrigerant and disposal costs of all refrigeration systems as required. Utility disconnection and termination of utility services shall be provided by the Plumbing, Electrical and Mechanical (HVAC) Trades.

H. Removal, cleaning, servicing, reassemble and reinstallation of items of food service equipment to be reused including warehousing and transportation costs for scheduled items of food service equipment to be refurbished off-site or to be temporarily stored off-site. This shall include pump-down and reclaim of refrigerant and disposal costs of all refrigeration systems as required. Utility disconnection and termination of discontinued services and modification or preparation or relocated utility services shall be provided by the Plumbing, Electrical and Mechanical (HVAC) Trades.

I. Removal, cleaning, servicing, crating and delivery including costs for transport of items of food service equipment to be reused in an alternate location. This shall include pump-down and reclaim of refrigerant and disposal costs of all refrigeration systems as required. Utility disconnection and termination of utility services shall be provided by the Plumbing, Electrical and Mechanical (HVAC) Trades.

J. Removal and disposal of all packing material.

K. All costs for special tools, crane rental or usage cost or rigging as may be required for delivery or installation of the food service equipment.

L. All work is to be performed by skilled labor utilizing the proper Trades having respective jurisdiction thereto. All work shall be performed at hours required to maintain consistent work schedules with all other Trades without additional cost.

M. Preparation of dimensioned utility rough-in floor plans coordinated with the Contract Documents and site conditions and the food service equipment manufacturers' utility connection points for all food service equipment.

N. Assist in the preparation of "chalk-line" mark-up of utility rough-in locations on the building floor at the job site.

O. Take complete financial responsibility for any and all additional expenses resulting from incomplete or inaccurate rough-in drawings or instructions for the final rough-in dimensioning at the job site.

P. Provide complete manufacturers' and fabricator shop drawings of all related items of food service equipment.

Q. Provide competent on-site supervision for the coordination of work and to assist and supervise the erection, assembly and installation of the food service equipment, this shall include any moving, shifting or disassembly of the food service equipment to enable work to be performed free of obstruction.

R. Attend all job conferences and meetings.

S. Maintaining coordination and control over the form, fit, function and utility requirements of all food service equipment, from placement of purchase orders through Final Acceptance.

T. Provide competent on-site final testing, demonstration and instruction in the use and service of all items of food service equipment in the form of a qualified manufacturer's representative for each item of food service equipment.

U. Providing access to the custom equipment fabricator's shop for inspection of construction and materials used at any time during the progress of fabrication.

V. Field verification of all measurements at the project site prior to the fabrication of custom fabricated and buy-out equipment and correct any deviation from the dimensions indicated on any plans and shop drawing which may affect the final form or fit of any item of food service equipment as a result of final building conditions and actual field dimensions.

W. All food service equipment shall conform to field verified dimensions and to the finished building conditions with edges scribed and sealed to wall surfaces, fitting to and around building obstructions. All joints, seams or surfaces shall be fully sealed with General Electric or equivalent clear silicone sealer.

X. Field verification of delivery access into and through the building to the final equipment location including access and clearance through hallways, doorways and elevators (cab size and weight restrictions); furnish food service equipment in sections or sub-assemblies as required for access.

Y. Keeping the premise free from accumulation of waste material and rubbish caused by his work. At the completion of each workday all waste material and rubbish must be removed and all areas swept broom clean.

Z. Physical damage to equipment, building or previous work completed or in the process of completion shall be repaired or replaced.

AA. Furnish as part of and affixed to the food service equipment, accessories, components and fixtures furnished standard with the equipment as specified or listed as an option and shall include the following:

1. PLUMBING ACCESSORIES: Pop-up, lever or basket type waste outlets, tailpieces, standing or connected overflows, faucets and spray units, vacuum breakers, shut-off and control valves and fittings.
2. STEAM AND GAS ACCESSORIES: Steam supply valves, thermostats, pressure reducing and regulating valves, shut-off and control valves, temperature and pressure gauges, copper steam coils or injector assemblies, traps and fittings
3. ELECTRICAL ACCESSORIES: Terminal blocks, conduit, wiring, signal and pilot lamps, on-off and control switches, control panels, magnetic contactor assemblies, heating elements, junction boxes, outlet boxes and receptacles and cord and plug sets.

4. REFRIGERATION ACCESSORIES: Copper insulated refrigeration tubing, valves, fittings, hangers, high- and low-pressure control switches, solenoid valves, evaporator coils, expansion valves, condensing units and condensate evaporators.

BB. All built-in accessories, components and fixtures shall be factory installed at the time of fabrication and shall comply with all applicable codes and regulations.

CC. Furnish and install copper insulated refrigeration lines from compressor location to evaporator coils and expansion valves for all refrigeration units and ice makers with remote or refrigeration systems other than self-contained.

DD. Furnish and install flexible stainless-steel gas flue tubing from exhaust collar on gas hot water booster heater terminating at the exhaust vent connection at the vent extension or condensate hood.

EE. Furnish 14-gauge galvanized steel welded roof curbs for all refrigeration condensing unit stands and exhaust fans and supply fan make-up air units including setting-in-place and securing to the building roof.

FF. Furnish and install in exhaust hood, plenum, duct and surface fire protection system. Entire system shall be furnished and installed in compliance with UL Standard 1254, UL Standard 300, NFPA 96 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17A-27. The manufacturer of the fire suppression system shall be ISO 9001 registered. The entire installation must conform to ADA (American Disabilities Act) latest edition. The system shall be an automatic fire suppression system using a wet chemical agent for grease related fires. The system shall be the pre-engineered type having minimum and maximum guidelines established by the manufacturer and listed by Underwriters Laboratories (UL). The system shall be installed and serviced by certified personnel trained by the manufacturer. Provide as part of fire system, mechanically operated gas supply line shut-off valve to interrupt gas supply to all gas operated cooking appliances. Gas valve shall be provided with manual reset to prevent gas flow to pilot devices on appliances prior to restart.

GG. Furnish and install remote and self-contained refrigeration system complete with condensing unit and insulated copper refrigeration lines charged with R448A refrigerant. Condensing unit shall be interconnected to a low profile, high velocity evaporator coil. Refrigeration system shall include all fittings, valves, switches, controls and all related components to comprise a complete operating unit of sufficient BTU capacity to maintain automatic operation of 35-degree F product temperature in coolers and -10-degree F product temperature in freezers. Refrigeration system provided with outdoor remote air-cooled condensing unit shall be provided with winterized controls (low ambient package) including crankcase heater, line dryers and head pressure control unless specified as part of a pre-assembled refrigeration rack system. Refrigeration lines to be run within any slab or floor shall be either hard copper or soft copper if run within conduit.

HH. All electrical wiring, plumbing lines, gas lines (except exposed threaded pipe gas manifolds at cooking appliances), steam lines and refrigeration lines shall be concealed in the floor, walls or above the finished ceiling in an acceptable manner and in compliance with all applicable codes. Where it is impractical to run lines within the floor, walls or above the finished ceiling, lines shall be enclosed in a stainless steel (or alternate “smooth and cleanable” approved material) with appropriate access for service or replacement. In situations of an island arrangement or where equipment is not situated with access to a wall surface, lines must be installed in the floor in an approved manner including in-ground conduit for refrigeration and beverage lines. In no case shall any lines be “exposed”.

II. Furnish materials and install all interconnecting wiring as required for the food service equipment, except for exhaust ventilation and fire suppression systems. This shall include inter-wiring of control panels furnished as a part of a fixture or appliance, on-off switches for light fixtures furnished as a part of a fixture or appliance, inter-wiring of control devices to motors furnished as a part of a fixture or appliance, time clock circuits for freezers from remote condensing unit to evaporator coil, heated pressure relief ports in walk-in freezer, electrical receptacles furnished as a part of a fixture or appliance, light fixtures in walk-in refrigeration to on-off switches and conduit junction boxes, ceiling mounted heat lamps to remote wall switch and inter-wiring of food waste disposer from control device to disposer motor as required to complete the installation of the food service equipment. This work does not pertain to the any of the exhaust and supply ventilation systems on the project.

JJ. Furnish materials and install heat tracing tape to all condensate lines within walk-in freezer; insulate entire heat tracing tape with foam pipe insulation.

KK. Furnish materials and install all interconnecting plumbing as required for the food service equipment, except for exhaust ventilation and fire suppression systems. This shall include faucets, drains, drains with connected overflow, shut-off valves, vacuum breakers, flow or pressure control valves, gauges, bleeder tubes, piping from disposer control devise to disposer cone and disposer body inlets and piping for steam operated equipment from boiler take-off valve at steam generator to steam inlet connection at appliance as required to complete the installation of the food service equipment.

LL. Furnish materials and install insulated copper interconnecting piping between the dishmachine and the hot water booster heater, this shall include the installation of pressure and temperature gauges, strainer and shock absorber in the hot water supply line to the booster heater.

MM. Furnish and install water filter assemblies, sized and of the proper type to accommodate the water flow rate and “particulate” requirement of the food service equipment; this shall include all combi and bake ovens, steam cookers, proofing cabinets, ice makers, coffee brewing equipment and soda and beverage dispensing equipment.

NN. Furnish and install copper condensate lines in walk-in refrigeration from evaporator coil to waste receptor.

OO. Furnish and install gas supply shut-off valve at each gas manifold connection and furnish and install flexible gas hose connectors to each shut-off valve and to each cooking appliance.

PP. Furnish materials and install interconnecting chrome plated exposed piping for hose reel and hose bibs including installation of check valves and vacuum breaker in supply line; this shall include chrome plated bleeder outlet if required by local health department regulations or local plumbing codes.

1.4 WORK BY THE ELECTRICAL TRADE

A. Rough-in utility connections including proper voltage, phase and amperage required to satisfactorily operate all items of food service equipment.

B. Final connection of the food service equipment from the rough-in location to the connection point on all food service equipment and necessary connection points.

C. All electrical components for the exhaust and supply ventilation system (including condensate hoods and pant leg vent systems) including, electrical disconnects, starters, exhaust fan on-off

switch with indicator lights located in kitchen and supply fan controller with indicator lights located in kitchen and dishroom.

D. Furnishing and installation of all accessories, components and fixtures other than those specified as part of the food service equipment, to include but not be limited to, electrical circuit breakers or fuses, electrical receptacles, disconnect switches, on-off switches or other fittings and appurtenances that are required to connect the food service equipment in accordance with manufacturer's instructions and result in proper operation.

E. Utility disconnection and termination of discontinued services of existing food service equipment to be terminated.

F. Furnishing and installing electrical plug and cord sets where not furnished as part of the appliance.

G. Electrical contractors or shunt-trip circuit breakers to interrupt electrical power to all electrically operated food service cooking appliances.

H. In-floor, flush mounted, waterproof electrical receptacles of type and capacity to match plug and cord sets for all mobile food service counter equipment.

I. Ceiling mounted, retractable drop cords to accommodate food service equipment in an island arrangement, of the type and capacity to match plug and cord sets of the food service appliances.

J. Furnishing materials and installation of all interconnecting wiring as required for the food service exhaust ventilation and fire suppression systems; this shall include wiring of electrically operated gas supply shut-off valves for fire suppression systems, fire suppression system wiring to building fire alarm, heat detector electrical detection device to automatically start supply and exhaust fans and exhaust hood light fixtures to remote wall switch.

1.5 WORK BY THE PLUMBING TRADE

A. Rough-in utility connections including gas, steam, hot and cold water and floor receptors and drains in proper sizes, pressures and quantities required to satisfactorily operate all items of food service equipment.

B. Final connection of the food service equipment from the rough-in location to the connection point on all food service equipment and necessary outlets.

C. Furnishing and installation of all accessories, components and fixtures other than those specified as part of the food service equipment, to include but not be limited to stop cocks, traps, pipe, shut-off valves, pressure reducing valves or other fittings and appurtenances that are required to connect the food service equipment in accordance with manufacturer's instructions and result in proper operation.

D. Furnishing and installing chrome plated indirect waste outlet piping for food service equipment, from the waste outlet connection on the food service equipment to the building waste receptacle (floor sink, etc.).

E. Flushing and sanitizing of lines before making final connections to the food service equipment.

F. Grease interceptors for food service equipment in capacity and size as required by code.

G. Furnish and install exposed threaded gas manifold piping for all cooking appliances and welded in-wall gas manifold piping.

H. Install gas shut-off valve supplied as part of the fire suppression system in the gas supply line in an exposed and accessible location.

1.6 WORK BY THE MECHANICAL TRADE

A. Supply and exhaust ventilation for indoor refrigeration condensing units based on 750 cfm for each air-cooled compressor horsepower and 250 cfm for each water-cooled compressor horsepower.

B. Exhaust ventilation for condensate applications including fully welded 18-gauge stainless steel or 12-gauge aluminum liquid tight ductwork pitched toward source to prevent leaking, fan and start-sop switch with indicator lights located in the dishroom.

C. Exhaust hood exhaust ventilation system including roof top mounted “utility set” type up-blast centrifugal fan with backward incline wheel, adjustable sheaves, vibration mounts and bird screen at discharge end; fan shall be rated at 14 sones or less and shall be UL 710 listed; roof curb, exhaust ductwork constructed of a minimum 16 gauge galvanized steel or 18 gauge stainless steel, fully welded liquid tight with clean-outs at every major bend and in 20 foot intervals; ductwork shall not exceed a three to one aspect ratio, connection to exhaust fan shall include a UL listed and rated vibration eliminator and ductwork shall be insulated with all prevailing codes.

D. Exhaust hood supply ventilation system including roof top mounted UL listed supply fan with vibration mounts, adjustable sheaves, roof curb, bird screen at intake end, maintainable filtration system, and gas or electric heated supply air heater (supply air heater heat incoming supply air below a 65-degree F ambient temperature) and 22-gauge galvanized steel ductwork.

E. Disconnection and termination of discontinued ductwork of existing exhaust or condensate hoods to be terminated or relocated, and modification or preparation of exhaust system for existing exhaust or condensate hoods to be relocated at the new location.

1.7 WORK BY THE CONSTRUCTION TRADE

A. Masonry bases, floor curbs, structural pads, floor depressions, roof curbs, flues and fireproof duct shafts or enclosures.

B. Conduit for beverage lines (PVC if embedded in concrete or smooth aluminum if exposed) with 24" radius sweep bends and 24" x 24" pull boxes every 100 lineal feet or three turns including sleeves any through walls, floors and ceilings.

C. Sleeves and openings through wall, floors and ceilings for passage of refrigeration lines.

D. Wall blocking or reinforcing to adequately support wall mounted food service equipment or fixtures; provide 3/4" thick exterior grade plywood backing for wood stud applications and 16-gauge steel backing for metal stud applications.

E. Stainless steel or FPR wall paneling behind all mop receptors, dishtables and pot / utensil washing sinks.

F. Installation of floor pans in floor depression with floor pans set flush and finished watertight around entire perimeter at juncture with floor surface.

G. Conduit for refrigeration lines (PVC if embedded in concrete or smooth aluminum if exposed) with 24" radius sweep bends including sleeves any through walls, floors and ceiling.

1.8 WORK BY THE ROOFING TRADE

A. Roof penetrations properly sealed and flashed to prevent water penetration.

1.9 BIDDING INSTRUCTIONS AND QUALIFICATION OF BIDDER

A. The primary items of food service equipment described in this specification are considered the basis of the bid. Only “equal” items listed as part of this specification will be considered and must meet the conditions of the base bid item; this shall include all materials and material finishes, fabrication methods, electrical, plumbing, and mechanical components, electrical control devices, hardware, accessories and options, exactly as specified without exception. It will be the full and complete responsibility of the Food Service Equipment Contractor to pay any and all costs incurred in adapting any other “equal” item to the mechanical, electrical, exhaust ventilation or structural systems of the building including any other cost increase incurred as a result of engineering changes to the mechanical, electrical, exhaust ventilation, architectural, structural or food service drawings. The contract is to be awarded as follows:

1. The competence and responsibility of the bidder.
2. An itemized cost breakdown of each scheduled item of food service equipment is required, as specified, in order that the District may, at his option, delete any item or supply any portion thereof, or increase the quantity of any item without affecting the cost quoted for the remaining items. “Pre-approved” substituted items must be submitted as an add or deduct alternate in addition to the base bid.
3. The District is not obligated to accept the lowest or any other bid. The award of the contract and choice of the food service equipment Contractor shall be at the District's discretion.

B. Each bidder shall be responsible to visit the project site of the proposed work and fully acquaint himself with conditions as they exist.

C. Each bidder is responsible to attend any pre-bid meeting as required by the District.

D. Each bidder shall be responsible to examine and review the contract document drawings and specifications. Should the bidder find during examination of the drawings and specifications any discrepancies, omissions, ambiguities, or conflicts in or among the contract documents or shall be in doubt as to their meaning, the District shall be notified no later than four working days prior to bid opening for clarification.

E. The failure or omission by any bidder to receive or examine any form, instrument or document or to visit the project site shall in no way relieve him from obligation with respect to his bid. No claims for any extras will be allowed due to unintentional errors, conflicts, or omissions in the contract documents drawings or specifications.

1.10 SUBMITTALS

A. Product Data: For each buy-out item of food service equipment indicated. Include manufacturer’s model number and accessories and requirements for access and maintenance clearances, water and drainage, power or fuel and service connections including roughing-in dimensions

B. Shop Drawings: For food service equipment not manufactured as standard production and catalog items by manufacturers. Shop drawings shall include the following information:

1. Dimensioned rough-in plans scaled at 1/4"=1'-0" accurately locating connection points and indicating utility data for all mechanical, electrical and supply and exhaust ventilation requirements.
2. Dimensioned plans scaled at ½"=1'-0" accurately locating and indicating the finished size of masonry bases, floor depressions in structural slabs, stub walls, curbs and finished openings for pass-thru equipment.
3. Dimensioned plans scaled at 1/4"=1'-0" accurately locating conduit and pull boxes for beverage and refrigeration lines including floor, wall and ceiling penetrations and termination points.
4. Dimensioned plans and detailed drawings of all custom fabricated food service equipment scaled at 3/4"-1'-0" for plan and elevation views and 1-½"=1'-0" for sectional views.

C. Copies of original maintenance and repair manuals including a list of all authorized service agencies responsible for each item of food service equipment.

1.11 QUALITY ASSURANCE

A. Manufacturer's qualifications shall include a firm that has regularly engaged in the manufacturing of food service equipment of the same type, capacity, performance and size as specified and whose products have been in similar service for not less than five years.

B. Custom fabricator qualifications for custom food service equipment shall include a skilled sheet metal shop with a minimum of five years' experience in custom sheet metal food service equipment fabrication of similar type as specified. All custom food service equipment shall be fabricated at the same shop.

C. Installer's qualifications shall include a firm with at least three years of successful installation experience on projects with a similar scope to that as required for this project.

D. Food service equipment dealers' qualifications shall include a firm which is regularly engaged in the purchasing of food service equipment as is a manufacturer authorized agent of the specified equipment for not less than five years. The dealer shall also employ a full time project management staff to oversee the purchase of the equipment in compliance with the specifications, coordinate the form and fit of the equipment to the project site conditions, attend all project meetings, coordinate shop drawing review, coordinate installation with the Trades, coordinate factory training and address all issues as they relate to the satisfactory completion of the facility in compliance with the specifications and related documentation.

E. Codes and Standards: All food service equipment furnished and installed under this specification shall be manufactured in strict compliance with the following publications or the current or revised related publication as well as all state, national and local codes and agencies having jurisdiction over same:

1. National Electrical Manufacturer Association NEMA
    a. ICS-77 Industrial Controls and Systems
2. National Electrical Manufacturer Association NEMA
    a. ICS-77 Industrial Controls and Systems
    b. 17.4 Local Application System
    c. 17.13 Water Sprinkler Systems
    d. 96-76 Installation of Equipment for the Removal of Smoke and Grease Laden Vapors for Commercial Cooking Equipment

3. National Sanitation Foundation NSF
    a. 11 76 Food Service Equipment
    b. 4 73 Commercial Cooking and Warming Equipment
    c. C-2-72 Special Equipment and/or Devices
4. National Electrical Manufacturer Association NEMA
    a. 57-78 Electric Lighting Fixtures
    b. 197-78 Commercial Electric Cooking Appliances
    c. 300 Fire Extinguishing Systems

F. All food service equipment shall be manufactured in strict compliance with standards as set forth by the National Sanitation Foundation (NSF) including fabrication of custom-built equipment and shall be listed with same and shall bear their seal. Any item of food service equipment lacking the NSF seal will be rejected.

G. All electrically operated food service equipment shall be constructed in strict compliance with standards as set forth by the Underwriters Laboratories (UL) and shall utilize approved components and assemblies and shall bear the label thereof.

H. Custom fabricated food service equipment shall be constructed to the standards as set forth by the National Association of Food Equipment Manufacturers (NAFEM).

I. All refrigeration equipment and all pressurized vessels shall be constructed, approved, inspected, registered and stamped and installed in strict compliance with the American Society of Mechanical Engineers (ASME), state and local codes for Unfired Pressure Vessels and all other agencies having jurisdiction thereof.

J. All gas operated food service equipment shall be fabricated in strict compliance with standards as set forth by the Underwriter Laboratory (UL) and shall be listed with same and shall bear their seal.

K. Steam operated equipment shall be fabricated and installed in accordance with Pennsylvania Department of Labor and Industry standards.

L. Product Options: Drawings indicate food service equipment based on the specific products indicated. Other manufacturers' equipment with equivalent size and performance characteristics may be considered.

M. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings." Review methods and procedures related to food service equipment including, but not limited to the following:

1. Review access requirements for equipment delivery.
2. Review equipment storage and security requirements.
3. Inspect and discuss condition of substrate and other preparatory work performed by other Trades.
4. Review structural loading limitations.
5. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment and facilities needed to make progress and avoid delays.

1.12 DELIVERY, STORAGE AND HANDLING

A. Deliver food service equipment as factory-assembled units with protective crating and covering.

B. Store food service equipment in original protective crating and covering and in a dry location.

1.13 PROJECT CONDITIONS

A. Field Measurements: Verify dimensions of food service equipment installation areas by field measurements before equipment fabrication and indicate measurements on Shop Drawings and Coordination Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1.14 COORDINATION

A. Coordinate equipment layout and installation with other work including light fixtures, HVAC equipment and fire-suppression system components.

B. Coordinate location and requirements of service-utility connections.

C. Coordinate size, location and requirements of concrete bases, positive slopes to drains, floor depressions and insulated floors. Concrete, reinforcement and formwork requirements are specified in Division 3 Section “Cast-in-Place Concrete”.

D. Coordinate installation of roof curbs, equipment supports and roof penetrations, as specified in Division 7 Section “Roof Accessories”.

1.15 WARRANTIES

A. General Warranty: The special warranty specified in this Article shall not deprive the District of other rights the District may have under other provisions of the Contract Documents and shall be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. All buy-out food service equipment herein specified shall have all parts and labor warranted in writing, from the date of Final Acceptance by the District against defective parts, materials, workmanship and design for a period of time as stated within the manufacturers standard published warranty, but no less than two years.

C. All custom fabricated food service equipment shall be warranted as stated above except for a period of two years.

D. Refrigeration equipment shall include start-up and two-year parts and labor warranty on the entire refrigeration system and manufacturers five-year parts warranty on hermetic scroll and semi-hermetic sealed compressors.

PART 2 - PRODUCTS

2.1 MATERIALS AND WORKMANSHIP

A. Stainless steel shall be type 302 or type 304 extra low carbon non-magnetic austenitic 18% chrome, 8% nickel alloy steel. Gauges shall be U.S. Standard of Thickness set forth below:

GAUGE	THICKNESS	GAUGE	THICKNESS
10	.1346	16	.0598

11	.1196	18	.0478
12	.1046	20	.0359
14	.0747	22	.0299

B. All sheets shall be of maximum length to permit fabrication from one sheet. All thickness must meet the above gauge thickness within tolerances set forth by the ANSI after polishing. Finished sheets exceeding these tolerances shall be rejected as not meeting this Specification.

C. Galvanealled steel shall be ARMCO steel or an approved grade of copper bearing steel shall be properly primed, degreased and finished with two coats of synthetic aluminum bronze.

D. Structural steel members used for framing, consisting of angles, bands, bars and channels shall be ductile in quality, free of hard spots, runs, checks, cracks and other surface defects and shall be smooth galvanized by the hot dip process with all surplus removed, free of runs, blisters, excess splatter and uncoated spots or patches.

E. White metal shall consist of corrosion resistant metal containing not less than 21% nickel. All castings shall be rough ground, polished and buffed to a bright luster and shall be free from pit marks, runs, checks, burrs and other imperfections.

F. Stainless steel pipe and tubing shall be seamless or welded of gauge specified and of true roundness. Seamless tubing shall be thoroughly and correctly annealed and ground smooth. Welded tubing shall be thoroughly heat treated and properly quenched to eliminate carbide precipitation, drawn true to size and roundness and polished to match stainless steel sheets.

G. Welding shall be of the electric submerged or concealed arc type, heliarc wherever practical. Where welding rods are required they shall be of the same composition as materials to be joined coated with a non-carbonaceous flux.

H. Plastic Laminate: Complying with NEMA LD 3 and NSF 35 requirements; NSF certified for end-use application indicated; 0.050 inch (1.27 mm) thick, smooth texture and easily cleanable.

1. Color: As selected by Architect from manufacturer’s full range of colors.

I. Plywood and Lumber: Close grain exterior grade mahogany or birch plywood.

J. Sealant: ASTM C 920; Type S, Grade NS, Class 25, Use NT. Provide elastomeric sealant NSF certified for end-use application indicated. Provide sealant that when cured and washed meets requirements of Food and Drug Administration’s 21 CFR, Section 177.2600 for use in areas that come in contact with food.

1. Color: As selected by Architect from manufacturer’s full range of colors.
2. Backer Rod: Closed-cell polyethylene in diameter larger than joint width.

K. Plastic: Except for plastic laminate, provide plastic materials and components complying with NSF 51.

L. Sound Dampening: NSF-certified, non-absorbent, hard drying, sound-deadening coating. Provide coating compounded for permanent adhesion to metal in 1/8-inch (3-mm) thickness that does not chip, flake or blister.

M. Gaskets: NSF certified for end-use application indicated; of resilient rubber, neoprene or PVC that is nontoxic, stable, odorless, nonabsorbent and unaffected by exposure to foods and cleaning compounds.

2.2 ACCESSORIES

A. Cabinet Hardware: Provide NSF-certified stainless-steel hardware for equipment items as indicated.

B. Casters: NSF-certified standard-duty stainless-steel swivel stem casters with 5-inch (125-mm) diameter wheels, polyurethane tires with 1-inch (25-mm) tread width and 300-lb (90-kg) load capacity per caster. Provide brakes on 2 casters per unit.

2.3 FABRICATION, GENERAL

A. All welds shall be strong and ductile, nonporous, free of pits and cracks. Parts which are to be welded shall be homogeneous, of a like color and finish to adjoining material. Excess metal and carbide precipitation shall be ground off, finished smooth and polished. Unexposed welds shall be pacified to prevent attrition. Brazed or soldered joints are unacceptable. Where galvanizing has been damaged due to the welding or grinding process, these areas shall be galvawelded to replace finish

B. All exposed surfaces of the food service equipment shall be free from bolts, screws and rivet fastenings. Wherever bolts are required they shall be of similar composition and finish as the metal to which they are applied.

C. Wherever practical all food service equipment and fixtures shall be factory or shop fabricated of one-piece construction, shipped to the project site as one unit completely assembled.

D. Items of food service equipment or fixtures too large to enter or transverse the building to the installation location in one assembly shall be constructed in sections and shall be furnished with field joints. Where field joints are necessary, all adjoining exposed surfaces shall be field welded at the project site as specified above for welding. Where conditions make welded field joints impractical, each sub-assembly shall be fabricated with off-set draw angles welded to the underside of each adjoining top surface and drawn together to a “hairline” seam with 1/4"-20 stainless steel bolts with lock washers and chrome plated acorn nuts. Bolted field joints will be permitted only where specifically shown on Drawings or specified for a particular item.

E. Wherever shear edges occur they shall be free of burrs, fins or irregular projections and shall be finished to prevent cutting or laceration when the hand is drawn over such shear edges. Brake bends shall be free of undue and where such bends do mar the uniform surface appearance of the material, such marks shall be removed by suitable grinding, polishing and finishing. In no case where miters or bullnose corners occur is overlapping materials acceptable.

2.4 GENERAL FRABRICATION STANDARDS

A. TOPS:

1. Tops shall be fabricated of 14-gauge stainless steel unless otherwise specified. All edges shall be bullnose or formed as specified with all joints butt-edged and electrically welded, ground smooth and polished so no evidence of welding will appear. Soldered corners to achieve round corner construction will not be accepted.

2. Tops adjacent to walls, columns or other equipment shall be turned up integrally into a backsplash as specified. All interior corners shall be coved on a ¾" radius, both horizontally and vertically, forming spherical corners. Ends of backsplashes shall be fully enclosed to the low point of the top edge, fully welded, ground smooth and polished.

B. SUPPORT FRAMING

1. Around the entire perimeter on the underside of all tops and set back 1" from the down-turned edge shall be a fully welded frame assembly fabricated of 1-1/2" x 1-1/2" x 1/8" stainless steel angle iron or material as specified. Provide intermediate cross bracing fabricated of the same material as the angle framing and fully weld to perimeter frame on centers not to exceed 24". Tack weld the entire frame assembly to the underside of the top surface.
2. Open base tables shall be provided with leg mounting channels for weld anchoring leg gussets and shall be fabricated of 1" x 4" x 1" 12-gauge stainless steel or material as specified fully welded at each end of frame and at intervals not to exceed 6'-0".
3. Cabinet base tables and counters shall be provided with triangular corner gusset plates for weld anchoring counter type legs and shall be fabricated of 12-gauge stainless steel fully welded at each corner of table or counter body and at intervals not to exceed 6'-0".
4. Freestanding sinks and Bain Maries shall be provided with triangular corner gusset plates for weld anchoring leg gussets and shall be fabricated of 12-gauge stainless steel, fully welded at each corner of sink or Bain Marie bottom and at intervals not to exceed 6'-0".

C. LEGS AND ADJUSTABLE BULLET FEET

1. Legs shall be constructed of 1-5/8" diameter 16-gauge stainless steel tubing. Each leg shall be swaged and tapered at the bottom. Fasten each leg to a 3-1/2" high conical shaped die-formed stainless steel gusset equivalent to Component Hardware A20-0206. Provide each leg with stainless steel adjustable foot insert equivalent to Component Hardware A10-0852.
2. Cabinet base tables and counters shall be provided with 6" high conical shaped die-formed stainless steel equipment leg with stainless steel adjustable round foot insert equivalent to Component Hardware A72-0811.

D. CROSSRAILS

1. Provide all open base tables and freestanding sinks and bain Maries with 1-1/4" diameter 16-gauge stainless steel tubular cross railing running between legs at a point 10" above the finished floor. Cross railing shall be continuously welded to legs, filleted, ground smooth and polished to provide a smooth coved radius with leg surface.
2. Where cross railing abuts cabinet base fixtures, cross railing shall be concealed bolt anchored to same utilizing stainless-steel hardware.

E. UNDERSHELVES

1. Provide solid fixed undershelf, constructed of 16-gauge stainless steel. Front edge shall be turned down 1" at 90 degrees and returned ½" at 45 degrees. Rear and ends shall be turned up 2" high on a 90-degree angle, interior corners coved on ¾" radius.

F. DRAWERS

1. Provide drawer pan constructed of 14-gauge stainless steel with inside corners coved on a 3/4" radius. Drawer front face shall be double pan type constructed of 16-gauge stainless steel with inner pan set into outer pan and welded in place. Drawer front shall be set into and shall be removable from a 14-gauge stainless steel, channel shaped drawer cradle.

Drawer suspension slides shall be secured to drawer frame assembly and shall be Component Hardware S52 series full extension type with 14-gauge stainless steel slides with stainless steel ball bearing wheels having a load capacity of 200 pounds. Provide hard rubber bumper drawer stops. Drawer suspension guides shall be fastened to 18-gauge stainless steel housing which is suspended from the angle framing under the table top. Provide drawer fronts with full grip recessed stainless steel flush pull handles.

2. Stainless steel drawer enclosure cabinet with quantity of drawers as specified with cabinet body fabricated of 18-gauge stainless steel, wrap around construction. The backs of front stiles shall be closed with tight fitting channel sections of 18-gauge stainless steel, welded in place, and closed on top and bottom. Drawer suspension slides shall be secured to drawer frame assembly and shall be Component Hardware S52 series full extension type with 14-gauge stainless steel slides with stainless steel ball bearing wheels having a load capacity of 200 pounds. Provide hard rubber bumper drawer stops. Provide drawer fronts with full grip recessed stainless steel flush pull handles.

G. CABINET BASES

1. Cabinet body shall be fabricated of 18-gauge stainless steel wrap around construction. The backs of front stiles shall be closed with tight fitting channel sections of 18-gauge stainless steel, welded in place and closed on top and bottom.
2. Cabinet base shelves shall be fixed bottom and intermediate fabricated of 18-gauge stainless steel. Front edge shall be turned down 1 1/2" at 90 degrees, returned 1/2" at 90 degrees. Rear and ends shall be turned up 2" at 90 degrees with interior corners coved on a ¾" radius. Shelf shall be weld anchored to cabinet body. Bottom shelf shall be fabricated flush with front mullions with fully welded facing junctures presenting seamless construction. Fixed intermediate shelves shall be designed similar to bottom shelf except front edge shall be set behind vertical mullions and fully welded thereto.

H. SLIDING DOORS

1. Sliding doors shall be double pan type constructed of 16-gauge stainless steel with inner pan set into outer pan and welded in place. Doors shall have welded internally 1" x 4" x 1" 14-gauge stainless steel hat type reinforcing channels. Doors shall be fitted with full grip, recessed type stainless steel flush pull handles. Provide 16-gauge stainless steel angle door stops welded to door. Provide hard rubber door stops. Provide each door with two, 1 3/8" diameter stainless steel ball bearing sheaves fastened to 1" x 1/8" thick stainless-steel bar stock hangers welded to top corners of each door for suspending on overhead door channel track. Provide hangers with stainless steel removable locks to prevent doors from jumping track during operation while permitting ease of removal. Fabricate overhead track of 14-gauge stainless steel and weld to cabinet body. Provide bottom of doors with nylon door guides secured to bottom shelf. Guides shall not interfere with door removal.

I. HINGED DOORS

1. Hinged doors shall be double pan type constructed of 16-gauge stainless steel with inner pan set into outer pan and welded in place. Hinges shall be stainless steel cam action pin type fastened by means of counter sunk flat head stainless steel screws staggered on centers and tapped into 1/4" thick stainless-steel bar stock welded behind door jamb. Doors shall be removable from hinges without the use of tools. Doors shall be held closed by permanent magnet closure devices. Doors shall be fitted with a full grip recessed type stainless steel flush pull handle. Provide hard rubber door stop bumpers.

J. SINKS

1. Sinks shall be fabricated of 14-gauge stainless steel with all interior corners coved on a ¾" radius both horizontally and vertically forming spherical corners.
2. Exposed edges of sink shall be finished with a 1 ½" diameter 180 degree rolled edge, rear and sides adjacent to adjoining surfaces shall have a backsplash turned up 10" high at a 90-degree angle on a ¾" radius and turned back 2 ½" on a 45-degree angle, then down ½" at 90 degrees along back.
3. Multiple sink compartments shall be divided with double wall 14-gauge stainless steel partitions 1" wide rounded on top and all corners at a ¾" radius. Finish bottom, back and front with 14-gauge stainless steel to form one continuous sink with no overlapping joints or open spaces between sink compartments.
4. Integral drainboards shall be constructed of 14-gauge stainless steel. The front portion shall continue the 1 ½" diameter 180 degree rolled rim of the sink bowl on a continuous level horizontal plane. The surface of the drainboard shall be pitched from 2 ½" at the end away from the sink to 3" at the sink bowl. Sink and drainboard backsplash shall be continuous and level on the horizontal plane. All interior corners both vertical and horizontal shall be coved on a ¾" radius. Drainboards shall be reinforced with 1" x 4" x 1", 12-gauge stainless steel "hat" channels extending front to rear tack welded to underside of drainboard for weld anchoring leg gussets.
5. Provide crossrails extending front to rear between legs, crossrails shall not extend along rear at sink to prevent interference with plumbing.
6. Built-in sink compartments shall be fabricated as an integral part of fixture with sink fully welded with adjacent top, weld ground smooth and polished.

K. MILLWORK

1. Millwork fabricator shop shall be a certified participant in AWI's Quality Certification Program (QCP) to standard "Premium" construction.
2. Tops shall be fabricated of 3/4" thick 5-7 ply BW marine grade plywood build up to a 1 ½" thickness. All plastic laminate finished edges shall be applied prior to the surface laminate. Provide cross bracing around entire perimeter below tops and above all interior dividers to minimize deflection from equipment. Tops shall be fabricated in sections as large as possible to minimize field seams. Field seams shall be assembled utilizing TB-2 yellow glue. The bottom surfaces of all tops must be sealed with gray cabinet liner to comply with Board of Health requirements. Cut-outs for drop-in equipment shall be cut in the shop and with all edges sealed. All drop-in equipment shall be pre-fitted in top prior to delivery to the job site. All drop-in equipment shall be sealed with General Electric or equivalent clear silicon sealer after installation. Hardwood edges shall be applied prior to surface laminate. All hardwood to match for color and grain. Edges to be chamfered and finished as specified. Solid surface tops shall receive full plywood substrate with 3/4" x 3" batons for proper air space. All tops shall be prepared for installation of sneeze guards including additional blocking and / or cutouts.
3. All cabinet base and interiors shall be fabricated of 3/4" thick 5-7 ply marine grade plywood with high-pressure laminate finish. Recessed toe base shall be 6" high fabricated of 3/4" thick 5-7 ply marine grade plywood with 16-gauge stainless steel finish. Shelf pilasters to be recessed type 250WH with 253WH locking clips. Cabinet backs shall be fabricated of 1/4" thick MELA-MDF board. Cabinet ends to be dadoed for back and bottom and notched to receive aprons and kicks. Butt or dowel construction will not be acceptable. Cabinets shall be assembled with TB-2 yellow glue with screws and staples. Cabinets with finished backs shall be fabricated of 3/4" thick 5-7 marine grade plywood with high-pressure laminate finish. Cabinets over 48" in length shall have interior dividers. Dividers shall be dadoed into the bottom and notched for aprons. Dividers shall be notched as required for equipment. Aprons shall be large enough to conceal drop-in equipment and also to house control panels. Cabinet bases shall be fabricated in sections as large as possible to minimize field seams.
4. Doors shall be fabricated of 3/4" thick MDF board with high-pressure laminate finish and shall be furnished with three BLUM 75M5580 or 75M5680 European style concealed

hinges. Door pulls shall be Hafele 116.39.437. Locks where required shall be cam style, keyed alike. Doors shall not exceed 27" in width and shall be of equal size.

5. Drawers shall be constructed of 3/8" thick birchwood with dove tail joinery. Drawer slides shall be Accuride 150 lb. full extension type with stainless steel ball bearing hardware.
6. Applied wood fascia panels and doors shall be stile and rail design. Panels to be recessed or raised as specified. All wood to be select for color and grain. Finish shall match stock color samples or custom to match furnished sample. All panels and doors to be equally sized per cabinet. Provide full wood louvered panels as required for equipment requiring air circulation. Finish all wood with stain followed by single coat of sealer. After sealer, apply one layer of Armourcote conversion varnish approved for use in food service with 55% gloss.

L. SOLID AND HARD SURFACE MATERIAL (“CORIAN” / “ZODIAQ”)

1. Provide counter top, tray slide, etc. of approved solid surface material. Material shall be fabricated and assembled per manufacturers approved methods utilizing a factory authorized and certified fabricator and installer. The edges of the top shall be formed as indicated on the food service and architectural detail drawings, routed and finished as directed. Openings shall have radius corners and shall be reinforced with additional material. Where drop-in appliances are to set on tops, the fixture shall be furnished with a ¾” thick marine grade plywood sub-top fabricated with a perimeter frame extending through the opening in the top preventing the appliance from setting directly on the solid surface material and allowing the sub-top to distribute the weight of the appliance. Where heated appliances are to set on the top the sub-top is to be fabricated as above to prevent heat from being in direct contact with the solid surface top; additional fiberboard insulation material is to be provided where transfer of radiated heat will contact any solid surface material

M. PAINTING

1. Galvanized steel shall be cleaned and degreased with mineral spirits, primed with a minimum of two coats of primer and spray finished with a minimum of two coats of gray epoxy enamel paint

N. LAMINATED PLASTIC

1. All exposed surfaces shall be faced with 1/16" thick high-pressure plastic laminate in color and pattern as specified.
2. All unexposed surfaces shall be faced with .020 or .030 gray thermoset decorative overlay.
3. Where the plastic laminate is to be bonded to removable or fixed panels the panels shall be fabricated of 3/4" thick close grain marine grade mahogany or birch plywood with surfaces bonded with waterproof glue.
4. Where the plastic laminate is to be bonded directly to the metal facing of a cabinet base table or counter, surfaces shall be bonded with contact adhesive.

O. CLOSURE TRIM

1. Provide closure trim pieces fabricated of 16-gauge stainless steel or of material and finish as specified, trim shall be one-piece constructions furnished to seal both horizontal and vertical junctures and openings

2.5 STAINLESS STEEL FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal products" for recommendations relative to applying and designating finishes.

1. Remove or blend tool and die marks and stretch lines into finish.
2. Grind and polish surfaces to produce uniform directional textured polished finish indicated, free of cross scratches. Run grain with long dimension of each piece.

B. Concealed Surfaces: Minimum of 80 grit finish.

C. Exposed Surfaces: No. 4 finish (bright, directional polish) of 180 grit.

D. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

E. Protect mechanical finishes on exposed surfaces from damage by applying a strippable temporary protective covering before shipment.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions with Installer for compliance with requirements for installation tolerances, service-utility connections and other conditions affecting installation and performance of food service equipment. Do not proceed with installation until unsatisfactory conditions have been corrected.

B. Examine roughing-in for piping, mechanical and electrical systems to verify actual locations of connections before installation

3.2 INSTALLATION

A. Set each item of fixed food service equipment securely in place, level and adjust to correct height. Anchor to supporting surface where required for sustained operation and use without shifting or dislocation. Provide concealed anchoring where possible. Adjust work surfaces to a level tolerance of 1/16" maximum offset and slope drainage surfaces at 1/16" per foot.

B. Complete field assembly of field joints by welding or bolting utilizing the method as indicated with the fixture. Grind all field welds smooth and polish. Set and trim all gaskets to be installed as part of field assembly.

C. Treat enclosed spaces that are inaccessible after food service equipment installation by covering all horizontal surfaces with powdered borax at a rate of 4 ounces per square foot.

D. Provide closure trim pieces fabricated of 16-gauge stainless steel or of material and finish as specified, trim shall be one-piece construction furnished to seal both horizontal and vertical junctures and openings where the conditions given below occur:

1. Food service equipment is installed into wall openings. Trim shall apply to both sides of wall opening with all corners fully welded, ground smooth and polished.
2. Two or more items of food service equipment are butted together.

3. Food service equipment is installed against wall, columns other equipment resulting in a gap or juncture exceeding 1/4" in width.
4. An open gap of any size between the juncture or joint between adjoining items of food service equipment, wall or column surfaces which might result in the penetration or collection of grease or vermin.

E. Provide cut-outs and openings in food service equipment as required to extend plumbing, electric, steam or gas lines through the food service equipment either for interconnection of utility lines or final connection.

F. Seal around each item of food service equipment with sealant for gaps or spaces less than 1/4" in width and with stainless steel trim for gaps or spaces exceeding 1/4" in width. Closure strips shall conform to the shape and size of the surfaces or juncture to be sealed and shall be neatly scribed for a tight fit.

3.3 PROTECTION AND CLEANING

A. Provide final protection and maintain conditions in a manner acceptable to District, Manufacturer and Installer that ensure food service equipment is without damage or deterioration at the time of Substantial Completion.

B. After completion of the food service equipment installation and completion of other major work in the food service area remove protective coverings and clean and sanitize all food service equipment both internally and externally. Restore exposed and semi-exposed finished to remove abrasions or other surface damage, polish exposed metal surfaces and touch-up painted surfaces. Replace work which cannot be successfully restored.

3.4 COMMISIONING

A. Delay start-up of the food service equipment until utility services have been installed, completed and tested, balanced and adjusted for pressure and voltage, and until water and steam lines have been treated and cleaned for sanitation. Before start-up of the food service equipment lubricate in accordance with manufacturer’s instructions.

1. Coordinate food service equipment startup with service-utility testing, balancing and adjustments. Do not operate steam lines before they have been cleaned and sanitized.

B. Provide on-site demonstration and formal technical training by the manufacturer’s technical representative for each item of food service equipment as required to instruct the District and its personnel in the safe operation and sanitation and maintenance of the food service equipment.

C. Test each item of food service equipment for proper operation.

1. Repair or replace equipment that is defective in operation including units that operate below required capacity or that operate with excessive noise or vibration.
2. Test refrigeration equipment’s ability to maintain specified operating temperature under heavy-use conditions. Repair or replace equipment that does not maintain specified operating temperature.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
4. Test motors and rotating equipment for proper rotation and lubricate moving parts according to manufacturer’s written instructions.

5. Test water, drain, gas, steam, oil, refrigerant and liquid-carrying components for leaks. Repair or replace leaking components.
6. Train District's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing and preventive maintenance for each food service equipment item.
7. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Contract Closeout".
8. Review data in the operation and maintenance manuals. Refer to Division 1 Section "Operation and Maintenance Data".
9. Schedule training with District through Construction Manager with at least seven days advance notice.

3.5 SCHEDULE OF EQUIPMENT

A. Equipment Schedule: Refer to all Contract Documents pertaining to the food service areas. Equipment itemized along with brands and model numbers and salient features establish the standard for construction, operation and engineering criteria.

B. Equipment indicated below is intended to establish the standard of quality of the food service equipment. Alternate "Equal" products by other manufacturers as approved by the Professional may be considered if equivalent in design, performance, durability and function.

C. This document is the intellectual property of Corsi Associates and as such use by any other entity is prohibited.

ITEM #01	WALK-IN COOLER/FREEZER COMBINATION
Quantity:	One (1)
Manufacturer:	Amerikooler / Bally / Kolpak
Model:	Size and shape as per plan
Construction:	Furnish and erect, compartment sectional urethane insulated walk-in cooler / freezer assembly.

Walk-in assembly shall bear the UL and NSF labels and meet 2015 Federal Regulations.

Ceiling and wall panels shall be constructed of 4" thick urethane insulation, assembly to be accomplished by the use of integral cam type locking device, secured in place during the foaming process. Seams between panels shall be insulated with vinyl foamed in place gasket material.

Ceiling and wall panels shall be finished of 18 gauge embossed aluminum on interior and exterior surfaces.

Walk-in assembly shall be provided with 1/8" thick aluminum diamond tread plate floor and integral interior entrance ramp with NSF approved coved corners, insulated with 4" thick urethane insulation and reinforced with ¾" thick 5-7 ply marine grade plywood underlayment. Floor installation shall be in accordance with manufacturer's recommended practice and shall sit on building floor. Building floor finish shall be flush and smooth to allow a level installation.

Walk-in assembly shall be furnished with in-fitting type door and frame assemblies constructed of 16 gauge stainless steel provided with three self-closing cam action chrome plated hinge assemblies, handles and hardware.

Provide each door with 2" dial type flush mount thermometer with chrome plated bezel mounted in door frame.

Provide each door with triple pane observation and 36” high 3/16" thick aluminum diamond tread kick plate on both interior and exterior side.

Provide each door with UL listed, vapor proof LED light fixture complete with toggle switch and pilot light and full perimeter frame condensation heater.

Provide four (4) additional UL listed, vapor proof LED ceiling mounted light fixtures complete with stainless steel mounting hardware. (Two in each compartment)

Foodservice Equipment Contractor shall install ceiling mounted light fixtures and furnish materials and inter-wire light fixtures and switch.

Walk-in freezer assembly shall be furnished with heated pressure relief port.

Furnish and install 18 gauge embossed aluminum vertical trim angles and ceiling closure panels.

Furnish and install entire refrigeration system complete with semi-hermetic condensing units and insulated copper refrigeration lines charged with R404A refrigerant. Each condensing unit shall be interconnected to a low profile, high velocity evaporator coil in each walk-in compartment. Refrigeration system shall include all fittings, valves, switches, controls and all related components to comprise a complete operating unit of sufficient BTU capacity to maintain automatic operation of 35 degree F product temperature in cooler and -10 degree F product temperature in freezer.

Refrigeration system shall be provided with outdoor remote air cooled condensing units with each condensing unit to be located on the building roof.

Condensing units shall be provided with winterized controls (low ambient package), including crankcase heater, line dryer, head pressure control and galvanized steel stand with stainless steel weather hood.

Provide all hangers and brackets as required to install refrigeration lines.

Construction Trade shall furnish all sleeves and openings through walls, ceiling and floor, passage of refrigeration lines.

Roofing Trade shall provide waterproof roof opening for passage of refrigeration lines.

Foodservice Equipment Contractor shall furnish materials and inter-wire defrost time clock circuit for walk-in freezer, from condensing unit to evaporator coil.

Foodservice Equipment Contractor shall furnish materials and install (wrap and insulated with foam pipe insulation) heat tracing tape to evaporator coil condensate line in walk-in freezer.

Foodservice Equipment Contractor shall furnish and install copper tubing and extend evaporator coil condensate line to floor receptacle.

Set and adjust all temperature and defrost cycles.

Provide start-up and two year material and labor warranty on entire refrigeration system, and five years manufacturers warranty on compressor.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #02 EVAPORATOR, WALK-IN COOLER
Quantity: One (1)
Manufacturer: Amerikooler / Bally / Kolpak
Model: Size and shape per plan
Remarks: Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #03 CONDENSING UNIT, COOLER
Quantity: One (1)
Manufacturer: Amerikooler / Bally / Kolpak
Model: Size and shape per plan
Remarks: Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #04 SPARE NUMBER

ITEM #05 EVAPORATOR, WALK-IN FREEZER
Quantity: One (1)
Manufacturer: Amerikooler / Bally / Kolpak
Model: Size and shape per plan
Remarks: Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #06 CONDENSING UNIT, WALK-IN FREEZER
Quantity: One (1)
Manufacturer: Amerikooler / Bally / Kolpak
Model: Size and shape per plan
Remarks: Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #07 WIRE SHELVING
Quantity: Fourteen (14)
Manufacturer: Metro / Eagle Group / Quantum
Model: PR2454NK3 (56)
Options: 63UPK3 Posts (56)
5MP Casters (28)
5MPB Casters (28)
Sup Info: Assemble into four tier shelving units, locate bottom shelf 12” above floor.

ITEM #08 WIRE SHELVING
Quantity: Two (2)
Manufacturer: Metro / Eagle Group / Quantum
Model: PR2430NK3 (8)
Options: 63UPK3 Posts (8)
5MP Casters (4)
5MPB Casters (4)
Sup Info: Assemble into four tier shelving units, locate bottom shelf 12” above floor.

ITEM #09 WIRE SHELVING
Quantity: Three (3)

Manufacturer:	Metro / Eagle Group / Quantum
Model:	PR2460NK3 (12)
Options:	63UPK3 Posts (12) 5MP Casters (6) 5MPB Casters (6)
Sup Info:	Assemble into four tier shelving units, locate bottom shelf 12” above floor.

ITEM #10	WIRE SHELVING
Quantity:	Two (2)
Manufacturer:	Metro / Eagle Group / Quantum
Model:	PR2436NK3 (8)
Options:	63UPK3 Posts (8) 5MP Casters (4) 5MPB Casters (4)
Sup Info:	Assemble into four tier shelving units, locate bottom shelf 12” above floor.

ITEM #11	DUNNAGE RACK
Quantity:	Thirteen (13)
Manufacturer:	Cambro / Metro / Eagle Group
Model:	DRS480480
Options:	DRLNK110 Camlink (12)

ITEM #12	BUN PAN RACK
Quantity:	Eight (8)
Manufacturer:	Eagle Group / Channel / Metro
Model:	404A

ITEM #13	WIRE SHELVING
Quantity:	Five (5)
Manufacturer:	Metro / Eagle Group / Quantum
Model:	PR2448NK3 (20)
Options:	63UPK3 Posts (20) 5MP Casters (10) 5MPB Casters (10)
Sup Info:	Assemble into four tier shelving units, locate bottom shelf 12” above floor.

ITEM #14	WIRE SHELVING
Quantity:	Three (3)
Manufacturer:	Metro / Eagle Group / Quantum
Model:	PR2436NK3 (15)
Options:	74UPK3 Posts (12) 5MP Casters (6) 5MPB Casters 6)
Sup Info:	Assemble into five tier shelving units, locate bottom shelf 12” above floor.

ITEM #15	FOOD PROCESSOR
Quantity:	One (1)
Manufacturer:	Robot Coupe / Waring / Dito
Model:	R2N
Sup Info:	Commercial Food Processor, 3 liter gray polycarbonate bowl with handle, vegetable prep attachment with external ejection, kidney-shaped opening, includes: (1) "S" blade (27055), (1) 2mm grating disc (27577), (1) 4mm slicing disc (27566), continuous feed, bowl attachment designed for vertical cutting & mixing, on/off & pulse switch, single speed, 1725 RPM.

ITEM #16	WORK TABLE, STAINLESS TOP

Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T3684STE-BS
Options:	E36A All welded construction E22 Weld in sink bowl 313304 Faucet upgrade 341189 Twist Handle Drain, 1-1/2 or 2" NPS connection -TB Twist bracket, per drain 351585 Sink cover E47 Sink cover holder Provide provisions to accept Item #102 undercounter refrigerator

ITEM #17	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T36144STE
Options:	Custom 11’-6” length E36A All welded construction E22 Weld in sink bowl 313304 Faucet upgrade 341189 Twist Handle Drain, 1-1/2 or 2" NPS connection -TB Twist bracket, per drain 351585 Sink cover E47 Sink cover holder DOS1284-14/3 Overshelf, table mount Provide provisions to accept Item #78 undercounter rack (3)

ITEM #18	20 QT. MIXER
Quantity:	One (1)
Manufacturer:	Hobart / Varimixer / Globe
Model:	HL200-1STD
Sup Info:	Includes but not limited to; #12 taper hub, manual bowl lift, stainless steel bowl, aluminum "B" beater, stainless steel "D" wire whip, aluminum "ED" spiral dough arm, stainless steel bowl guard, 1/2 hp, cord with plug.

ITEM #19	HAND SINK
Quantity:	Eight (8)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	HSA-10-FAW-LRS
Options:	318496 Paper towel dispenser (8) 300602 Soap dispenser (8) 307120 Wrist handles (8) -LRS Left and right side splashes (8)
Sup Info:	Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use. Construction Trade shall provide wall blocking as required for mounting. Foodservice Equipment Contractor to verify soap dispenser and paper towel dispenser type with the Owner.

ITEM #20	TRASH RECEPTACLE
Quantity:	Eleven (11)
Manufacturer:	Rubbermaid
Model:	FG354060GRAY
Options:	FG267360GRAY (11)

ITEM #21	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T36144SE
Options:	Custom 11’-6” length E36A All welded construction E59 Undershelf upgrade DOS12144-14/3 Overshelf, table mount (custom 11’-6” length) YCORSI-502971-MOD Drawers (2)

ITEM #22	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T3672STE
Options:	E36A All welded construction DOS1272-14/3 Overshelf, table mount Provide provisions to accept Item #23 ingredient bins (4)

ITEM #23	INGREDIENT BIN
Quantity:	Four (4)
Manufacturer:	Cambro / Carlisle
Model:	IB36148
Options:	SCP12CW135 Scoop (4)

ITEM #24	MIXER, FLOOR
Quantity:	One (1)
Manufacturer:	Hobart / Varimixer / Globe
Model:	HL600-1STD
Options:	VS9-12 9” Vegetable Slicer for #12 attachment hub; includes back case, hopper front, & adjustable slicer plate, NSF Bowl truck
Sup Info:	Includes but not limited to: #12 taper attachment hub, manual bowl lift, bowl guard, stainless steel bowl, "B" beater, "D" whip, "ED" dough hook

ITEM #25	REACH-IN REFRIGERATOR
Quantity:	Two (2)
Manufacturer:	Continental / True / Traulsen
Model:	2RNSS
Options:	Stainless steel interior Stainless steel exterior Stainless steel case back Doors hinged per plan Exterior mounted digital thermometer (2) Automatic condensate evaporator (2) Swivel casters with polyurethane tires and front locking brakes (2) Plug and cord set 10’ cord (2) Six shelves total each section

ITEM #26	WIRE SHELVING
Quantity:	Six (6)
Manufacturer:	Metro / Eagle Group / Quantum
Model:	PR2430NK3 (30)
Options:	74UPK3 Posts (24)

	5MP Casters (12) 5MPB Casters (12)
Sup Info:	Assemble into five tier shelving units, locate bottom shelf 12” above floor.

ITEM #27	THREE COMPARTMENT SINK
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	FN2860-3-24-14/3
Options:	313296 Pre-rinse faucet 313297 Add-a-faucet 301190 Pre-rinse wall bracket 313293 Faucet 341189 Twist handle drain (3) -TB Twist bracket (3) 326271 Sink cover (3) E47 Sink cover holder

ITEM #28	POT RACK, WALL MOUNT
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	WSP1260
Options:	300696 Additional pot hooks (5)
Sup Info:	Includes (5) double pronged pot hooks.

Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

Construction Trade shall provide wall blocking as required for mounting.

ITEM #29	POT RACK, WALL MOUNT
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	WSP1236
Options:	300696 Additional pot hooks (3)
Sup Info:	Includes (3) double pronged pot hooks.

Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

Construction Trade shall provide wall blocking as required for mounting.

ITEM #30	FOOD WASTE DISPOSER
Quantity:	One (1)
Manufacturer:	Salvajor / In-Sinkerator
Model:	300-CA-ARSS-LD-PP
Options:	18CC 18” cone 980105 Mounting bracket PP PP-type control panel with mounted solenoid valve DP Dejamming prong
Sup Info:	Food Service Kitchen Equipment Contractor shall furnish and install interconnecting piping and all components or parts as required by disposer manufacturer or as supplied as part of disposer in accordance with the manufacturer instructions.

Food Service Kitchen Equipment Contractor shall furnish and install all interconnecting wiring as required between disposer motor and control device.

Mount to control panel to wall or mounting bracket with stainless steel mounting hardware of proper type for application.

Construction Trade shall reinforce wall as required to support weight of control panel while in use.

ITEM #31 ICE BIN/ DISPENSER
Quantity: One (1)
Manufacturer: Follett / Scotsman / Ice-o-Matic
Model: DEV2100SG-72-75

ITEM #32 ICE MAKER
Quantity: Two (2)
Manufacturer: Hoshizaki / Scotsman / Ice-o-Matic
Model: KM-1100MAJ

ITEM #32F WATER FILTRATION SYSTEM FOR ICE CUBER
Quantity: Two (2)
Manufacturer: Everpure / 3M / Optipure
Model: QC7I PF TWIN 7FC-S
Option: EV969271 Cartridge
EV953426 Replacement cartridge
Sup Info: Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

General contractor shall provide wall blocking as required for mounting.

Food Service Equipment Contractor shall install ice maker filter system in water supply line and furnish and install interconnecting piping between water filter and ice maker water inlet

ITEM #33 ICE TRANSPORT CART
Quantity: Two (2)
Manufacturer: Cambro / Follett
Model: ICS125L110

ITEM #34 WORK TABLE, STAINLESS TOP
Quantity: One (1)
Manufacturer: Eagle Group / John Boos / Advance Tabco
Model: T36120SE
Options: E36A All welded construction
E59 Undershelf upgrade
YCORSI-502971-MOD Drawers (2)
DOS12120-14/3 Overshelf, table mount

ITEM #35 FOOD SLICER
Quantity: Two (2)
Manufacturer: Hobart / Globe / Berkel
Model: HS7N-1
Options: HS-HVYGRP Heavy duty meat grip (2)

ITEM #36 WORK TABLE, STAINLESS TOP
Quantity: One (1)
Manufacturer: Eagle Group / John Boos / Advance Tabco
Model: T36108STE
Options: E36A All welded construction

	DOS12108-14/3 Overshelf, table mount
	YCORSI-502971-MOD Drawer
	Provide provisions to accept Item #37 undercounter refrigerator
ITEM #37	REFRIGERATOR, UNDERCOUNTER
Quantity:	Four (4)
Manufacturer:	Continental / True / Traulsen
Model:	SW60N-U
Options:	Stainless steel interior (4)
	Stainless steel exterior (4)
	Stainless steel case back (4)
	Left Door hinged on left, center & right doors hinged on right, standard (4)
	Exterior mounted digital thermometer (4)
	Automatic condensate evaporator (4)
	Swivel casters with polyurethane tires and front locking brakes (4)
	Plug and cord set 10’ cord (4)
ITEM #38	TRASH RECEPTACLE
Quantity:	Five (5)
Manufacturer:	Rubbermaid
Model:	FG265500GRAY
Options:	FG265400GRAY (5)
ITEM #39	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T36108STE
Options:	E36A All welded construction
	DOS12108-14/3 Overshelf, table mount
	YCORSI-502971-MOD Drawer
	Provide provisions to accept Item #37 undercounter refrigerator
ITEM #40	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T3684STE-BS
Options:	E36A All welded construction
	E22 Weld in sink bowl
	313304 Faucet upgrade
	341189 Twist Handle Drain, 1-1/2 or 2" NPS connection
	-TB Twist bracket, per drain
	351585 Sink cover
	E47 Sink cover holder
	E20 Sink, 10" x 14" x 9-1/2" bowl
	E33 Sink splashes, single thickness 4" tall, each
	DOS12108-14/3 Overshelf, table mount
	Provide provisions to accept Item #37 undercounter refrigerator
ITEM #41	EXHAUST HOOD
Quantity:	One (1)
Manufacturer:	Accurex / Captive Aire
Model:	Size and shape as per plan
Construction:	Furnish and install exhaust hood with integral plenum box make-air system.

Entire exhaust ventilation system shall be constructed in compliance with UL, NSF, NFPA, IMC 2018 (including automatic start-up of the exhaust and supply ventilation upon activation of any cooking appliance) and any prevailing statutes and codes.

Hood shall be 21'-8" long constructed in two equal sections of 18 gauge 304 stainless steel with all seams continuously welded, ground smooth and polished. Provide a full compliment of stainless steel "high efficiency" baffle type grease extractors.

Furnish remote bulb thermostat with watertight hardware and install in either the exhaust plenum of the hood or in the exhaust duct. Provide NEMA 3 control panel box with hinged front cover complete with supply and exhaust fan contactors wired to an adjustable thermostat control, field wiring terminal strip and on-off switch.

Provide 18 gauge 304 stainless steel supply and exhaust duct collar.

Provide 18 gauge 304 stainless steel insulated supply air plenum box assembly with internal air volume control damper integral along the face of the hood. Mount in finished ceiling along face of hood and furnish full length stainless steel perforated removable panels for discharge of supply air along entire face of hood.

Provide stainless steel threaded hanger rods complete with stainless steel mounting hardware for securing to structural ceiling.

Mechanical (HVAC) Trade shall furnish and install a complete exhaust air handling system including exhaust fan and controller, fan start-stop switch with status lights, 16 gauge insulated welded ductwork from exhaust collar on exhaust hood to fan, hinged roof curb with grease trough and removable grease container.

Mechanical (HVAC) Trade shall install exhaust hood heat detector(s) in exhaust hoods with multiple exhaust collars in the exhaust duct just after the point of the pant leg juncture; this includes punching of the required hole in the duct and installation of the heat detector and fitting.

Mechanical (HVAC) Trade shall furnish and install a complete supply air handling system including supply fan and controller (with maintainable filter system) and supply air heater with thermostat control (to temper incoming supply air below 65 degree F ambient), fan start-stop switch with indicator lights, galvanized steel ductwork from supply collar on exhaust hood to fan and roof curb.

Electrical Trade shall furnish and install interconnecting wiring between fan motors, controllers and switches.

Electrical Trade shall furnish and install inter-wiring of cooking appliance start-up inter-lock device and the supply and exhaust ventilation system and wire per the manufacturer's instructions and per applicable codes.

Furnish four (4) UL listed vapor-proof recessed LED light fixtures wired to a common on-off switch with stainless steel cover plate located on front face of control package/wall mounted utility cabinet.

Electrical Trade shall furnish materials and inter-wire light fixtures to switch on front face of utility cabinet.

Mechanical (HVAC) Trade shall furnish and install INVERTER DUTY THREE PHASE exhaust fan and controller.

Mechanical (HVAC) Trade shall furnish fans set compatible with variable frequency drive specification.

Electrical Trade shall furnish and install Interconnecting wiring of the system between the exhaust hood sensors, remote frequency drive unit and exhaust and supply fan motors.

Furnish and install 18 gauge stainless steel ceiling closure panels extending from the top of the exhaust ventilator to the finished ceiling. Panels shall be removable without the use of tools for access.

Furnish and install 18 gauge 304 stainless steel wall panels extending from the bottom of the rear of the exhaust hood to the upper edge of the baseboard molding and extending along the full length of all wall surfaces. Wall panel sections shall be fitted with ½" wide off-set seams at intermediate joints to allow panel sections to fit tightly against the wall and to result in watertight seams. Secure wall panels to building wall with wall panel adhesive of proper type for wall construction. Seal end seams with General Electric or equivalent clear silicone sealer.

Electrical Trade shall provide the inter-wiring between the control enclosure, fire system, supply and exhaust fans and variable frequency drives and duct riser temperature switch.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #41.1 HOOD CONTROL PANEL
Quantity: One (1)
Manufacturer: Accurex / Captive Aire
Model: Size and shape per plan
Sup Info: Furnish 18 gauge stainless steel utility and fire system enclosure cabinet with hinged access doors for both hood and fire system controls and fire suppression tanks. System shall be listed by ETL (UL 508A) NSF, NFPA, IMC 2018 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17-27. Cabinet may be freestanding wall type or integral with exhaust hood as shown on the contract drawings. Furnish stainless steel mounting hardware of proper type for wall construction for wall mounted cabinet.

Furnish and install variable volume motor control center with variable frequency drive, input / output processor and keypad enclosed within a stainless steel utility cabinet for remote mounting. System shall include, but not be limited to, electronic variable volume motor starters with thermal overload, input / output processors, control keypad, temperature and optic sensors and plug and play cables. Temperature sensor shall be mounted in the exhaust duct collar; optic sensor shall be mounted inside the ends of the hood with air purge units mounted on top.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #41.2 WET CHEMICAL FIRE SUPPRESSION SYSTEM
Quantity: One (1)
Manufacturer: Ansul Fire Protection
Model: R-102
Sup Info: Furnish and install in exhaust hood and surface fire protection system.

Entire system shall be furnished and installed in compliance with UL, NSF, NFPA,

Factory Mutual, IMC 2018 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17-27.

Furnish and install in exhaust hood as part of fire system, mechanically operated fusible link temperature detection system to activate entire fire system in event of fire.

All piping and nozzles of fire system shall be factory installed in exhaust hood, exposed piping, nozzles and fittings shall be chrome plated.

Inter-wiring of the fire system to the exhaust hood shall be furnished and installed by the Electrical Trade.

Electrical Trade shall furnish and install electric shunt-trip circuit breakers or electric shut-off contactors to interrupt electric power to all electrically operated cooking appliances.

Provide dry contacts in fire system to interface with building fire alarm system as required, electrical tie-in shall be the responsibility of the Electrical Trade.

Provide as part of fire system, mechanically operated gas supply line shut-off valve to interrupt gas supply to all gas operated cooking appliances. Gas valve shall be provided with manual reset to prevent gas flow to pilot devices on appliances prior to restart.

Provide one remote manual pull station to actuate fire system in the event of a fire.

Plumbing Trade shall install gas shut-off valve in gas supply line.

Electrical Trade shall furnish and install electric shunt-trip circuit breakers or electric shut-off contactors to interrupt electric power to all electrically operated cooking appliances.

Provide dry contacts in fire system to interface with building fire alarm system as required, electrical tie-in shall be the responsibility of the Electrical Trade.

Provide as part of fire system, start-up testing of the fire system as required by local fire codes. Subsequent testing of the fire system for a period of one year after start-up shall be included as part of this contract.

ITEM #42	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T3648SE-BS
Options:	E36A All welded construction
	E59 Undershelf upgrade

ITEM #43	SIX-BURNER RANGE
Quantity:	One (1)
Manufacturer:	Garland / Vulcan / Imperial
Model:	M43R
Options:	Stainless steel sides
	Stainless steel back
	Rear gas connection
	Stainless steel manifold covers
	Manifold end caps

PCASTPC-M Swivel casters with polyurethane tires and front locking brakes
2670200 Gas pressure regulator
M34SD Backguard flue riser
Dormont 1675KIT48PS gas hose kit

Sup Info: Foodservice Equipment Contractor shall install disconnect at wall connection and to cooking appliance per manufacturer's instructions.

Foodservice Equipment Contractor shall provide and secure restraining cable between wall and equipment.

ITEM #44 FLOOR TROUGH
Quantity: One (1)
Manufacturer: IMC Teddy / Eagle Group / Advance Tabco
Model: ASFT-3036-SG
Sup Info: Construction Trade shall provide floor recess and install floor pan in recess flush with adjacent kitchen floor in a watertight manner.

ITEM #45 TILT SKILLET
Quantity: One (1)
Manufacturer: Cleveland / Groen / Vulcan
Model: SGL-40-T1
Options: DPK29 Double pantry faucet
Faucet bracket
Pan carrier
PT2 Power tilt with manual override
TD2SK 2" tangent draw-off
Gas pressure regulator
Dormont 1675KITCF2S-48 gas hose kit
Dormont W50BP48 Water hose kit (2)
Sup Info: Foodservice Equipment Contractor shall install disconnect at wall connection and to cooking appliance per manufacturer's instructions.

Foodservice Equipment Contractor shall provide and secure restraining cable between wall and equipment.

ITEM #46 CONVECTION STEAMER
Quantity: One (1)
Manufacturer: Cleveland / Groen / Vulcan
Model: 24-CGA-10.2
Options: Gas pressure regulator
11000115898 Installation of first unit
11000115830 Pre-installation site survey
INSKITCGA6 Installation kit
DISSOLVE Descaling solution
BDPK1 Boiler descaling pump kit
LGDCK Drain cooling kit
Dormont 1675KITCF2S48 Gas hose kit
Dormont W75BP2Q48 Water hose kit
Sup Info: Foodservice Equipment Contractor shall install disconnect at wall connection and to cooking appliance per manufacturer's instructions.

Foodservice Equipment Contractor shall provide and secure restraining cable between wall and equipment.

ITEM #47 CONVECTION OVEN
Quantity: Two (2)

Manufacturer:	Blodgett / Garland / Vulcan
Model:	DFG-100 DBL
Options:	Solid state thermostat (2) Mechanical timer (2) Stainless steel draft diverter (2) 4 ¼" low profile swivel casters with polyurethane tires and front locking brakes (2) Stainless steel solid back panel (2) Gas manifold (2) Gas pressure regulator (2) Dormont 1675KITCF2S48 Gas hose kit (2)
Sup Info:	Foodservice Equipment Contractor shall install disconnect at wall connection and to cooking appliance per manufacturer's instructions. Foodservice Equipment Contractor shall provide and secure restraining cable between wall and equipment.

ITEM #48	EXHAUST HOOD
Quantity:	One (1)
Manufacturer:	Accurex / Captive Aire
Model:	Size and shape as per plan
Construction:	Furnish and install exhaust hood with integral plenum box make-air system. Entire exhaust ventilation system shall be constructed in compliance with UL, NSF, NFPA, IMC 2018 (including automatic start-up of the exhaust and supply ventilation upon activation of any cooking appliance) and any prevailing statutes and codes. Hood shall be 21'-8" long constructed in two equal sections of 18 gauge 304 stainless steel with all seams continuously welded, ground smooth and polished. Provide a full compliment of stainless steel "high efficiency" baffle type grease extractors. Furnish remote bulb thermostat with watertight hardware and install in either the exhaust plenum of the hood or in the exhaust duct. Provide NEMA 3 control panel box with hinged front cover complete with supply and exhaust fan contactors wired to an adjustable thermostat control, field wiring terminal strip and on-off switch. Provide 18 gauge 304 stainless steel supply and exhaust duct collar. Provide 18 gauge 304 stainless steel insulated supply air plenum box assembly with internal air volume control damper integral along the face of the hood. Mount in finished ceiling along face of hood and furnish full length stainless steel perforated removable panels for discharge of supply air along entire face of hood. Provide stainless steel threaded hanger rods complete with stainless steel mounting hardware for securing to structural ceiling. Mechanical (HVAC) Trade shall furnish and install a complete exhaust air handling system including exhaust fan and controller, fan start-stop switch with status lights, 16 gauge insulated welded ductwork from exhaust collar on exhaust hood to fan, hinged roof curb with grease trough and removable grease container. Mechanical (HVAC) Trade shall install exhaust hood heat detector(s) in exhaust hoods with multiple exhaust collars in the exhaust duct just after the point of the pant leg juncture; this includes punching of the required hole in the duct and installation of the heat detector and fitting.

Mechanical (HVAC) Trade shall furnish and install a complete supply air handling system including supply fan and controller (with maintainable filter system) and supply air heater with thermostat control (to temper incoming supply air below 65 degree F ambient), fan start-stop switch with indicator lights, galvanized steel ductwork from supply collar on exhaust hood to fan and roof curb.

Electrical Trade shall furnish and install interconnecting wiring between fan motors, controllers and switches.

Electrical Trade shall furnish and install inter-wiring of cooking appliance start-up inter-lock device and the supply and exhaust ventilation system and wire per the manufacturer's instructions and per applicable codes.

Furnish four (4) UL listed vapor-proof recessed LED light fixtures wired to a common on-off switch with stainless steel cover plate located on front face of control package/wall mounted utility cabinet.

Electrical Trade shall furnish materials and inter-wire light fixtures to switch on front face of utility cabinet.

Mechanical (HVAC) Trade shall furnish and install INVERTER DUTY THREE PHASE exhaust fan and controller.

Mechanical (HVAC) Trade shall furnish fans set compatible with variable frequency drive specification.

Electrical Trade shall furnish and install Interconnecting wiring of the system between the exhaust hood sensors, remote frequency drive unit and exhaust and supply fan motors.

Furnish and install 18 gauge stainless steel ceiling closure panels extending from the top of the exhaust ventilator to the finished ceiling. Panels shall be removable without the use of tools for access.

Furnish and install 18 gauge 304 stainless steel wall panels extending from the bottom of the rear of the exhaust hood to the upper edge of the baseboard molding and extending along the full length of all wall surfaces. Wall panel sections shall be fitted with ½" wide off-set seams at intermediate joints to allow panel sections to fit tightly against the wall and to result in watertight seams. Secure wall panels to building wall with wall panel adhesive of proper type for wall construction. Seal end seams with General Electric or equivalent clear silicone sealer.

Electrical Trade shall provide the inter-wiring between the control enclosure, fire system, supply and exhaust fans and variable frequency drives and duct riser temperature switch.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #48.1 HOOD CONTROL PANEL
Quantity: One (1)
Manufacturer: Accurex / Captive Aire
Model: Size and shape per plan
Sup Info: Furnish 18 gauge stainless steel utility and fire system enclosure cabinet with hinged access doors for both hood and fire system controls and fire suppression tanks. System shall be listed by ETL (UL 508A) NSF, NFPA, IMC 2018 and any prevailing

statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17-27. Cabinet may be freestanding wall type or integral with exhaust hood as shown on the contract drawings. Furnish stainless steel mounting hardware of proper type for wall construction for wall mounted cabinet.

Furnish and install variable volume motor control center with variable frequency drive, input / output processor and keypad enclosed within a stainless steel utility cabinet for remote mounting. System shall include, but not be limited to, electronic variable volume motor starters with thermal overload, input / output processors, control keypad, temperature and optic sensors and plug and play cables. Temperature sensor shall be mounted in the exhaust duct collar; optic sensor shall be mounted inside the ends of the hood with air purge units mounted on top.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #48.2 WET CHEMICAL FIRE SUPPRESSION SYSTEM
Quantity: One (1)
Manufacturer: Ansul Fire Protection
Model: R-102
Sup Info: Furnish and install in exhaust hood and surface fire protection system.

Entire system shall be furnished and installed in compliance with UL, NSF, NFPA, Factory Mutual, IMC 2018 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17-27.

Furnish and install in exhaust hood as part of fire system, mechanically operated fusible link temperature detection system to activate entire fire system in event of fire.

All piping and nozzles of fire system shall be factory installed in exhaust hood, exposed piping, nozzles and fittings shall be chrome plated.

Inter-wiring of the fire system to the exhaust hood shall be furnished and installed by the Electrical Trade.

Electrical Trade shall furnish and install electric shunt-trip circuit breakers or electric shut-off contactors to interrupt electric power to all electrically operated cooking appliances.

Provide dry contacts in fire system to interface with building fire alarm system as required, electrical tie-in shall be the responsibility of the Electrical Trade.

Provide as part of fire system, mechanically operated gas supply line shut-off valve to interrupt gas supply to all gas operated cooking appliances. Gas valve shall be provided with manual reset to prevent gas flow to pilot devices on appliances prior to restart.

Provide one remote manual pull station to actuate fire system in the event of a fire.

Plumbing Trade shall install gas shut-off valve in gas supply line.

Electrical Trade shall furnish and install electric shunt-trip circuit breakers or electric shut-off contactors to interrupt electric power to all electrically operated cooking appliances.

Provide dry contacts in fire system to interface with building fire alarm system as required, electrical tie-in shall be the responsibility of the Electrical Trade.

Provide as part of fire system, start-up testing of the fire system as required by local fire codes. Subsequent testing of the fire system for a period of one year after start-up shall be included as part of this contract.

ITEM #49	WORK TABLE, STAINLESS TOP
Quantity:	Two (2)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T3648SE-BS
Options:	E36A All welded construction (2)
	E59 Undershelf upgrade (2)
	YCORSI-502971-MOD Drawers (2)

ITEM #50	REFRIGERATED EQUIPMENT STAND
Quantity:	Two (2)
Manufacturer:	Continental / Victory / True
Model:	D48GN
Options:	Flat top (2)
	Stainless steel interior (2)
	Stainless steel exterior (2)
	Stainless steel case back (2)
	Exterior mounted digital thermometer (2)
	Automatic condensate evaporator (2)
	Swivel casters with polyurethane tires and front locking brakes (2)
	Plug and cord set (2)

ITEM #51	GRIDDLE, COUNTERTOP
Quantity:	Two (2)
Manufacturer:	Garland / Vulcan / Imperial
Model:	GTGG48-GT48M
Options:	Gas pressure regulator (2)
	Dormont 1675KITCF2S48 Gas hose kit (2)
Sup Info:	Foodservice Equipment Contractor shall install disconnect at wall connection and to cooking appliance per manufacturer’s instructions.

Foodservice Equipment Contractor shall provide and secure restraining cable between wall and equipment.

ITEM #52	FRYER
Quantity:	One (1)
Manufacturer:	Frymaster / Pitco / Vulcan
Model:	FPPH455
Options:	8030002 Filter powder
	8030170 Filter paper
	8239116 Sediment filter screen
	8030103 Sediment tray
	8030197 Clean-out rod
	8236559 Splash shield
	8030429 Fryer brush
	8239416 Frypot cover
	8233938 Crumb scoop
	CM3.5 Controller, standard
	6” casters
	Gas pressure regulator

	Rear gas manifold FWH-1A French fry warmer and holding station (with heat lamp) Spreader cabinet with cutout in top Holding pan with screen for spreader cabinet Natural gas Dormont 16100KITCF2S-48 gas hose kit (2)
Sup Info:	Foodservice Equipment Contractor shall install disconnect at wall and to cooking appliance per manufacturer's instructions. Foodservice Equipment Contractor shall provide and secure restraining cable between wall and equipment.
ITEM #53	REACH-IN FREEZER
Quantity:	Two (2)
Manufacturer:	Continental / True / Traulsen
Model:	1FNSS
Options:	Stainless steel interior (2) Stainless steel exterior (2) Stainless steel case back (2) Doors hinged per plan (2) Exterior mounted digital thermometer (2) Automatic condensate evaporator (2) Swivel casters with polyurethane tires and front locking brakes (2) Plug and cord set 10' cord (2) Six shelves total each section (2)
ITEM #54	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T3072SE
Options:	E36A All welded construction E20 Sink, 10" x 14" x 9-1/2" bowl E33 Sink splashes, single thickness 4" tall, each DOS1272-14/3 Overshelf, table mount YCORSI-502971-MOD Drawer
ITEM #55	REFRIGERATOR, SANDWICH PREP
Quantity:	One (1)
Manufacturer:	Continental / True / Traulsen
Model:	SW48N18M
Options:	Stainless steel interior Stainless steel exterior Stainless steel case back Left Door hinged on left & right door hinged on right, standard Exterior mounted digital thermometer Automatic condensate evaporator Swivel casters with polyurethane tires and front locking brakes Plug and cord set 10' cord Pan openings in top (00HFL) Stainless steel flat cover - with hinges 10" cutting board, rear mounted
ITEM #56	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T3084STE

Options:	E36A All welded construction
	E22 Weld in sink bowl
	313304 Faucet upgrade
	341189 Twist Handle Drain, 1-1/2 or 2" NPS connection
	-TB Twist bracket, per drain
	351585 Sink cover
	E47 Sink cover holder
	DOS1284-14/3 Overshelf, table mount
	Provide provisions to accept Item #57 undercounter refrigerator
ITEM #57	REFRIGERATOR, UNDERCOUNTER
Quantity:	Two (2)
Manufacturer:	Continental / True / Traulsen
Model:	UC48SN
Options:	Stainless steel interior (2)
	Stainless steel exterior (2)
	Stainless steel case back (2)
	Left Door hinged on left, center & right doors hinged on right, standard (2)
	Exterior mounted digital thermometer (2)
	Automatic condensate evaporator (2)
	Swivel casters with polyurethane tires and front locking brakes (2)
	Plug and cord set 10’ cord (2)
ITEM #58	WIRE SHELVING
Quantity:	Two (2)
Manufacturer:	Metro / Eagle Group / Quantum
Model:	PR1854NK3 (10)
Options:	74UPK3 Posts (8)
	5MP Casters (4)
	5MPB Casters (4)
Sup Info:	Assemble into five tier shelving units, locate bottom shelf 12” above floor.
ITEM #59	DUNNAGE RACK
Quantity:	One (1)
Manufacturer:	Cambro / Metro / Eagle Group
Model:	DRS360480
Options:	DRLNK110
ITEM #60	SPARE NUMBER
ITEM #61	WIRE SHELVING
Quantity:	Thirty-two (32)
Manufacturer:	Metro / Eagle Group / Quantum
Model:	PR2460NK3 (160)
Options:	74UPK3 Posts (160)
	5MP Casters (80)
	5MPB Casters (80)
Sup Info:	Assemble into five tier shelving units, locate bottom shelf 12” above floor.
ITEM #62	SPARE NUMBER
ITEM #63	SODA SYSTEM (RACK, B-I-B BOXES, CO2 TANKS)
Quantity:	Two (2)
Sup Info:	Not in Foodservice Equipment Contract, furnished by Others
ITEM #64	SODA CONDUIT
Quantity:	Five (5)

Sup Info:	Not in Foodservice Equipment Contract, furnished by Others
ITEM #65	WIRE SHELVING
Quantity:	Two (2)
Manufacturer:	Metro / Eagle Group / Quantum
Model:	PR2454NK3 (10)
Options:	74UPK3 Posts (8) 5MP Casters (4) 5MPB Casters (4)
Sup Info:	Assemble into five tier shelving units, locate bottom shelf 12” above floor.
ITEM #66	SPARE NUMBER
ITEM #67	SPARE NUMBER
ITEM #68	CLEAN DISHTABLE
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	CDTL-108-14/3
ITEM #69	FLOOR TROUGH
Quantity:	One (1)
Manufacturer:	IMC Teddy / Eagle Group / Advance Tabco
Model:	ASFT-12108-SG
Sup Info:	Construction Trade shall provide floor recess and install floor pan in recess flush with adjacent kitchen floor in a watertight manner.
ITEM #70	DISHWASHER, CONVEYOR TYPE
Quantity:	One (1)
Manufacturer:	Hobart / Champion / Stero
Model:	CLPS86eN-ADV7
Options:	CL86EN-ADVHTE15K Electric tank heat 15kW CL86EN-ADVERH30K 30kW electric booster CL86EN-ADVELE0AX 208v/60/3-ph SGLPT-KIT4-CLE Single point electrical connection HOBINST-SGLPT-CLE Accessory installation CL86ADV-HGTHTS Higher than standard CL86EN-ADVDIR0RL Right to left operation CL86EN-ADVFETSTD Standard feet CL-BDR0NO Without blower dryer PRESREG-1/20BR Brass pressure regulator 1/2INSHK-ABSRBR Water shock absorber kit CLE/TBL-SWITCH Table limit switch CLE-Series Exhaust fan activation switch
ITEM #71	CONDENSATE HOOD
Quantity:	One (1)
Manufacturer:	Accurex / Captive Aire
Model:	Size and shape per plan
Construction:	Furnish and install condensate hood.
	Entire condensate ventilation system shall be constructed in compliance with UL, NSF and any prevailing statutes and codes.
	Fabricate entire hood of 18 gauge 304 stainless steel fully welded watertight construction.

Provide stainless steel welded hanger mounting clips with threaded stainless steel hanger and structural ceiling providing necessary angles and channels and utilizing stainless steel mounting hardware.

Mechanical (HVAC) Trade shall provide stainless steel welded ductwork (horizontal duct runs shall be pitched back toward condensate hood) and fan to comprise a complete condensate exhaust system.

Electrical Trade shall install fan switch with indicator lights located on dish machine and inter-wire to fan.

Furnish and install plastic drain tubing from nipple on bleeder drain outlet to soiled dishtable top surface.

Furnish and install 18 gauge stainless steel ceiling closure panels extending from the top of the exhaust ventilator to the finished ceiling. Panels shall be removable without the use of tools for access.

Furnish and install 18 gauge 304 stainless steel wall panels extending from the bottom of the rear of the exhaust hood to the upper edge of the baseboard molding and extending along the full length of all wall surfaces. Wall panel sections shall be fitted with ½" wide off-set seams at intermediate joints to allow panel sections to fit tightly against the wall and to result in watertight seams. Secure wall panels to building wall with wall panel adhesive of proper type for wall construction. Seal end seams with General Electric or equivalent clear silicone sealer.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #72	SCRAP CONVEYOR TROUGH
Quantity:	One (1)
Manufacturer:	Salvajor / In-Sinkerator
Model:	300-TVR
Options:	980101 Stainless steel cover RSS Remote start/stop switch 980104 Mounting bracket for RSS 980211 Seismic flange for support leg
Sup Info:	Food Service Kitchen Equipment Contractor shall furnish and install interconnecting piping and all components or parts as required by disposal system manufacturer or as supplied as part of disposer in accordance with the manufacturer instructions.

Food Service Kitchen Equipment Contractor shall furnish and install all interconnecting wiring as required between disposal system motor and control device.

Mount to control panel to wall or mounting bracket with stainless steel mounting hardware of proper type for application.

Construction Trade shall reinforce wall as required to support weight of control panel while in use.

ITEM #73	SOILED DISHTABLE, CORNER
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	Size and shape as per plan
Construction:	Top shall be fabricated of 14 gauge stainless steel. Exposed edges shall be 3" high,

turned up on a 3/4" radius, terminating into a 1-1/2" diameter, 180 degree rolled edge. Provide backsplash along adjoining surfaces with top turned up integrally 10" high on a 3/4" radius at a 90 degree angle, turned back 2-1/2" on a 45 degree angle and down 1/2" on a 45 degree angle. Where the dishtable top enters the dishmachine, backsplash and top shall be turned down into the mouth of the dishmachine and fastened thereto in a watertight manner, as recommended by the manufacturer of the dishmachine.

Pre-rinse sink shall be fabricated of 14 gauge stainless steel with interior corners coved on a 3/4" radius and constructed integrally with dishtable top. Locate pre-rinse sink 1" from the inside roll of the dishtable front edge. Sink size shall be 20" long x 20" wide x 10" deep.

Punch top and provide T&S Brass & Bronze Works B-113 pre-rinse assembly with spray handle and B109 wall bracket.

Furnish and install Component Hardware E32-4900 stainless steel open waste outlet with flat strainer plate.

Provide 16 gauge stainless steel, perforated removable scrap basket with interior corners coved on a 3/4" radius. Scrap basket to fit inside pre-rinse sink, set 1/8" clear of sides of prerinse sink and provided with four 1" high stainless steel tubular fully enclosed legs. Provide scrap basket with two 1" diameter, stainless steel tubular rack guides, fully welded to sides of scrap basket and set flush with dishtable- top surface.

Fabricate pass window frame and sill assembly of 14 gauge stainless steel. Coordinate length, width and wall thickness of wall opening per architectural drawings. Pass window frame shall be 2" wide on top and sides turned back 1" at 90 degrees to wall surface. Sill shall be fabricated with both edges turned down 2" at 90 degrees returned to wall 1" at 90 degrees with ends closed to sides. Fabricate frame and sill with full perimeter field joint to facilitate installation into wall opening, fully weld and polish field joint after installation into wall opening. Secure frame and sill assembly to wall opening in a concealed manner utilizing stainless steel fasteners and of a type suitable for wall construction.

Furnish and install Cornell ESC-20 manually operated jamb mounted counter shutter assembly in pass window opening. Shutter assembly frame, guides, bracket plates, hood and slats shall be fabricated of 16 gauge stainless steel; shutter assembly shall be provided less sill. Provide chrome plated cylinder type lock assembly on reinforced bottom bar. Fabricate frame with split frame assembly to facilitate installation into wall opening. Secure frame assembly to wall opening in a concealed manner per manufacturer instructions utilizing stainless steel fasteners and of a type suitable for wall construction.

Dishtable shall be reinforced with 14 gauge stainless steel, 1" x 4" x 1" "hat" channels welded to underside of dishtable top, front to rear at legs for weld anchoring leg gussets, and longitudinally the full length of the dishtable at center of top between leg channels.

Mount on leg assembly constructed of 1-5/8" diameter 16 gauge stainless steel tubing. Each leg shall be provided with a stainless steel bullet shaped adjustable foot. Fasten each leg to a 3-1/2" high stainless steel conical shaped die-formed gusset, fully welded to leg mounting channel.

Provide 1-1/4" diameter 16 gauge stainless steel tubular cross railing running between legs at a point 10" above the finished floor. Railing shall be continuously

welded to legs provide a smooth coved radius.

Provide provisions for Item #72 scrap conveyor trough.

ITEM #74 HOSE REEL WITH SPRAY
Quantity: One (1)
Manufacturer: T & S / Component Hardware / Fisher Equipment
Model: B-1433-711202QD
Options: G019430-45 EasyInstall Universal Hose Reel Swing Bracket, fits 1/2" & 3/8" hose reels, includes mounting hardware, stainless steel (2)
Sup Info: Foodservice Equipment Contractor shall furnish and install interconnecting chrome plated exposed piping and install check valves and vacuum breaker in supply line.

Furnish stainless steel mounting hardware of proper type for wall construction and install to wall.

Construction Trade to reinforce wall behind hose reel to sustain weight while in use.

ITEM #75 TRASH COUNTER
Quantity: One (1)
Manufacturer: Duke / Multiteria / Delfield
Model: Size and shape per plan
Construction: Fabricate counter top of solid surface material. Material shall be fabricated and assembled per manufacturers approved methods utilizing a factory authorized and certified fabricator and installer. The edges of the top shall be formed as indicated. Openings shall have radius corners and shall be reinforced with additional material.

Counter base shall be fabricated of 18 gauge stainless steel wrap around type construction. Provide stainless steel fully welded channel frame around the entire perimeter of the counter top with intermediate cross bracing extending front to rear on centers not to exceed 24” to support top. Provide interior of counter base with solid fixed open bottom and intermediate shelves constructed of 16 gauge stainless steel unless specified otherwise. The front edge of each shelf shall be turned down 2" at 90 degrees and returned 1/2" at 90 degrees. Rear and ends shall be turned up 2" high on a 90 degree angle, interior corners coved on 3/4" radius.

Hinged doors shall be fabricated of ¾” thick MDF board and shall be furnished with three BLUM 75M5580 or 75M5680 European style concealed hinges. Door pulls shall be Hafele 116.39.437. Finish doors with laminated plastic on all edges and interior and exterior face. Doors shall not exceed 27" in width and shall be of equal size. Provide each door with chrome plated cylinder locks keyed alike.

Furnish two 8" diameter holes in countertop for trash as shown on plans. Line the entire opening perimeter with laminated plastic in finish as the counter top and furnish hole with an 18 gauge type 304 stainless steel removable sleeve to line opening. Each sleeve shall have a 1/2" flange around the perimeter of the top and shall be 1-1/2" high overall.

Furnish utility chases through counter body and die-raised openings in counter top for passage of plumbing and utility lines.

Provide 12 gauge stainless steel 1" x 5" x 1" “hat” type leg mounting channels extending full width of counter on centers not to exceed 48" in length and fully welded to the angle iron frame. Mount counter assembly on 6" high stainless steel counter type conical legs with stainless steel adjustable bullet feet fully welded to leg mounting channels.

Counter front and exposed ends shall be provided with high pressure laminated plastic faced panels close fitted with hairline joints and secured in position in a concealed manner and removable without the use of tools. Laminate selection to be made by the Architect/Owner.

Provide 6” high recessed toe base on customers side and exposed ends fabricated of 18 gauge 304 stainless steel and secured to counter base for removal without tools.

ITEM #76 TRASH RECEPTACLE
Quantity: Two (2)
Manufacturer: Rubbermaid
Model: FG263200GRAY
Options: FG263100GRAY (2)

ITEM #77 HOT/HOLDING CABINET
Quantity: Two (2)
Manufacturer: Metro / Cres Cor / Winston
Model: C589L-SDC-L
Options: C5-HANDLE Rear Push Handle (2)
C5-PERMBUMP Full perimeter bumper (2)
C5-6CASTER 6" polyurethane caster upgrade (2)

ITEM #78 BUN PAN RACK
Quantity: Four (4)
Manufacturer: Eagle Group / Channel / Metro
Model: 430S

ITEM #79 WORK TABLE, STAINLESS TOP
Quantity: One (1)
Manufacturer: Eagle Group / John Boos / Advance Tabco
Model: T36120SE-BS
Options: E36A All welded construction
E22 Weld in sink bowl
313304 Faucet upgrade
341189 Twist Handle Drain, 1-1/2 or 2" NPS connection
-TB Twist bracket, per drain
351585 Sink cover
E47 Sink cover holder
YCORSI-502971-MOD Drawer

ITEM #80 SHELF, WALL MOUNT
Quantity: Two (2)
Manufacturer: Eagle Group / John Boos / Advance Tabco
Model: WS1284-14/3
Sup Info: Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

Construction Trade shall provide wall blocking as required for mounting.

ITEM #81 DELI COUNTER
Quantity: One (1)
Manufacturer: Duke / LTI / Delfield
Model: Size and shape as per plan
Construction: Provide counter top of approved solid surface material. Material shall be fabricated

and assembled per manufacturer's approved methods utilizing a factory authorized and certified fabricator and installer. The front edge of the top shall be formed as indicated on the food service and architectural detail drawings routed and finished as directed. Openings shall have radius corners and shall be reinforced with additional material. Where drop-in appliances are to set on the top the fixture shall be furnished with a 3/4" thick 5-7 ply marine grade BW plywood sub-top. Where heated appliances are to set on the top the sub-top is to be insulated from the drop-in appliance with hard fiberboard insulation to prevent heat from being in direct contact with the solid surface top. All drop-in equipment shall be pre-fitted in top prior to delivery to the job site. All drop-in equipment shall be sealed with General Electric clear silicon sealer after installation.

Provide exposed front and sides of counter with ¾" thick 5-7 ply marine grade plywood with laminated plastic finish and 14 gauge stainless steel angle mop guards extending along the bottom of each panel and secured to the underside of the panel. Counter end panels slaff be fabricated of stainless steel.

Counter base shall be fabricated of 18 gauge stainless steel wrap around type construction. Provide stainless steel fully welded channel frame around the entire perimeter of the counter top with intermediate cross bracing extending front to rear on centers not to exceed 24" to support top. Provide interior of counter base with solid fixed open bottom and intermediate shelves constructed of 16 gauge stainless steel unless specified otherwise. The front edge of each shelf shall be turned down 2" at 90 degrees and returned 1/2" at 90 degrees. Rear and ends shall be turned up 2" high on a 90 degree angle, interior corners coved on 3/4" radius.

All appliances and components to be furnished as built-in equipment as part of the counter shall be factory installed per the manufacturers instructions, all electrical wiring and components shall conform to UL and shall be installed in accordance with the National Electric Code with all wiring extended to a junction box connection point in counter base with all wires tagged and identified.

Provide provisions for Item #57 undercounter refrigerator.

Provide provisions for Item #86 drop-in hot/cold well.

Provide provisions for Item #88 sandwich prep refrigerator.

Furnish die-raised utility chases through the cabinet body and openings with plastic grommets in the solid surface material counter top for passage of plumbing and utility lines.

Mount counter assembly on 12 gauge stainless steel triangular leg gusset mounting channels on centers not to exceed 48" in length and fully welded to the cabinet body. Mount counter assembly on 6" high 1 5/8" diameter 16 gauge stainless steel tubular legs with stainless steel adjustable bullet feet fully weld legs to mounting gussets. Provide 6" high recessed toe base on customers side and exposed ends fabricated of ¾" thick 5-7 ply marine grade plywood faced with 14 gauge stainless steel.

Make factory preparation of the top and underbracing and supervise field installation of sneeze guards. Extend any wiring for display and heat lights to a junction box in counter base with all wiring tagged and identified.

ITEM #82 FROST TOP, DROP-IN
Quantity: One (1)
Manufacturer: Duke / LTI / Delfield

Model:	RFT2-SL
ITEM #83	COLD WELL, DROP-IN
Quantity:	One (1)
Manufacturer:	Duke / LTI / Delfield
Model:	FCP1-SB
ITEM #84	COLD WELL, DROP-IN
Quantity:	One (1)
Manufacturer:	Duke / LTI / Delfield
Model:	FCP5-SB
ITEM #85	SNEEZE GUARD ASSEMBLY
Quantity:	One (1)
Manufacturer:	PMG / Versaguard
Model:	FM2R-A
Options:	Size and shape as per plan Stainless steel tubing Finish: Brushed aluminum 3/8" Tempered glass 1" radius corner End Panels Ultra-Slim LED lights 4000k Remote infinite switch Millwork undercounter mount
ITEM #86	DROP-IN, HOT/COLD/FREEZE
Quantity:	Four (4)
Manufacturer:	Duke / LTI / Delfield
Model:	HCF-2
ITEM #87	RAPID COOK OVEN W/ PANINI PRESS
Quantity:	One (1)
Manufacturer:	Turbochef / Merrychef / Amana
Model:	I5-TOUCH CONTROL I5-9500-801
Options:	MDD-1001 Open kitchen bundle I5-9039 Filter 105703 Turbochef guard kit 105704 Powder cleaner kit
Sup Info:	Includes but not limited to; digital display, removable rack and grease collection pan, top and bottom jet plates, pull down door with ergonomic handle, multi-speed impingement blower, 13 1/2" x 14 1/4, (2) solid PTFE baskets, (1) oven cleaner (1) oven guard, (1) aluminum paddle, (2) trigger sprayers, (1) standard rack, side hand grips, stainless steel front, top & sides.
ITEM #88	REFRIGERATOR, SANDWICH PREP
Quantity:	One (1)
Manufacturer:	Continental / True / Traulsen
Model:	SW36N12M-HGL
Options:	Stainless steel interior Stainless steel exterior Stainless steel case back Left Door hinged on left & right door hinged on right, standard Exterior mounted digital thermometer Automatic condensate evaporator Swivel casters with polyurethane tires and front locking brakes

Plug and cord set 10’ cord
Pan openings in top
8" cutting board, rear mounted

ITEM #89 REFRIGERATOR, PIZZA PREP
Quantity: One (1)
Manufacturer: Continental / True / Traulsen
Model: PA43N
Options: Stainless steel interior
Stainless steel exterior
Stainless steel case back
Left Door hinged on left & right door hinged on right, standard
Exterior mounted digital thermometer
Automatic condensate evaporator
Swivel casters with polyurethane tires and front locking brakes
Plug and cord set 10’ cord
Pan openings in top
(00VL) Lid with vision panel
ZZCUTTINGBOARD01 15-11/16" cutting board
5" Swivel Casters standard

ITEM #90 EXHAUST HOOD
Quantity: One (1)
Manufacturer: Accurex / Captive Aire
Model: Size and shape as per plan
Construction: Furnish and install exhaust hood with integral plenum box make-air system.

Entire exhaust ventilation system shall be constructed in compliance with UL, NSF, NFPA, IMC 2018 (including automatic start-up of the exhaust and supply ventilation upon activation of any cooking appliance) and any prevailing statutes and codes.

Hood shall be 5’-6” long constructed of 18 gauge 304 stainless steel with all seams continuously welded, ground smooth and polished. Provide a full compliment of stainless steel “high efficiency” baffle type grease extractors.

Furnish remote bulb thermostat with watertight hardware and install in either the exhaust plenum of the hood or in the exhaust duct. Provide NEMA 3 control panel box with hinged front cover complete with supply and exhaust fan contactors wired to an adjustable thermostat control, field wiring terminal strip and on-off switch.

Provide 18 gauge 304 stainless steel supply and exhaust duct collar.

Provide 18 gauge 304 stainless steel insulated supply air plenum box assembly with internal air volume control damper integral along the face of the hood. Mount in finished ceiling along face of hood and furnish full length stainless steel perforated removable panels for discharge of supply air along entire face of hood.

Provide stainless steel threaded hanger rods complete with stainless steel mounting hardware for securing to structural ceiling.

Mechanical (HVAC) Trade shall furnish and install a complete exhaust air handling system including exhaust fan and controller, fan start-stop switch with status lights, 16 gauge insulated welded ductwork from exhaust collar on exhaust hood to fan, hinged roof curb with grease trough and removable grease container.

Mechanical (HVAC) Trade shall install exhaust hood heat detector(s) in exhaust hoods with multiple exhaust collars in the exhaust duct just after the point of the pant leg juncture; this includes punching of the required hole in the duct and installation of the heat detector and fitting.

Mechanical (HVAC) Trade shall furnish and install a complete supply air handling system including supply fan and controller (with maintainable filter system) and supply air heater with thermostat control (to temper incoming supply air below 65 degree F ambient), fan start-stop switch with indicator lights, galvanized steel ductwork from supply collar on exhaust hood to fan and roof curb.

Electrical Trade shall furnish and install interconnecting wiring between fan motors, controllers and switches.

Electrical Trade shall furnish and install inter-wiring of cooking appliance start-up inter-lock device and the supply and exhaust ventilation system and wire per the manufacturer's instructions and per applicable codes.

Furnish four (4) UL listed vapor-proof recessed LED light fixtures wired to a common on-off switch with stainless steel cover plate located on front face of control package/wall mounted utility cabinet.

Electrical Trade shall furnish materials and inter-wire light fixtures to switch on front face of utility cabinet.

Mechanical (HVAC) Trade shall furnish and install INVERTER DUTY THREE PHASE exhaust fan and controller.

Mechanical (HVAC) Trade shall furnish fans set compatible with variable frequency drive specification.

Electrical Trade shall furnish and install Interconnecting wiring of the system between the exhaust hood sensors, remote frequency drive unit and exhaust and supply fan motors.

Furnish and install 18 gauge stainless steel ceiling closure panels extending from the top of the exhaust ventilator to the finished ceiling. Panels shall be removable without the use of tools for access.

Furnish and install 18 gauge 304 stainless steel wall panels extending from the bottom of the rear of the exhaust hood to the upper edge of the baseboard molding and extending along the full length of all wall surfaces. Wall panel sections shall be fitted with ½" wide off-set seams at intermediate joints to allow panel sections to fit tightly against the wall and to result in watertight seams. Secure wall panels to building wall with wall panel adhesive of proper type for wall construction. Seal end seams with General Electric or equivalent clear silicone sealer.

Electrical Trade shall provide the inter-wiring between the control enclosure, fire system, supply and exhaust fans and variable frequency drives and duct riser temperature switch.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #90.1 HOOD CONTROL PANEL
Quantity: One (1)

Manufacturer: Accurex / Captive Aire
Model: Size and shape per plan
Sup Info: Furnish 18 gauge stainless steel utility and fire system enclosure cabinet with hinged access doors for both hood and fire system controls and fire suppression tanks. System shall be listed by ETL (UL 508A) NSF, NFPA, IMC 2018 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17-27. Cabinet may be freestanding wall type or integral with exhaust hood as shown on the contract drawings. Furnish stainless steel mounting hardware of proper type for wall construction for wall mounted cabinet.

Furnish and install variable volume motor control center with variable frequency drive, input / output processor and keypad enclosed within a stainless steel utility cabinet for remote mounting. System shall include, but not be limited to, electronic variable volume motor starters with thermal overload, input / output processors, control keypad, temperature and optic sensors and plug and play cables. Temperature sensor shall be mounted in the exhaust duct collar; optic sensor shall be mounted inside the ends of the hood with air purge units mounted on top.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #90.2 WET CHEMICAL FIRE SUPPRESSION SYSTEM
Quantity: One (1)
Manufacturer: Ansul Fire Protection
Model: R-102
Sup Info: Furnish and install in exhaust hood and surface fire protection system.

Entire system shall be furnished and installed in compliance with UL, NSF, NFPA, Factory Mutual, IMC 2018 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17-27.

Furnish and install in exhaust hood as part of fire system, mechanically operated fusible link temperature detection system to activate entire fire system in event of fire.

All piping and nozzles of fire system shall be factory installed in exhaust hood, exposed piping, nozzles and fittings shall be chrome plated.

Inter-wiring of the fire system to the exhaust hood shall be furnished and installed by the Electrical Trade.

Electrical Trade shall furnish and install electric shunt-trip circuit breakers or electric shut-off contactors to interrupt electric power to all electrically operated cooking appliances.

Provide dry contacts in fire system to interface with building fire alarm system as required, electrical tie-in shall be the responsibility of the Electrical Trade.

Provide as part of fire system, mechanically operated gas supply line shut-off valve to interrupt gas supply to all gas operated cooking appliances. Gas valve shall be provided with manual reset to prevent gas flow to pilot devices on appliances prior to restart.

Provide one remote manual pull station to actuate fire system in the event of a fire.

Plumbing Trade shall install gas shut-off valve in gas supply line.

Electrical Trade shall furnish and install electric shunt-trip circuit breakers or electric shut-off contactors to interrupt electric power to all electrically operated cooking appliances.

Provide dry contacts in fire system to interface with building fire alarm system as required, electrical tie-in shall be the responsibility of the Electrical Trade.

Provide as part of fire system, start-up testing of the fire system as required by local fire codes. Subsequent testing of the fire system for a period of one year after start-up shall be included as part of this contract.

ITEM #91	CONVEYOR OVEN
Quantity:	Two (2)
Manufacturer:	Lincoln / Middleby Marshall
Model:	1116-000-U
Options:	1120-1 Portable stand with casters L4612883 Oven cleaner kit (2) Gas pressure regulator (2) Dormont 1675KITCF2S48 Gas hose kit (2)
Sup Info:	Foodservice Equipment Contractor shall install disconnect at wall connection and to cooking appliance per manufacturer's instructions.

Foodservice Equipment Contractor shall provide and secure restraining cable between wall and equipment.

ITEM #92	REFRIGERATOR, WORK TOP
Quantity:	One (1)
Manufacturer:	Continental / True / Traulsen
Model:	SW36NBS
Options:	Stainless steel interior Stainless steel exterior Stainless steel case back Left Door hinged on left, center & right doors hinged on right, standard Exterior mounted digital thermometer Automatic condensate evaporator Swivel casters with polyurethane tires and front locking brakes Plug and cord set 10' cord

ITEM #93	EXHAUST HOOD
Quantity:	One (1)
Manufacturer:	Accurex / Captive Aire
Model:	Size and shape as per plan
Construction:	Furnish and install exhaust hood with integral plenum box make-air system.

Entire exhaust ventilation system shall be constructed in compliance with UL, NSF, NFPA, IMC 2018 (including automatic start-up of the exhaust and supply ventilation upon activation of any cooking appliance) and any prevailing statutes and codes.

Hood shall be 9'-0" long constructed of 18 gauge 304 stainless steel with all seams continuously welded, ground smooth and polished. Provide a full compliment of stainless steel "high efficiency" baffle type grease extractors.

Furnish remote bulb thermostat with watertight hardware and install in either the exhaust plenum of the hood or in the exhaust duct. Provide NEMA 3 control panel box

with hinged front cover complete with supply and exhaust fan contactors wired to an adjustable thermostat control, field wiring terminal strip and on-off switch.

Provide 18 gauge 304 stainless steel supply and exhaust duct collar.

Provide 18 gauge 304 stainless steel insulated supply air plenum box assembly with internal air volume control damper integral along the face of the hood. Mount in finished ceiling along face of hood and furnish full length stainless steel perforated removable panels for discharge of supply air along entire face of hood.

Provide stainless steel threaded hanger rods complete with stainless steel mounting hardware for securing to structural ceiling.

Mechanical (HVAC) Trade shall furnish and install a complete exhaust air handling system including exhaust fan and controller, fan start-stop switch with status lights, 16 gauge insulated welded ductwork from exhaust collar on exhaust hood to fan, hinged roof curb with grease trough and removable grease container.

Mechanical (HVAC) Trade shall install exhaust hood heat detector(s) in exhaust hoods with multiple exhaust collars in the exhaust duct just after the point of the pant leg juncture; this includes punching of the required hole in the duct and installation of the heat detector and fitting.

Mechanical (HVAC) Trade shall furnish and install a complete supply air handling system including supply fan and controller (with maintainable filter system) and supply air heater with thermostat control (to temper incoming supply air below 65 degree F ambient), fan start-stop switch with indicator lights, galvanized steel ductwork from supply collar on exhaust hood to fan and roof curb.

Electrical Trade shall furnish and install interconnecting wiring between fan motors, controllers and switches.

Electrical Trade shall furnish and install inter-wiring of cooking appliance start-up inter-lock device and the supply and exhaust ventilation system and wire per the manufacturer’s instructions and per applicable codes.

Furnish four (4) UL listed vapor-proof recessed LED light fixtures wired to a common on-off switch with stainless steel cover plate located on front face of control package/wall mounted utility cabinet.

Electrical Trade shall furnish materials and inter-wire light fixtures to switch on front face of utility cabinet.

Mechanical (HVAC) Trade shall furnish and install INVERTER DUTY THREE PHASE exhaust fan and controller.

Mechanical (HVAC) Trade shall furnish fans set compatible with variable frequency drive specification.

Electrical Trade shall furnish and install Interconnecting wiring of the system between the exhaust hood sensors, remote frequency drive unit and exhaust and supply fan motors.

Furnish and install 18 gauge stainless steel ceiling closure panels extending from the top of the exhaust ventilator to the finished ceiling. Panels shall be removable without the use of tools for access.

Furnish and install 18 gauge 304 stainless steel wall panels extending from the bottom of the rear of the exhaust hood to the upper edge of the baseboard molding and extending along the full length of all wall surfaces. Wall panel sections shall be fitted with ½" wide off-set seams at intermediate joints to allow panel sections to fit tightly against the wall and to result in watertight seams. Secure wall panels to building wall with wall panel adhesive of proper type for wall construction. Seal end seams with General Electric or equivalent clear silicone sealer.

Electrical Trade shall provide the inter-wiring between the control enclosure, fire system, supply and exhaust fans and variable frequency drives and duct riser temperature switch.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #93.1 HOOD CONTROL PANEL
Quantity: One (1)
Manufacturer: Accurex / Captive Aire
Model: Size and shape per plan
Sup Info: Furnish 18 gauge stainless steel utility and fire system enclosure cabinet with hinged access doors for both hood and fire system controls and fire suppression tanks. System shall be listed by ETL (UL 508A) NSF, NFPA, IMC 2018 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17-27. Cabinet may be freestanding wall type or integral with exhaust hood as shown on the contract drawings. Furnish stainless steel mounting hardware of proper type for wall construction for wall mounted cabinet.

Furnish and install variable volume motor control center with variable frequency drive, input / output processor and keypad enclosed within a stainless steel utility cabinet for remote mounting. System shall include, but not be limited to, electronic variable volume motor starters with thermal overload, input / output processors, control keypad, temperature and optic sensors and plug and play cables. Temperature sensor shall be mounted in the exhaust duct collar; optic sensor shall be mounted inside the ends of the hood with air purge units mounted on top.

Refer to latest approved Engineering Drawings for engineering data and design methods and features which shall take precedence to this specification.

ITEM #93.2 WET CHEMICAL FIRE SUPPRESSION SYSTEM
Quantity: One (1)
Manufacturer: Ansul Fire Protection
Model: R-102
Sup Info: Furnish and install in exhaust hood and surface fire protection system.

Entire system shall be furnished and installed in compliance with UL, NSF, NFPA, Factory Mutual, IMC 2018 and any prevailing statutes or codes including automatic shut-down of all cooking appliances per code section 44 of NFPA 17-27.

Furnish and install in exhaust hood as part of fire system, mechanically operated fusible link temperature detection system to activate entire fire system in event of fire.

All piping and nozzles of fire system shall be factory installed in exhaust hood, exposed piping, nozzles and fittings shall be chrome plated.

Inter-wiring of the fire system to the exhaust hood shall be furnished and installed by the Electrical Trade.

Electrical Trade shall furnish and install electric shunt-trip circuit breakers or electric shut-off contactors to interrupt electric power to all electrically operated cooking appliances.

Provide dry contacts in fire system to interface with building fire alarm system as required, electrical tie-in shall be the responsibility of the Electrical Trade.

Provide as part of fire system, mechanically operated gas supply line shut-off valve to interrupt gas supply to all gas operated cooking appliances. Gas valve shall be provided with manual reset to prevent gas flow to pilot devices on appliances prior to restart.

Provide one remote manual pull station to actuate fire system in the event of a fire.

Plumbing Trade shall install gas shut-off valve in gas supply line.

Electrical Trade shall furnish and install electric shunt-trip circuit breakers or electric shut-off contactors to interrupt electric power to all electrically operated cooking appliances.

Provide dry contacts in fire system to interface with building fire alarm system as required, electrical tie-in shall be the responsibility of the Electrical Trade.

Provide as part of fire system, start-up testing of the fire system as required by local fire codes. Subsequent testing of the fire system for a period of one year after start-up shall be included as part of this contract.

ITEM #94	FRYER
Quantity:	One (1)
Manufacturer:	Frymaster / Pitco / Vulcan
Model:	FPPH355
Options:	8030002 Filter powder 8030170 Filter paper 8239116 Sediment filter screen 8030103 Sediment tray 8030197 Clean-out rod 8236559 Splash shield 8030429 Fryer brush 8239416 Frypot cover 8233938 Crumb scoop CM3.5 Controller, standard 6” casters Gas pressure regulator Rear gas manifold FWH-1A French fry warmer and holding station (with heat lamp) Spreader cabinet with cutout in top Holding pan with screen for spreader cabinet Natural gas Dormont 16100KITCF2S-48 gas hose kit (2)
Sup Info:	Foodservice Equipment Contractor shall install disconnect at wall and to cooking appliance per manufacturer’s instructions.

Foodservice Equipment Contractor shall provide and secure restraining cable

between wall and equipment.

ITEM #95 WORK TABLE, STAINLESS TOP
Quantity: One (1)
Manufacturer: Eagle Group / John Boos / Advance Tabco
Model: T3660SE-BS
Options: E36A All welded construction
E59 Undershelf upgrade
YCORSI-502971-MOD Drawers

ITEM #96 GRILL / PIZZA COUNTER
Quantity: One (1)
Manufacturer: Duke / LTI / Delfield
Model: Size and shape as per plan
Construction: Provide counter top of approved solid surface material. Material shall be fabricated and assembled per manufacturer's approved methods utilizing a factory authorized and certified fabricator and installer. The front edge of the top shall be formed as indicated on the food service and architectural detail drawings routed and finished as directed. Openings shall have radius corners and shall be reinforced with additional material. Where drop-in appliances are to set on the top the fixture shall be furnished with a 3/4" thick 5-7 ply marine grade BW plywood sub-top. Where heated appliances are to set on the top the sub-top is to be insulated from the drop-in appliance with hard fiberboard insulation to prevent heat from being in direct contact with the solid surface top. All drop-in equipment shall be pre-fitted in top prior to delivery to the job site. All drop-in equipment shall be sealed with General Electric clear silicon sealer after installation.

Provide exposed front and sides of counter with ¾" thick 5-7 ply marine grade plywood with laminated plastic finish and 14 gauge stainless steel angle mop guards extending along the bottom of each panel and secured to the underside of the panel. Counter end panels slaff be fabricated of stainless steel.

Counter base shall be fabricated of 18 gauge stainless steel wrap around type construction. Provide stainless steel fully welded channel frame around the entire perimeter of the counter top with intermediate cross bracing extending front to rear on centers not to exceed 24" to support top. Provide interior of counter base with solid fixed open bottom and intermediate shelves constructed of 16 gauge stainless steel unless specified otherwise. The front edge of each shelf shall be turned down 2" at 90 degrees and returned 1/2" at 90 degrees. Rear and ends shall be turned up 2" high on a 90 degree angle, interior corners coved on 3/4" radius.

All appliances and components to be furnished as built-in equipment as part of the counter shall be factory installed per the manufacturers instructions, all electrical wiring and components shall conform to UL and shall be installed in accordance with the National Electric Code with all wiring extended to a junction box connection point in counter base with all wires tagged and identified.

Provide provisions for Item #86 drop-in hot/cold well.

Provide provisions for Item #97 drop-in heated shelf (2).

Provide provisions for Item #99 drop-in hot/cold well.

Provide provisions for Item #100 undercounter hot/holding cabinet.

Furnish die-raised utility chases through the cabinet body and openings with plastic

grommets in the solid surface material counter top for passage of plumbing and utility lines.

Mount counter assembly on 12 gauge stainless steel triangular leg gusset mounting channels on centers not to exceed 48" in length and fully welded to the cabinet body. Mount counter assembly on 6” high 1 5/8” diameter 16 gauge stainless steel tubular legs with stainless steel adjustable bullet feet fully weld legs to mounting gussets. Provide 6” high recessed toe base on customers side and exposed ends fabricated of ¾" thick 5-7 ply marine grade plywood faced with 14 gauge stainless steel.

Make factory preparation of the top and underbracing and supervise field installation of sneeze guards. Extend any wiring for display and heat lights to a junction box in counter base with all wiring tagged and identified.

ITEM #97	HEATED SHELF, DROP-IN
Quantity:	Two (2)
Manufacturer:	Hatco / Merco / APW Wyott
Model:	GRSSB-4818
Options:	Thermostat control with lighted rocker switch, standard (2)

ITEM #98	SNEEZE GUARD ASSEMBLY
Quantity:	One (1)
Manufacturer:	PMG / Versaguard
Model:	FM2R-A
Options:	Size and shape as per plan Stainless steel tubing Finish: Brushed aluminum 3/8" Tempered glass 1" radius corner End Panels GRNM Hatco, narrow max watt heat lamp & Ultra-Slim LED lights 4000k Remote infinite switch Millwork undercounter mount

ITEM #99	DROP-IN, HOT/COLD/FREEZE
Quantity:	Two (2)
Manufacturer:	Duke / LTI / Delfield
Model:	HCF-3

ITEM #100	HOT/HOLDING CABINET, MOBILE, UNDERCOUNTER
Quantity:	One (1)
Manufacturer:	Metro / Cres Cor / Winston
Model:	C563L-SFC-L
Options:	C5-HANDLE Rear Push Handle C5-PERMBUMP Full perimeter bumper C5-6CASTER 6" polyurethane caster upgrade

ITEM #101	HEATED ZONE MERCHANDISER
Quantity:	One (1)
Manufacturer:	Hatco / Merco / APW Wyott
Model:	HZMH-48D
Options:	BLACK Black, designer color Architect/owner to select/verify final finish

ITEM #102	REFRIGERATOR, UNDERCOUNTER
Quantity:	Two (2)

Manufacturer: Continental / True / Traulsen
Model: SW48N-U
Options: Stainless steel interior (2)
Stainless steel exterior (2)
Stainless steel case back (2)
Left Door hinged on left, center & right doors hinged on right, standard (2)
Exterior mounted digital thermometer (2)
Automatic condensate evaporator (2)
Swivel casters with polyurethane tires and front locking brakes (2)
Plug and cord set 10’ cord (2)

ITEM #103 SPARE NUMBER

ITEM #104 ACTION / ENTRÉE COUNTER
Quantity: One (1)
Manufacturer: Duke / LTI / Delfield
Model: Size and shape as per plan
Construction: Provide counter top of approved solid surface material. Material shall be fabricated and assembled per manufacturer’s approved methods utilizing a factory authorized and certified fabricator and installer. The front edge of the top shall be formed as indicated on the food service and architectural detail drawings routed and finished as directed. Openings shall have radius corners and shall be reinforced with additional material. Where drop-in appliances are to set on the top the fixture shall be furnished with a 3/4” thick 5-7 ply marine grade BW plywood sub-top. Where heated appliances are to set on the top the sub-top is to be insulated from the drop-in appliance with hard fiberboard insulation to prevent heat from being in direct contact with the solid surface top. All drop-in equipment shall be pre-fitted in top prior to delivery to the job site. All drop-in equipment shall be sealed with General Electric clear silicon sealer after installation.

Provide exposed front and sides of counter with ¾” thick 5-7 ply marine grade plywood with laminated plastic finish and 14 gauge stainless steel angle mop guards extending along the bottom of each panel and secured to the underside of the panel. Counter end panels slaff be fabricated of stainless steel.

Counter base shall be fabricated of 18 gauge stainless steel wrap around type construction. Provide stainless steel fully welded channel frame around the entire perimeter of the counter top with intermediate cross bracing extending front to rear on centers not to exceed 24” to support top. Provide interior of counter base with solid fixed open bottom and intermediate shelves constructed of 16 gauge stainless steel unless specified otherwise. The front edge of each shelf shall be turned down 2" at 90 degrees and returned 1/2" at 90 degrees. Rear and ends shall be turned up 2" high on a 90 degree angle, interior corners coved on 3/4" radius.

All appliances and components to be furnished as built-in equipment as part of the counter shall be factory installed per the manufacturers instructions, all electrical wiring and components shall conform to UL and shall be installed in accordance with the National Electric Code with all wiring extended to a junction box connection point in counter base with all wires tagged and identified.

Provide provisions for Item #86 drop-in hot/cold well (2).

Provide provisions for Item #99 drop-in hot/cold well.

Provide provisions for Item #106 induction cooking system.

Furnish die-raised utility chases through the cabinet body and openings with plastic grommets in the solid surface material counter top for passage of plumbing and utility lines.

Mount counter assembly on 12 gauge stainless steel triangular leg gusset mounting channels on centers not to exceed 48" in length and fully welded to the cabinet body. Mount counter assembly on 6” high 1 5/8” diameter 16 gauge stainless steel tubular legs with stainless steel adjustable bullet feet fully weld legs to mounting gussets. Provide 6” high recessed toe base on customers side and exposed ends fabricated of ¾" thick 5-7 ply marine grade plywood faced with 14 gauge stainless steel.

Make factory preparation of the top and underbracing and supervise field installation of sneeze guards. Extend any wiring for display and heat lights to a junction box in counter base with all wiring tagged and identified.

ITEM #105	SNEEZE GUARD ASSEMBLY
Quantity:	One (1)
Manufacturer:	PMG / Versaguard
Model:	FM2R-A
Options:	Size and shape as per plan
	Stainless steel tubing
	Finish: Brushed aluminum
	3/8" Tempered glass
	1" radius corner
	End Panels
	GRNM Hatco, narrow max watt heat lamp & Ultra-Slim LED lights 4000k
	Remote infinite switch
	Millwork undercounter mount

ITEM #106	INDUCTION COOKING SYSTEM
Quantity:	One (1)
Manufacturer:	Spring USA / Cooktek / Electrolux
Model:	ICS234-26

ITEM #107	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T36108SE
Options:	E36A All welded construction
	E59 Undershelf upgrade
	DOS12108-14/3 Overshelf, table mount
	YCORSI-502971-MOD Drawers (2)

ITEM #108	WORK TABLE, STAINLESS TOP
Quantity:	One (1)
Manufacturer:	Eagle Group / John Boos / Advance Tabco
Model:	T36108STE
Options:	E36A All welded construction
	E22 Weld in sink bowl (2)
	313304 Faucet upgrade
	341189 Twist Handle Drain, 1-1/2 or 2" NPS connection (2)
	-TB Twist bracket, per drain
	351585 Sink cover (2)
	E47 Sink cover holder
	DOS12108-14/3 Overshelf, table mount

Provide provisions to accept Item #102 undercounter refrigerator

ITEM #109 WORK TABLE, STAINLESS TOP
Quantity: Two (2)
Manufacturer: Eagle Group / John Boos / Advance Tabco
Model: T36108SE
Options: E36A All welded construction (2)
E59 Undershelf upgrade (2)
DOS12108-14/3 Overshelf, table mount (2)
YCORSI-502971-MOD Drawers (4)

ITEM #110 WORK TABLE, STAINLESS TOP
Quantity: One (1)
Manufacturer: Eagle Group / John Boos / Advance Tabco
Model: T36108STE
Options: E36A All welded construction
DOS12108-14/3 Overshelf, table mount
YCORSI-502971-MOD Drawer
Provide provisions to accept Item #37 undercounter refrigerator

ITEM #111 SODA / ICE DISPENSER
Quantity: One (1)
Sup Info: Not in Foodservice Equipment Contract, furnished by Others

ITEM #112 ICE MAKER
Quantity: One (1)
Manufacturer: Hoshizaki / Scotsman / Ice-o-Matic
Model: KMD-530MAJ

ITEM #112F WATER FILTRATION SYSTEM FOR ICE CUBER
Quantity: One (1)
Manufacturer: Everpure / 3M / Optipure
Model: QC7I SINGLE 4FC-S
Option: EV969231 Replacement cartridge
Sup Info: Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

General contractor shall provide wall blocking as required for mounting.

Food Service Equipment Contractor shall install ice maker filter system in water supply line and furnish and install interconnecting piping between water filter and ice maker water inlet

ITEM #113 COFFEE BREWER
Quantity: One (1)
Manufacturer: Bunn-O-Matic
Model: 34600.0000

ITEM #113F WATER FILTRATION SYSTEM FOR COFFEE BREWER
Quantity: One (1)
Manufacturer: Everpure / 3M / Optipure
Model: QC7I SINGLE 4FC-S
Option: EV969231 Replacement cartridge
Sup Info: Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use.

General contractor shall provide wall blocking as required for mounting.

Food Service Equipment Contractor shall install coffee brewer filter system in water supply line and furnish and install interconnecting piping between water filter and coffee brewer water inlet.

ITEM #114 THERMAL SERVER, BREW-THRU
Quantity: Three (3)
Manufacturer: Bunn-O-Matic / FETCO / Curtis
Model: 39400.0001

ITEM #115 CONDIMENT CADDY RACK
Quantity: One (1)
Manufacturer: Vollrath / Cal Mil
Model: CTC-3X2V

ITEM #116 BEVERAGE COUNTER
Quantity: One (1)
Manufacturer: Duke Manufacturing
Model: Size and shape per plan
Construction: Furnish counter top with approved solid surface material. Material shall be fabricated and assembled per manufacturer's approved methods utilizing a factory authorized and certified fabricator and installer. The front edge of the top shall be formed as indicated on the food service and architectural detail drawings routed and finished as directed. Openings shall have radius corners and shall be reinforced with additional material.

Solid surface material shall be fabricated and assembled per manufacturers approved methods by a factory authorized fabricator utilizing factory trained and certified personnel. The solid surface material top shall be set over a sub-top fabricated of ¾" thick 5-7 ply marine grade plywood.

Provide counter front with ¾" thick 5-7 ply marine grade plywood with laminated plastic finish and 14 gauge stainless steel angle mop guards extending along the bottom of each panel and secured to the underside of the panel. Counter end panels slaff be fabricated of stainless steel.

Counter base shall be fabricated of 18 gauge stainless steel wrap around type construction. Provide stainless steel fully welded channel frame around the entire perimeter of the counter top with intermediate cross bracing extending front to rear on centers not to exceed 24" to support top. Provide interior of counter base with solid fixed open bottom and intermediate shelves constructed of 16 gauge stainless steel unless specified otherwise. The front edge of each shelf shall be turned down 2" at 90 degrees and returned 1/2" at 90 degrees. Rear and ends shall be turned up 2" high on a 90 degree angle, interior corners coved on 3/4" radius.

Hinged doors shall be fabricated of ¾" thick MDF board and shall be furnished with three BLUM 75M5580 or 75M5680 European style concealed hinges. Door pulls shall be Hafele 116.39.437. Finish doors with laminated plastic on all edges and interior and exterior face. Doors shall not exceed 27" in width and shall be of equal size. Provide each door with chrome plated cylinder locks keyed alike.

All appliances and components to be furnished as built-in equipment as part of the counter shall be factory installed per the manufacturers instructions, all electrical wiring and components shall conform to UL and shall be installed in accordance with the

National Electric Code with all wiring extended to a junction box connection point in counter base with all wires tagged and identified.

Furnish die-raised utility chases through the cabinet body and openings with plastic grommets in the solid surface material counter top for passage of plumbing and utility lines.

Mount counter assembly on 12 gauge stainless steel triangular leg gusset mounting channels on centers not to exceed 48" in length and fully welded to the cabinet body. Mount counter assembly on 6” high 1 5/8” diameter 16 gauge stainless steel tubular legs with stainless steel adjustable bullet feet fully weld legs to mounting gussets. Provide 6” high recessed toe base on customers side and exposed ends fabricated of ¾" thick 5-7 ply marine grade plywood faced with 14 gauge stainless steel.

ITEM #117 CONVEYOR TOASTER
Quantity: One (1)
Manufacturer: Hatco / Toastmaster / APW
Model: TQ-800

ITEM #118 AMBIENT DISPLAY CASE
Quantity: One (1)
Manufacturer: Equipex / Cal Mil
Model: TN-583

ITEM #119 WAFFLE MIX DISPENSER
Quantity: One (1)
Sup Info: Not in Foodservice Equipment Contract, furnished by Others

ITEM #120 WAFFLE BAKER
Quantity: One (1)
Manufacturer: Hatco / Waring / Nemco
Model: FWM-1B

ITEM #121 SNEEZE GUARD ASSEMBLY
Quantity: One (1)
Manufacturer: PMG / Versaguard
Model: FM2N-G
Options: Size and shape as per plan
Stainless steel tubing
Finish: Brushed aluminum
3/8" Tempered glass
1" radius corner
End Panels
Millwork undercounter mount

ITEM #122 SNEEZE GUARD
Quantity: One (1)
Manufacturer: PMG / Versaguard
Model: FM2N-A
Options: Size and shape as per plan
Stainless steel tubing
Finish: Brushed aluminum
3/8" Tempered glass
1" radius corner
End Panels
GRNM Hatco, narrow max watt heat lamp & Ultra-Slim LED lights 4000k

Remote infinite switch
Millwork undercounter mount

ITEM #123 SALAD/DESSERT COUNTER
Quantity: One (1)
Manufacturer: Duke / LTI / Delfield
Model: Size and shape as per plan
Construction: Provide counter top of approved solid surface material. Material shall be fabricated and assembled per manufacturer's approved methods utilizing a factory authorized and certified fabricator and installer. The front edge of the top shall be formed as indicated on the food service and architectural detail drawings routed and finished as directed. Openings shall have radius corners and shall be reinforced with additional material. Where drop-in appliances are to set on the top the fixture shall be furnished with a 3/4" thick 5-7 ply marine grade BW plywood sub-top. Where heated appliances are to set on the top the sub-top is to be insulated from the drop-in appliance with hard fiberboard insulation to prevent heat from being in direct contact with the solid surface top. All drop-in equipment shall be pre-fitted in top prior to delivery to the job site. All drop-in equipment shall be sealed with General Electric clear silicon sealer after installation.

Provide exposed front and sides of counter with ¾" thick 5-7 ply marine grade plywood with laminated plastic finish and 14 gauge stainless steel angle mop guards extending along the bottom of each panel and secured to the underside of the panel. Counter end panels slaff be fabricated of stainless steel.

Counter base shall be fabricated of 18 gauge stainless steel wrap around type construction. Provide stainless steel fully welded channel frame around the entire perimeter of the counter top with intermediate cross bracing extending front to rear on centers not to exceed 24" to support top. Provide interior of counter base with solid fixed open bottom and intermediate shelves constructed of 16 gauge stainless steel unless specified otherwise. The front edge of each shelf shall be turned down 2" at 90 degrees and returned 1/2" at 90 degrees. Rear and ends shall be turned up 2" high on a 90 degree angle, interior corners coved on 3/4" radius.

All appliances and components to be furnished as built-in equipment as part of the counter shall be factory installed per the manufacturers instructions, all electrical wiring and components shall conform to UL and shall be installed in accordance with the National Electric Code with all wiring extended to a junction box connection point in counter base with all wires tagged and identified.

Provide provisions for Item #82 drop-in frost top.

Provide provisions for Item #83 drop-in cold well.

Provide provisions for Item #84 drop-in cold well.

Furnish die-raised utility chases through the cabinet body and openings with plastic grommets in the solid surface material counter top for passage of plumbing and utility lines.

Mount counter assembly on 12 gauge stainless steel triangular leg gusset mounting channels on centers not to exceed 48" in length and fully welded to the cabinet body. Mount counter assembly on 6" high 1 5/8" diameter 16 gauge stainless steel tubular legs with stainless steel adjustable bullet feet fully weld legs to mounting gussets. Provide 6" high recessed toe base on customers side and exposed ends fabricated

of ¾" thick 5-7 ply marine grade plywood faced with 14 gauge stainless steel.

Make factory preparation of the top and underbracing and supervise field installation of sneeze guards. Extend any wiring for display and heat lights to a junction box in counter base with all wiring tagged and identified.

ITEM #124	REVERSE OSMOSIS SYSTEM
Quantity:	One (1)
Manufacturer:	Everpure / 3M / Optipure
Model:	EZ-RO 200/10G-BL
Remarks:	EV969331 Replacement cartridge EZ-200 Replacement cartridge RO SYSTEM INSTALL - LEVEL I Installation
Sup Info:	Furnish stainless steel mounting hardware of proper type for wall construction and to sustain weight while in use. General contractor shall provide wall blocking as required for mounting. Plumbing Trade shall install RO system in water supply line and furnish and install interconnecting piping between RO system and combi oven water inlet.

ITEM #125	WIRE SHELVING
Quantity:	Five (5)
Manufacturer:	Metro / Eagle Group / Quantum
Model:	PR2448NK3 (4)
Options:	63UPK3 Posts (4) 5MP Casters (12) 5MPB Casters (2)
Sup Info:	Assemble into four tier shelving units, locate bottom shelf 12” above floor.

ITEM #126	DUNNAGE RACK
Quantity:	One (1)
Manufacturer:	Cambro / Metro / Eagle Group
Model:	DRS360480
Options:	DRLNK110 Camlink (1)

END OF SECTION 114000

SECTION 123661.16

SOLID SURFACING COUNTERTOPS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Solid surface material countertops.
2. Solid surface material backsplashes.
3. Solid surface material end splashes.
4. Solid surface material window sills.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

C. Samples: For each type of material exposed to view.

PART 2 - PRODUCTS

2.1 SOLID SURFACE MATERIALS (SS)

A. Solid Surface Material: Homogeneous-filled plastic resin complying with ICPA SS-1.
1. Manufacturers: Available manufacturers include but are not limited to the following:
a. Corian Design (DuPont)
b. LG Hi-Macs
c. Formica
d. Wilsonart
e. Or equal as approved by the Professional.
2. Type: Provide Standard type unless Special Purpose type is indicated.
3. Colors and Patterns: As selected by Architect from manufacturer's full range.

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

A. Fabricate countertops according to solid surface material manufacturer's written instructions and to the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom.

B. Configuration:

1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.
3. End Splash:[Matching backsplash.

C. Countertops and sills: 3/4-inch- thick, solid surface material or 1/2-inch with front edge built up with same material.

D. Backsplashes: **1/2-inch-**thick, solid surface material.

E. Joints: Fabricate in sections for joining in field.

F. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by solid surface material manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.

B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 INSTALLATION

A. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Predrill holes for screws as recommended by manufacturer.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops and sills to subtops with adhesive according to solid surface material manufacturer's written instructions.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive.

F. Install aprons to backing and countertops with adhesive.

G. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

H. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.16

SECTION 12 3661.19

QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Quartz agglomerate countertops.
2. Quartz agglomerate backsplashes.
3. Quartz agglomerate end splashes.
4. Quartz agglomerate apron fronts.

1.3 ACTION SUBMITTALS

A. Product Data: For countertop materials.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

1. Show locations and details of joints.
2. Show direction of directional pattern, if any.

C. Samples for Verification: For the following products:

1. Countertop material, 6 inches square.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.

B. Installer Qualifications: Fabricator of countertops.

1.7 FIELD CONDITIONS

A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS (QTZ)

A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of polymers, resins, and pigment and complying with ISFA 3-01.

1. Manufacturers: Available manufacturers include but are not limited to the following:
   a. Caeserstone
   b. Cambria
   c. LX Hauseys
   d. Wilsonart
   e. Or equal as approved by the Professional.
2. Colors and Patterns: As indicated by manufacturer's designations .

B. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 FABRICATION

A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."

1. Grade: Custom .

B. Configuration:

1. Front: Straight, slightly eased at top .
2. Backsplash: Straight, slightly eased at corner .
3. End Splash: Matching backsplash .

C. Countertops: 3/4-inch- thick, quartz agglomerate with front edge built up with same material.

D. Backsplashes: 3/4-inch- thick, quartz agglomerate.

E. Fabricate tops with shop-applied edges unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

1. Fabricate with loose backsplashes for field assembly.

F. Joints:

1. Fabricate countertops in sections for joining in field.
   a. Joint Locations: Not within 18 inches of a sink or cooktop and not where a countertop section less than 36 inches long would result, unless unavoidable.
   b. Joint Type, Sealant Filled: 1/16 inch in width.

G. Cutouts and Holes:

1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
   a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch into fixture opening.
2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.
3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.

2.3 INSTALLATION MATERIALS

A. Adhesive: Product recommended by quartz agglomerate manufacturer.

1. Verify adhesives have a VOC content of 70 g/L or less.

B. Sealant for Countertops: Comply with applicable requirements in Section 07 9200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet, 1/4 inch maximum. Do not exceed 1/64-inch difference between planes of adjacent units.

B. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.

C. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

D. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.

E. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.

F. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.

G. Apply sealant to gaps at walls; comply with Section 07 9200 "Joint Sealants."

END OF SECTION 12 3661.19

SECTION 12 4813

ENTRANCE FLOOR MATS AND FRAMES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.3 SUMMARY

A. Section Includes:

1. Resilient-tile entrance mats.

1.4 COORDINATION

A. Coordinate size and location of recesses in concrete to receive floor mats and frames.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for floor mats and frames.

B. Samples: For the following products, in manufacturer's standard sizes:

1. Floor Mat: Assembled sections of floor mat.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: For floor mats and frames to include in maintenance manuals.

PART 2 - PRODUCTS

2.1 ENTRANCE FLOOR MATS AND FRAMES, GENERAL

A. Accessibility Standard: Comply with applicable provisions in the DOJ's "2010 ADA Standards for Accessible Design" and ICC A117.1 .

B. Testing Requirements:

1. Pill Test CPSC FF 1 70: Pass
2. Radiant Panel ASTM E648: Class I
3. NBS smoke ASTM E662 NF: <450
4. Static AATCC 134: <3.5 kv
5. Coefficient of Friction: 0.6 (Meets ADA requirements)

2.2 MANUFACTURERS

A. Subject to compliance with requirements, provide products by listed manufacturer or from one of the following:

1. Patcraft.
2. Mannington Commercial.
3. Mohawk.
4. Shaw Contract.
5. Interface
6. Tarkett
7. Or equal as approved by the Professional.

2.3 RESILIENT-TILE ENTRANCE MATS

A. Resilient-Tile Entrance Mat (WOM-1)

1. Basis-of-Design Manufacturer: Patcraft
2. Style: Navigate It I0659
3. Color: To be selected by Architect from manufacturer’s full range
4. Construction: Pattern loop
5. Fiber: Post-industrial recycled nylon
6. Dye Methold: 100% solution dyed
7. Size: 18” x 36”
8. Gauge: 1/12 inches
9. Stitches: 9 per inch
10. Finished Pile Thickness: 0.111 inches
11. Total Thickness: 0.26 inches
12. Average Density: 8432 oz/yd³
13. Tufted Yarn Weight: 26 oz/yd²
14. Primary Backing: Non-woven synthetic
15. Secondary Backing: Equivalent to Patcraft “Ecoworx Tile”

B.

2.4 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete fill and grout equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.5 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install surface-type units to comply with manufacturer's written instructions; coordinate with entrance locations and traffic patterns.

3.3 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION 12 4813

SECTION 210000

FIRE SUPPRESSION SCOPE

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION OF WORK

A. The work to be performed under these Specifications shall include providing all labor, materials, and equipment necessary to furnish and install, complete, properly, and fully all fire suppression work as shown on the Drawings or herein specified. It is the intent of these Specifications that a complete operating system be installed; the .3 Contractor shall carefully examine the site, drawings, and Specifications, and shall include all items necessary to accomplish this purpose. The work, in general, shall include, but shall not be limited to the following:

1. Provide wet sprinkler fire suppression systems for areas of the building as indicated, including, but not limited to:
    a. Double check detector valve assembly.
    b. Riser check valve assembly.
    c. Fire Department inlet connection.
    d. Control valves with monitor (tamper) switches.
    e. Flow switches.
    f. Sprinklers and related piping and equipment.
    g. Wet system main line air vent.
2. Testing, adjusting and balancing all fire suppression piping and equipment.
3. All control and interlock wiring shall be by the .3 Contractor as specified herein, except as otherwise specified or noted on drawings.

1.03 WORK BY OTHER TRADES

A. Cutting, patching, painting, electrical, plumbing, fire suppression, etc., shall be done by the affected trade at this Contractor’s expense for changes required in work already installed or work required by other trades for changes made by this Contractor in type or size of equipment purchased.

1.04 WORK NOT INCLUDED

A. The following construction and equipment related to the work under this Contract will be provided by others:

1. Openings in exterior walls. (.1 Contractor)
2. Furring around piping. (.1 Contractor)
3. Final painting of interior surfaces. (.1 Contractor)
4. Recesses and openings in construction for fire protection piping and equipment. (.1 Contractor).
5. Chases for piping where specifically shown on the Drawings. (.1 Contractor)

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 210100

BASIC FIRE SUPPRESSION MATERIALS AND METHODS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 FIRE SUPPRESSION WORK

A. These Specifications are issued to cover all work in connection with the complete installation of the fire suppression work. Fire suppression work is hereby defined to include work as herein specified and as shown on the Drawings issued in connection with this project. All fire suppression work shall be completed by a licensed, certified Fire Suppression Contractor. Any reference or letting of work to subcontractors or manufacturers in these Specifications does not relieve the .3 Contractor of his responsibility for the work, materials, and equipment under this Contract. The .3 Contractor is responsible for the work and performance of his subcontractors.

B. The word "building" used throughout these Specifications shall be interpreted to mean the entire Building Complex.

C. The actual runs and locations of all piping, equipment, and materials shall be determined at the site and shall be installed to meet the various conditions at the building. It is, however, the .3 Contractor's responsibility to predetermine the exact locations of piping and equipment, and to notify the other contractors accordingly and prior to any installation to avoid confliction with other piping and equipment. Any changes necessary to conceal pipes or clear pipes and equipment of other trades shall be made without additional expense to the Client Agency.

D. All work shall be executed, and all equipment constructed and installed in accordance with the requirements of the Pennsylvania Uniform Construction Code, the Pennsylvania Department of Health, the Pennsylvania Department of Labor and Industry, OSHA, all referenced National Fire Suppression Association Standards contained therein, and all applicable federal, state, county and local ordinances and regulations. Nothing contained in these Specifications or shown on the Drawings shall be construed to conflict with the aforesaid codes, ordinances, or regulations. Certificates of approval shall be obtained from any department issuing same and shall be turned over to the Client Agency at the completion of the work. All fees and permits required shall be satisfied and obtained by the .3 Contractor and the cost shall be included in the Contract price.

E. The .3 Contractor shall carefully examine the general building drawings, all electrical drawings, and carry on his work so as not to delay or interfere with the work of other trades. The .3 Contractor shall obtain in writing from the other contractors such data as is necessary to coordinate his work with other branches. This coordination must take place prior to any piping or equipment installation. As the work in the building nears completion, all threading, cutting, and similar work shall be done where directed by the Professional. Upon completion of the work, all remaining waste materials and rubbish resulting from the Contract work shall be removed from the building and premises.

F. Where the phrase "or approved equivalent," "or equivalent," or "approved" appears in these Specifications, it shall refer to the approval of the Professional/Engineer on the material or equipment involved. Substitutions of non-named suppliers after bidding shall be summarily rejected.

G. The term "Provide" means to furnish and install. The term "Furnish", used separately, means to obtain and deliver on the job for installation by other trades.

H. The .3 Contractor will provide chases and openings in walls, floors, ceilings, and partitions of new construction to receive piping, risers, and other equipment insofar as it is possible to predetermine the exact location, but the .3 Contractor shall install his work sufficiently in advance of the building construction to permit his work to be built into place.

I. The .3 Contractor shall furnish and place all sleeves required for pipes passing through floors, walls and ceilings before such general construction work is built into place. The .3 Contractor shall place all inserts required for hangers and supports, as the construction work progresses, so that unnecessary cutting of construction work will be eliminated.

J. Equipment and materials of similar types shall be of the same manufacturer unless specifically indicated otherwise on the Drawings or herein specified. The .3 Contractor shall make final connections between all equipment furnished under this Contract and equipment furnished under other contracts, except as otherwise specified herein.

K. The materials used throughout shall be those of reputable manufacturers and shall be the best of their respective kinds. All equipment, components and materials shall be installed in a neat and workmanlike manner in accordance with best trade practices, manufacturer's recommendations, and applicable codes and standards and by persons skilled in each particular branch of the work assigned to them. All work shall be installed subject to the approval of the Professional.

L. All piping work shall be installed plumb, level, and square per code requirements. All piping shall be run in straight horizontal or vertical sections and shall be under inspection during installation. Any piping, fittings, hangers, and/or systems deemed unacceptable per inspection during installation shall be repaired, replaced, and corrected with no additional cost to the project.

M. A complete list of materials proposed for each installation shall be submitted to the Professional for approval before delivery to the site. The .3 Contractor shall submit samples of materials for approval at the site as requested by the Professional. Such materials may be incorporated into the structures after serving their purpose as samples.

N. Where the .3 Contractor elects to substitute approved materials or equipment for materials or equipment specified, the .3 Contractor will be held responsible for all electrical changes required for their installation at no additional cost to the Client Agency. If additional engineering design is required, the .3 Contractor shall reimburse the design engineer all costs.

O. The .3 Contractor shall be entirely responsible for all apparatus, equipment and appurtenances furnished by him or his Subcontractors in connection with the work, and special care shall be taken to protect all parts thereof in such manner as may be necessary or as may be directed. Protection shall include covers, crating, sheds, or other means to prevent dirt, grit, plaster, or other foreign substances from entering the working parts of machinery or equipment. Special care shall be taken to keep all open ends of pipes, etc., closed while in storage and during installation. Where equipment must be stored outside the building, it shall be totally covered and secured with heavy waterproof tarps and kept dry at all times. Where equipment has been subjected to moisture, it shall be suitably dried out before placed in service. Rusted piping, interior or exterior of piping, will not be permitted for installation. Equipment with rusted finishes will not be permitted before or after installation. Materials and equipment shall be stored in areas designated by the Professional.

P. The .3 Contractor or his subcontractors will not be permitted to use corridors as storage areas for their piping, materials, or equipment. Piping, materials, and equipment shall be stored in areas as coordinated with the Professional.

Q. Elevations and locations shown on the Drawings are approximately correct; however, the .3 Contractor shall field check and otherwise verify all such data at the site before proceeding with the work. The .3 Contractor shall make necessary survey equipment available at all times and shall make use of such equipment wherever necessary to properly install his piping or equipment.

R. All work shown on the Drawings and not specifically included in the Specifications shall be considered a part of the Contract work. All work included in the Specifications and not specifically included on the Drawings shall also be considered a part of the Contract work.

S. Carefully examine all Drawings and Specifications included under this Contract and Drawings and Specifications included under other contracts and report any discrepancies noticed to the Professional.

T. Due to the small scale of the Drawings, it is not possible to indicate all offsets, fittings, valves, access panels, adapters, and similar parts which may be required. The Drawings are diagrammatic generally indicative of the work to be installed. The .3 Contractor shall carefully investigate the structural and finish conditions affecting the work and arrange all work accordingly, furnishing necessary parts and equipment as may be required to meet the various conditions.

U. The .3 Contractor shall layout his work from dimensions of Architectural and Structural Drawings and actual dimensions of equipment being installed. Layouts in congested areas should not be scaled from Fire Suppression and Electrical Drawings. Clearances shall be provided on all sides of equipment as required for proper maintenance purposes and as required by the Pennsylvania Department of Labor and Industry.

V. The .3 Contractor shall furnish the services of manufacturers' representatives for all equipment furnished under these Contract Documents. The amount of factory service provided by the .3 Contractor shall be as normally recommended and furnished by the various equipment manufacturers unless specified otherwise. Testing of such systems and equipment shall be made under the direct supervision of competent authorized service representatives. Any and all expenses incurred by the equipment manufacturers' representatives shall be borne by the .3 Contractor.

W. All equipment and materials shall be manufactured in accordance with national standards established by manufacturer's associations, engineering and testing societies, such as NBMA, NEMA, ASTM, AMCA, ASME, ANSI, ACI, FM, U.L., where such standards have been established. The standards shall be construed to mean their correct specifications and designations as amended, as of the date of bid opening.

X. When the installation is reported in writing by the .3 Contractor to be complete and ready for acceptance, tests and inspection shall be made by the .3 Contractor in the presence of the Professional to ascertain whether it complies with the Specifications and Contract, and upon its failure to do so, the .3 Contractor shall at once remedy all defects and shortcomings and any additional tests that may be required shall be entirely at the .3 Contractor's expense. All of the testing work shall be done when and as directed by the Professional before the system is accepted.

Y. Where the building insulation or vapor barrier is broken due to the installation of piping and equipment, the .3 Contractor shall properly repair all insulation and seal all openings with vapor barrier covering and vapor barrier adhesive, of types installed with the insulation.

Z. The Professional reserves the right to revise locations of piping and equipment within the building, as long as sizes remain the same. The .3 Contractor should include suitable allowance in his bid price for the above.

AA. In all cases where equipment and materials are specified in the singular or plural number, it is intended that such reference shall apply to as many such items as are required to complete the installation.

BB. Where piping or other equipment passes through fire or smoke barrier stops, walls, floors, or ceilings, the .3 Contractor shall furnish and install sleeves and shall thoroughly seal openings around sleeves, pipes, and equipment with fire and smoke resistant materials. Materials shall be furnished by the .3 Contractor as required to maintain the fire rating of the walls, partitions, ceilings and floors in accordance with the requirements of NFPA, the Pennsylvania Department of Labor and Industry, and other applicable codes.

CC. All moving parts of equipment and appurtenances installed shall be properly lubricated by the .3 Contractor.

DD. The .3 Contractor will be responsible for the completion of all work included under this Contract and shall employ skilled and qualified tradespeople as necessary to satisfy all work and trades.

EE. All capped or plugged connections shall be suitable for permanent, gastight installations.

1.03 CODE COMPLIANCE

A. All fire suppression work, and materials shall comply with all applicable codes. Energy conservation shall be provided for plumbing systems as described in The International Energy Conservation Code.

1.04 ROUGH-IN

A. The .3 Contractor shall verify roughing-in dimensions for all equipment prior to roughing-in for such equipment.

1.05 SHOP DRAWINGS

A. Shop drawing submittals shall not be regarded as installation manuals. It is the responsibility of the .3 Contractor to obtain installation recommendations from the manufacturer of each item of the equipment.

B. The .3 Contractor shall submit prints of shop drawings and manufacturers' data for approval in the manner prescribed. Refer to this section for "Required Submittals."

1.06 RESPONSIBILITIES OF BIDDERS

A. Before ordering any material or doing any work, this .3 Contractor shall verify all measurements at the site and shall be responsible for the correctness of same. Any differences encountered between the site measurements and those shown on the Drawings shall be submitted to the Professional for consideration before proceeding with the work.

B. This .3 Contractor is assumed to be skilled in the trade and is solely responsible for compliance with health and safety regulations, performing the work in a safe and competent manner, and installation procedures required for the work as outlined in these documents.

C. This Contract is all-inclusive of the work indicated on the Drawings and herein specified, and no separate Contract work, supplementary labor or service will be provided by the Client Agency, except as otherwise noted on the Drawings or herein specified.

D. If any part of the installation specified or shown on the Drawings to be executed under this Contract requires a trade or classification of mechanics other than is normally directly employed by the .3 Contractor, it shall be expressly understood that the .3 Contractor shall sublet or engage mechanics experienced in each explicit trade involved to execute the work for the .3 Contractor.

1.07 SCAFFOLDING AND RIGGING

A. The .3 Contractor shall provide all the scaffolding required to do the work included in this Contract. All necessary precautions must be taken in high risk areas. Provide temporary rigging, as required, to install work.

1.08 DRAWINGS

A. The drawings are intended to be diagrammatic and are based on one (1) manufacturer's equipment. They are not intended to show every item in its exact location, the exact dimensions, or all the details of the equipment. The .3 Contractor shall verify the actual dimensions of any substituted materials and equipment to ensure that they will fit in the available space. All apparatus shall be located, and all pipes run in the manner and locations shown thereon as closely as conditions will permit, and deviations therefrom shall be made only with the consent of the Professional, and without additional charge to the Client Agency.

1.09 TEN-DAY PRIOR APPROVAL

A. Any equipment or components proposed for this project, other than model numbers named in the bid documents, shall have pertinent submittal data and descriptive cover sheet submitted to the DGS ten (10) days prior to the bid date for inclusion in an addendum, if and when, reviewed and accepted for bidding.

B. This is for pre-bid review and is not to be regarded as submittals required for construction.

C. Bidder shall base the bid on items of equipment actually named in bid documents or addendums issued prior to bidding. Verbal acceptance will not be recognized unless verified in writing. It is the Bidders' responsibility to ascertain that all equipment has been accepted by requiring copies of the Professional's written acceptance from the Equipment Suppliers.

1.10 STANDARD OF QUALITY

A. All material shall be strictly in accordance with the quality, style and size as specified herein. Manufacturers' names and model numbers are given in the Specifications for the purpose of establishing a standard of quality, style, size, and type, and shall not be construed to exclude equipment or material of other manufacturers.

B. When the .3 Contractor elects to substitute materials or equipment other than that specified, the .3 Contractor will be held responsible for all electrical changes required for the installation of substituted materials or equipment at no additional cost to the Client Agency. All changes shall be subject to electrical and Professional's complete approvals.

C. When the .3 Contractor desires to furnish equipment of another manufacturer, the .3 Contractor shall include a complete Specification of the substituted item with each submission copy of shop drawings indicating the necessary modifications to his standard product to satisfy the requirements of the Contract Specifications.

D. Final approval of competitive equipment is reserved by the Professional, when in their opinion, the equipment does not correspond to that specified.

1.11 WARRANTIES

A. The .3 Contractor shall warrant that the materials and workmanship used in the erection of this installation are as herein specified, and he shall provide all labor and materials required to make good any defects in same which become apparent within one (1) year from date of acceptance of beneficial, permanent use of completed work in writing, providing such defects are due to faulty materials or workmanship and not to misuse of apparatus by the Client Agency, its employees, or tenants. Certain equipment shall be warranted or guaranteed for longer than one (1) year from date of final acceptance where specifically mentioned in these specifications. This warranty shall be in writing and shall include written copies of factory warranties and expiration dates on items of equipment where the warranty date might differ from the acceptance date. No warranty shall start before the acceptance date. The acceptance will be for complete sections. No partial acceptance will be approved.

B. The equipment and materials manufacturers are expected to recognize that they are responsible for the failure of their products to perform in accordance with data furnished by them or their authorized representatives as well as misrepresentations of such data. When the products have been installed in accordance with the manufacturer's published or written instructions and recommendations and such products fail, then the .3 Contractor and the manufacturers are responsible for replacement of the products and all associated work and materials without additional cost to the Client Agency. This warranty applies to all items supplied on the equipment and not just those that are the product of the manufacturer.

C. The .3 Contractors' warranty shall include at least two (2) inspections of the system to repair and replace any items found to be defective during this period. The first shall be approximately six (6) months after the acceptance of the system and the second at the end of the first year.

1.12 REQUIRED SUBMITTALS

A. Shop drawing submittals shall be clearly marked to show the intended item with identification as to unit number or other marking to show location, service, and function. Submittals not marked to identify the equipment and application will be rejected.

B. Prior acceptance of equipment, per the shop drawing procedure as specified in these documents, is required before installing equipment. Any equipment installed without prior acceptance shall be subject to rejection, whether specified or not. All costs for the removal of rejected equipment and materials, and all costs for the replacement of such equipment and materials with approved equipment and materials shall be incurred by the .3 Contractor without additional expense to the Client Agency.

C. The Equipment Supplier, by submitting, certifies that the materials or equipment proposed is satisfactory for the application intended, including adverse conditions that may prevail at the job site, and that the materials and equipment are in current production with no known plans to cease production.

D. The .3 Contractor agrees that submittals processed by the Professional are not change orders; that the purpose of submittals by the .3 Contractor is to demonstrate to the Professional that the .3 Contractor understands the design concept; and that this understanding is demonstrated by indicating which equipment and materials the .3 Contractor intends to furnish and install and the fabrication and installation method that the .3 Contractor intends to use.

E. The .3 Contractor further agrees that if deviations, discrepancies or conflicts between submittals, and Contract documents are discovered either prior to or after submittals are processed by the Professional; the Contract documents shall control and shall be followed.

F. At the close of the job, prior to final review, five (5) bound indexed copies with hard back binders of the following for each system and associated equipment shall be submitted by transmittal to the Professional for review and acceptance. All brochures and formats must be approved by the Professional.

   1. Approved cut sheets for all installed job specific equipment, such as alarm check valve, double detector check valve, alarm bell, all types of sprinkler heads, water flow indicators, monitor switches, Fire department connection, piping specialties, and other items. Generic type cut sheets will be rejected without review and must be resubmitted for approval.
   2. Manufacturers' names, addresses, and telephone numbers of each installed job specific equipment. Also included shall be the manufacturers' representatives' names, addresses, and telephone numbers.
   3. Fully completed test reports as required by job conditions and specifications.
   4. Equipment warranties.
   5. .3 Contractors' warranties.
   6. Parts lists and operating and maintenance manuals for all equipment; not generic but for each specific piece of equipment installed.
   7. Operating instructions (in writing).
   8. Written instructions on operating, preventative, routine, and breakdown maintenance, and care of the systems.
   9. Lubrication and recommended spare parts.

G. The .3 Contractor shall obtain two copies of a signed receipt from the Client Agency for the written instructions, equipment brochures, cut sheets, operating and maintenance manuals, manufacturers' and representatives' data, warranties, and test reports. One (1) copy of the receipt shall be delivered to the Professional, one (1) copy to the Client Agency, and one (1) copy shall be retained by the .3 Contractor.

H. The Professional shall submit deferred submissions of Fire Suppression Systems plans and calculations to the Department of Labor and Industry once shop drawings are submitted and reviewed by the Professional. The submission to the Department of Labor and Industry must occur at least two weeks prior to installation. A statement signed by the Design Professional in Responsible Charge must be included with plans for either of these systems. The statement should indicate that the design professional has reviewed the shop drawings and found them to be in general conformance with the design of the building.

I. Submit shop drawings and manufacturer's data for the following items in accordance with the Contract Documents. Additional items may be required at the Professional's discretion.

1. Hangers, supports, inserts and pipe sleeves.
2. Valves, pressure gauges, and mechanical pipe couplings.
3. Location and size of sleeves for openings in floors and walls; escutcheons.
4. Valve tags and lists and stenciling materials.
5. Access panels.
6. Identification labels.
7. Fireproofing materials.
8. Paint.
9. Piping.
10. Fire Department inlet connection.
11. Double detector check valve assembly.
12. Alarm check valve.
13. Electric alarm bell.
14. Monitor (tamper) switches.
15. Flow switches.
16. Sprinkler heads of all types and other miscellaneous equipment.

1.13 UTILITIES AND PROTECTION OF SERVICES

A. Do not interrupt any utility or service without adequate previous notice and schedule.

B. The .3 Contractor shall, at his own expense, repair, replace and maintain in service any utilities, facilities or services (underground, aboveground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction. The material used by the .3 Contractor shall be approved by the Professional.

1.14 RECORD (AS-BUILT) DRAWINGS

A. The .3 Contractor shall maintain a complete set of blue-line prints at the site and shall record all deviations in his work (in red) from that indicated on the Contract Drawings. Dimensions must be recorded using permanent reference points such as columns, building walls and like items. These record drawings must be turned over to the Client Agency prior to final acceptance.

1.15 INSTRUCTIONS TO CLIENT AGENCY'S OPERATING PERSONNEL

A. The .3 Contractor and his subcontractors shall satisfactorily complete the systems so that they are functional and operating to the satisfaction of the Professional. All systems, their controls and their sequencing must be demonstrated to the satisfaction of the Professional.

B. The .3 Contractor shall furnish the services of qualified personnel, approved by the Professional and thoroughly familiar with the completed installation, to instruct the Client Agency's permanent operating personnel in the proper operation of all systems included under this Contract and the proper care of all equipment and apparatus. These services shall be furnished for a period of two (2) 8- hour days after the operation of the building has been taken over by the Client Agency.

C. When instructions are provided under this Contract, the .3 Contractor shall have in his possession three copies of an identifying letter which shall list the names of the .3 Contractor's qualified instruction personnel, including manufacturer's representatives and subcontractors that will be giving instructions. Likewise, on the same letter, spaces shall be provided for the Client Agency's personnel who will receive the instructions. After instructions have been given and received for each system, the .3 Contractor's representatives and subcontractors shall sign and date the letter, and the Client Agency's personnel shall sign and date the letter acknowledging that they have received adequate instructions for operating and maintaining the systems and equipment. One (1) signed copy shall be delivered to the Client Agency, one (1) copy to the Professional, and one (1) copy shall be retained by the .3 Contractor.

D. It is the intent that the entire systems with their complement of equipment and auxiliary equipment operate properly in accordance with the design concept and functional intent. It is also the intent that the Client Agency be given complete instructions for the proper operation and maintenance of all systems.

PART 2 – PRODUCTS

2.01 GENERAL

A. All products shall be first-line quality, of grade and type shown on the Drawings, and specified or equivalents accepted by the Professional in writing.

B. All products shall be in current production with no notice having been given that this product is to be drastically changed, modified or discontinued from production.

C. The Supplier, by submitting, certifies that the equipment being proposed is proper for the application intended and that it has the capacity called for on the Drawings or in the Specifications.

2.02 COMPLETE SYSTEM

A. All products, materials, and accessories shall be furnished, and installed as required, for a complete system ready for the Client Agency's beneficial use.

2.03 EQUIPMENT AND MATERIALS DEVIATIONS

A. When any material or equipment is identified on the drawings or in the Specifications by reference to a manufacturer's name or model number; it is intended to establish a required standard of design and quality; and it is not intended to limit competition.

B. When the Drawings and/or Specifications indicate one or more manufacturers' names for materials or equipment, the Bidder may submit a bid based on materials or equipment of manufacturers not named but considered by the Bidder to be equivalent to the standard of design and quality specified; however, such substitutions must be accepted by the Professional as equivalent. If the Bidder elects to bid on a substitution without securing written consent of the Professional prior to receipt of the bids, then it will be understood that proof of compliance with the specified requirements is the direct responsibility of the Bidder, and no such materials or equipment may be purchased or installed without written acceptance.

C. Bidders are advised to ascertain such acceptance from their Suppliers by requesting copies of acceptance in writing signed by the Professional from their Suppliers.

D. Where the equipment's electrical characteristics (i.e. horsepower, wattage, voltage, amperage draw, etc.) deviate from the fire protection and/or the electrical design, it is the responsibility of the .3 Contractor to strictly coordinate all electrical requirements prior to submittal, to meet the specific electrical requirements without a change order. Confirmation of coordination shall be included with the appropriate submittal. No change orders shall be awarded due to lack of coordination between trades.

2.04 ELECTRICAL WORK FOR FIRE SUPPRESSION EQUIPMENT

A. Electrical characteristics shall be determined from the Drawings and verified on the job.

1. All power wiring by .4 Contractor; all control wiring by .3 Contractor, except as herein specified; refer to “Control Wiring”, this section. All power wiring and connections for all motors, including starters, controllers, and breakers will be furnished and installed under the .4l Contract.
2. In general, rigid conduit or tubing for control wiring shall be used, but equipment that requires movement or that would transmit vibration to conduit shall be wired with flexible (liquid tight) steel conduit, not over eighteen (18") inches long.
3. All equipment with control wiring shall be grounded with a green-covered ground wire run inside the conduit and connected to the equipment frame on one (1) end and to grounding system on the other end.
4. All electrical work required in the Contract shall conform to all applicable requirements of Division 26 of these Specifications.
5. The .3 Contractor shall employ an approved, licensed Electrical Subcontractor, fully qualified in the trade, to perform all electrical control work required under the Contract.
6. This .3 Contractor shall not run piping above motors, switchboards, or panelboards in accordance with the National Electrical Code, unless specifically indicated on the drawings to serve that area with fire suppression. Before piping is installed, coordinate exact locations with the .4 Contractor. Failure to comply with this requirement shall be cause for the piping to be removed and relocated at no additional cost to the Client Agency.

2.05 CONTROL WIRING

A. Furnish and install control wiring as indicated on the drawings or as specified in various portions of the specifications. All control wiring is the responsibility of the .3 Contractor, who provides the particular equipment, except as herein specified.
   1. The .4 Contractor will extend control wiring from fire suppression monitor (tamper) switches and flow indicators to the fire alarm system.
   2. The .4 Contractor will extend control wiring from the fire alarm panel to the electric alarm bell.

B. Control wiring, in general, shall mean “low voltage” wiring, such as 24 volt, 12 volt, and 6 volt wiring, and shall include the providing of all required motor controls, relays, pilot devices, all related raceway systems, all related conductors, and all final electrical connections other than three phase power connections.

C. For 120V or 277V line voltage equipment provided under the Fire Suppression Contract, the .4 Contractor will provide single phase feeders and make final connections.

D. All control wiring shall be extended in conduit. Use "plenum wire" without conduit where runs are in conditioned spaces such as relief, air conditioned, or return plenums.

E. Control wiring shall be run in conduit and shall be copper conductors provided with Type THHN or dual rated THHN-THWN insulation and protective covering, not less than No. 12 AWG, run in accordance with the National Electrical Code; and in general, conforming to Division 21 specifications for this project.

F. Conduit above ground for control wiring shall be rigid steel conduit or electrical metallic tubing, run in accordance with the National Electrical Code; and in general, conforming to Division 21 specifications for this project.

G. Conduit below ground or below slab for control wiring shall be Schedule 40 PVC, UL rated for 90 degrees C., run in accordance with the National Electrical Code; and, in general, conforming to Division 21 specifications for this project.

2.06 TAMPERPROOF SCREWS

A. All screws exposed on fire suppression equipment installed under this Contract, such as on wall access panels and similar equipment, shall be tamperproof type. Screws shall be vandalproof slot type, Holt head, Allen head, or similar types. Phillips head screws are not regarded as tamperproof.

B. Finish of screws shall match the finish of equipment in which they are being installed.

2.07 ACCESS PANELS

A. The .3 Contractor shall furnish factory-fabricated access panels for access to all concealed valves, flow switches, tamper switches, and other fire suppression items where no other means of access is available. Access panels shall be of appropriate size but not less than 18", flush type, hinged to drop down and out, concealed hinge and vandalproof operated spanner head cam lock, stainless steel in tile work and prime coated sheet steel in plaster or acoustical tile of all types. The .3 Contractor shall install access panels where required. Exact locations and sizes of panels shall be determined by the .3 Contractor, but panels shall be located for a symmetrical appearance. Access panels are not required at lift-out removable tile ceilings.

B. At locations where access panels are installed in fire-rated construction, access panels shall contain the 1-1/2 hour fire-rated "B" label; and in addition, shall also be provided with layers of gypsum wall board in thicknesses which will supply additional fire ratings equal to the fire ratings of adjacent construction.

C. Access panels shall be Cierra Products, Acudor, or Zurn.

2.08 SLEEVES AND ESCUTCHEONS

A. The .3 Contractor shall provide sleeves for all piping and equipment passing through walls, floors and foundations. Sleeves, in general, shall be constructed of Schedule 40 steel pipe. Space between pipe and sleeve shall be sealed with a fire stopping material. Sleeves are not required for core- drilled holes; however, openings shall be filled with firestopping.

B. Where pipe motion, due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe.

C. Sleeve installations in exterior and designated interior walls, foundations and slab on grade floors shall consist of steel sleeves with the annular space between the carrier pipe and sleeve continuously filled with modular, mechanical type, inter-locking synthetic rubber links. Sleeves shall be Model WS and links, Model LS, all as manufactured by LINK-SEAL Division, Thunderline Corporation, or Advance Products & Systems, Inc.

D. Sleeves through fire rated construction shall be sealed as specified under the "Fire Stopping" section of this Specification.

E. Escutcheons, including floor, wall, and ceiling plates, shall be chrome, cast brass, setscrew type. Provide “deep type” escutcheons where required to conceal connections; use split ring backup escutcheons beneath deep escutcheons for extra depth where necessary.

2.09 FIRE STOPPING

A. Seal openings of fire rated construction with a material or product that has been tested at an independent testing laboratory, such as UL, FM, etc. Fire stopping shall conform to ASTM E-814 and UL 1479, or UL 2079 with fire ratings equal to or exceeding the fire rating of the construction involved (Refer to General Construction Documents). Fire stopping shall be UL classified. Fire stopping of this type shall also be utilized for openings through smoke/fire rated construction. Refer also to applicable International Building Code Standards.

B. If desired by the .3 Contractor and approved by local codes, the “Hydro Flame” pipe sleeving system will be acceptable, by Pre-sealed Systems, 3M, or Hilti. Penetration system shall be UL certified, a water/fire stop system, tested to ASTM E814. Flame Through/F-Rating: up to 3 hours. System shall be secure, waterproof, fire rated, smokeproof, protects against gases, prevents mold intrusion, and shall allow for pipe expansion and contraction.

C. If desired by the .3 Contractor and approved by local codes, the "Pro Set" water/fire stop piping penetration systems also may be utilized. Penetration systems shall be UL certified and shall be the "Pro Set" System A, System B, or System C, 3M, or Hilti.

D. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, release agents, water repellents, and any other substances that may affect proper adhesion.

E. Comply with manufacturer's recommendations for temperature and humidity conditions before, during, and after installation of firestopping

PART 3 – EXECUTION

3.01 WORKMANSHIP

A. All work shall be performed by competent mechanics using proper tools and equipment to produce first-quality work. All work shall be neatly installed, accessible for maintenance, and complete with all accessories required.

3.02 ACCESSIBILITY

A. All equipment shall be installed in such away that all components requiring access (tamper switches, flow switches, valves, etc.) are so located and installed that they may be serviced, reset, replaced or recalibrated, etc. by service people with normal service tools and equipment. If any equipment or components are shown in such a position that this .3 Contractor cannot comply with the above, the .3 Contractor shall notify the Professional.

3.03 FOUNDATIONS AND SPECIAL SUPPORTS

A. For concrete bases for equipment included under this Contract, the .3 Contractor shall establish sizes and locations of the various bolts, together with the templates for holding these bolts in position. Anchor bolts shall be placed in steel pipe sleeves to allow for adjustment, with suitable plate at bottom end of sleeve to hold the bolt. Each piece of equipment designated to have a base shall have a concrete base of not less than four (4") inches high, which shall project four (4") inches on all sides beyond the equipment. Bases shall have greater depths of height where so noted on the drawings. Refer to "Concrete Work".

3.04 RECORD (AS-BUILT) DRAWINGS

A. The .3 Contractor shall maintain a complete set of Contract Drawings at the site and shall record all deviations in his work **(in red ink or pencil**) from that indicated on the Contract Drawings. Deviations shall be clearly and accurately recorded so that the Engineer can prepare final record (as-built) drawings using the .3 Contractor's marked-up drawings. Dimensions shall be recorded using permanent reference points such as columns, building walls and like items. These record drawings shall be submitted to the Architect prior to final acceptance.

3.05 CODES, STANDARDS, AND REGULATIONS

A. All materials and workmanship shall comply with all applicable codes, federal and state laws, Specifications, local and county codes and ordinances, industry standards, utility company regulations, NFPA, and NEC. In case of a difference between codes, Specifications, federal and state laws, local and county codes and ordinances, industry standards, utility company regulations, NFPA, and NEC, and the Contract documents, the most stringent shall govern. The .3 Contractor shall promptly notify the Professional in writing of any such difference.

B. Reference to the following codes shall mean:

REFERENCE	DEFINITION
ASTM	American Society for Testing Materials
NFPA	National Fire Protection Association
UL	Underwriters Laboratories, Inc.
NEMA	National Electric Manufacturers Association
ANSI	American National Standards Institute
IBC	International Building Code

IPC	International Plumbing Code
NEC	National Electrical Code

C. Should the .3 Contractor perform any work that does not comply within the requirements of the applicable building codes, state laws and federal laws, local and county codes and ordinances, industry standards, utility company regulations, NFPA, and NEC, the .3 Contractor shall bear all costs arising in correcting the deficiencies.

D. This .3 Contractor is assumed to be skilled in the trade and is solely responsible for compliance with OSHA regulations, performing the work in a safe and competent manner, and in installation procedures required for this work. All supervision assigned to this project shall be experienced in this type of work. The .3 Contractor's superintendent shall be designated as Safety Inspector, unless the .3 Contractor designates another person and notifies the Professional of this change.

3.06 PERMITS, FEES, TESTS AND INSPECTIONS

A. The .3 Contractor shall give all requisite notices, obtain and pay all deposits, permits, and fees, necessary for the installation, tests, and inspections of all work provided under this Specification, and included under this Contract. All tests shall be conducted in the presence of the Professional.

3.07 REVIEW BY PROFESSIONAL

A. The .3 Contractor shall notify the Professional at the following stages of construction so that the Professional may visit the site for review and consultation:

1. When equipment installation starts.
2. When ceiling installation will cover any work not reviewed.
3. When any piping is to be permanently concealed by construction.
4. When testing is started.

B. Should the .3 Contractor fail to notify the Professional at the times prescribed above, it shall then be the .3 Contractor's responsibility and cost to expose any concealed lines or demonstrate the acceptability of any part of the system. Any extra cost, caused by the removal of work by other trades, shall be borne by this Contractor, at no cost to the Client Agency.

3.08 EARLY START-UP

A. This .3 Contractor shall do all possible to see that the fire suppression equipment is connected with electrical power as early as possible, so that final testing can be started. Should this .3 Contractor be ready for operation and power is not available, the .4 Contractor and the Professional shall be notified.

3.09 CLEANING AND PAINTING

A. Periodically remove from the building site all rubbish and accumulated materials.

B. At the completion of the project, thoroughly clean all equipment and remove all trash, cartons, and similar debris from the area. Make any necessary corrections or repair/replace any damaged materials or equipment. Leave the entire systems in a thoroughly clean and orderly manner.

C. Where welding of pipe destroys factory pipe coating, piping shall be repainted. Any finished surfaces that have been scratched or discolored shall be touched up or repainted with paint to match the original color, to the satisfaction of the Professional. If any part has been bent, broken or otherwise damaged, it shall be replaced new prior to final review.

D. The following items of equipment and piping being furnished under this Contract shall be prime coated and finish painted by the .3 Contractor. Painting shall be in strict accordance with the requirements and recommendations of OSHA.

1. All equipment and piping installed outside the building exposed to weather. Colors shall be as selected by the Professional.

2. All non-galvanized and unpainted support steel, brackets, hangers, and other miscellaneous metals, including above ceilings, loft spaces, pipe shafts, mezzanine spaces, and accessible pipe spaces.
3. All piping in Mechanical Equipment Room.

E. Surfaces required to be finished painted shall be painted as follows:
1. All piping shall be painted with one (1) coat of rust inhibitive red primer and one (1) coat of gloss enamel.
2. All other ferrous metals shall be painted with one (1) prime coat of equipment and machinery primer and one (1) finish coat of gloss enamel.
3. Coated black steel piping need not be painted above ceilings; however, rusted or scraped piping shall be touched up, to keep a like new finish.
4. All galvanized surfaces shall be painted with one (1) prime coat of galvanized steel primer and one (1) finish coat of gloss enamel. All aluminum surfaces shall be painted one (1) prime coat of aluminum primer and one (1) finish coat of gloss enamel. Paint shall be of types specifically made for these surfaces.
5. All other copper and brass surfaces shall be painted with one (1) prime coat of zinc chromate primer and one (1) finish coat of gloss enamel.

F. Color code fire suppression piping as specified. Paint exterior fire suppression devices, including exposed drains, of colors selected by the Professional.

G. Paint shall be of colors selected by the Professional.

H. Finish paint color samples shall be submitted to the Professional for approval.

I. Paint shall be as manufactured by PPG, Rust-Oleum, or Sherwin-Williams.

J. All painting shall be done in a careful, neat and workmanlike manner with particular care being exercised to protect building equipment and finishes. All surfaces shall be thoroughly cleaned of rust, scale, dirt, grease, dust, and like items, and sanded so as to provide bond for new paint. The .3 Contractor shall be entirely responsible for cleaning all surfaces and should evidence appear to the Professional that the surface was not properly prepared, the .3 Contractor shall remove paint, prepare surface and repaint as required at no additional cost.

K. The .3 Contractor shall be responsible for painting his piping and equipment installed in finished areas.

L. Refer to “Fire Suppression Identification”, Section 210553, for stenciling and labeling.

3.10 FINAL CONNECTIONS

A. All equipment noted as furnished and installed by other contractors or by the Client Agency, that requires fire suppression services, will be furnished and installed complete with trim by that party, except as herein specified. The .3 Contractor shall coordinate type and location of equipment, rough-in services noted or required, and make final connections. Provide required piping adapters.

3.11 MAINTENANCE

A. .3 Contractor shall be responsible for maintenance of all equipment and apparatus included under this Contract until final project completion.

3.12 FIRE SUPPRESSION PLANS

A. The fire suppression plans are intended to be diagrammatic and are based on one (1) manufacturer's equipment. They are not intended to show every item in its exact location, the exact dimensions, or all the details of the equipment. The .3 Contractor shall verify the actual dimensions of any specified or substituted materials and equipment to ensure that they will fit in the available space. All apparatus shall be located as closely as conditions will permit and deviations therefrom shall be made only with the consent of the Professional and without additional charge to the Client Agency. The right is reserved by the Professional to make any reasonable changes in the location of the equipment prior to rough-in without invoking additional expense to the Client Agency.

3.01 COORDINATION-CONTRACTORS

A. The .3 Contractor must arrange work to eliminate conflictions with work of other contractors.

B. Actual location of pipe and equipment shall be determined at site. .3 Contractor shall confer with other contractors as to locations of electrical and equipment provided under their contracts, before erecting any work. In case of confliction, the Professional shall have the final decision, with no cost to Client Agency.

C. .3 Contractor shall furnish .4 Contractor information on electrical requirements of equipment provided under Contract. Equipment connections shall be made in neat and workmanlike manner, placing equipment in proper operating condition, with provisions for maintenance or replacement. Equipment manufacturer's recommendations shall be followed for final connections.

3.14 FLASHINGS

A. The .3 Contractor shall provide wall and floor flashings as specified.

3.15 TESTS AND ADJUSTMENTS - GENERAL REQUIREMENTS

A. The .3 Contractor shall furnish all labor, material, and equipment necessary for performance of all tests required by any of the agencies having jurisdiction. Testing procedures shall be outlined hereinafter under the respective sections of these specifications.

B. All tests shall be conducted in the presence of the Professional. No piping shall be concealed until the system has been approved.

C. At the completion of the work, all equipment, valves, flow switches, tamper switches, sprinkler heads, and related components, etc., shall be adjusted for proper operation.

D. The .3 Contractor shall obtain certificates of approval, acceptance and compliance with regulations of all agencies having jurisdiction. Work shall not be deemed complete until such certificates have been delivered to the Professional.

E. Also, refer to Section 214000 "Fire Suppression Testing, Adjusting, Balancing".

3.16 CONCRETE WORK

A. Furnish and install all concrete work related to work included under this Contract. Construct concrete forms and bases for the equipment installed under this Contract. Bases and forms shall be of suitable dimensions for all equipment. All concrete work shall be constructed subject to the approval of the Professional.

B. For each piece of floor mounted equipment shown or specified to have a concrete base or pier built on the floor slab, the .3 Contractor shall install a floor slab of suitable size for the equipment to rest thereon. Each foundation shall extend 4" above the floor line (unless otherwise indicated on the Drawings) and shall extend a minimum of 4" on each side of the equipment. Conform with specific equipment manufacturer's recommendations for construction of bases and foundations in each instance.

C. Bases shall be reinforced with 6 x 6 x #10 gauge wire mesh unless detailed otherwise and anchored through floor construction with 3/4" diameter bolts or rods. Anchor bolts for equipment shall be placed in base before equipment is set.

D. Concrete shall attain a minimum compressive strength of 3,300 psi at the age of 28 days, unless otherwise specified or indicated on the Drawings. Tests shall be made by an approved laboratory if in the opinion of the Professional the concrete is not satisfactory. All costs in connection with tests of concrete shall be borne by the .3 Contractor.

E. All materials used for plain and reinforced concrete and the measuring, mixing, handling, placing and curing shall conform to current specifications of the American Concrete Institute (ACI 304 and ACI 318-71). Cement shall be normal Portland cement, Type I or Type II, conforming to ASTM Designation C-150.

F. Aggregates shall consist of sand of approved quality, crushed stone, and washed gravel conforming to ASTM Standard Specification Designation C-33 and shall be supplied from a source approved by the Professional. The maximum size of the aggregate shall be no larger than 1/5 of the narrowest dimensions between forms of the members for which the concrete is to be used, no larger than 3/4 of the minimum clear spacing between reinforcing bars. All water for concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

G. Slag in any form will not be permitted as an aggregate.

H. Proportions shall be in accordance with American Concrete Institute Standard "Recommended Practice for the Design of Concrete Mixes ACI 211.1."

I. Metal reinforcement shall be deformed steel bars, cold-drawn steel wire, or fabricated forms of these materials. All bars shall be deformed, intermediate grade new billet steel. These materials shall conform in quality to Standard Specifications of the American Society for Testing Materials of the following applicable titles and serial designations:

   Bars

   Billet-Steel Bars for Concrete Reinforcement ---------- A 615

   Rail-Steel Bars for Concrete Reinforcement ---------- A 616

   Wire

   Cold Drawn Steel Wire for Concrete Reinforcement ---------- A 82

   Fabricated Materials

   Fabricated Steel Bar Mats for Concrete Reinforcement ---------- A 184

   Welded Steel Wire Fabric for Concrete Reinforcement ---------- A 185

J. Forms shall be of steel or wood and shall conform to the shape, lines, grades and dimensions of the concrete. All formwork shall comply with ACI 347. They shall be sufficiently tight to prevent leakage of mortar and shall be properly braced and tied together so as to maintain the desired position and shape during and after placing concrete. Forms shall be removed in such a manner as to assure the complete safety of the structure. All exposed corners or edges shall be chamfered. All burrs, fins, irregularities of forming, or spillage shall be removed, and the surface float or trowel finished to a smooth straight surface.

K. Concrete shall be integrally waterproofed with Rez-Seal, by Euclid Chemical Company, or equal as approved by the Professional.

L. Water stops of plastic, as manufactured by Ryerson, or equal as approved by the Professional, shall be installed in all concrete joints and between pours.

3.17 MISCELLANEOUS IRON WORK

A. Furnish and install all miscellaneous iron work including, but not limited to, piping hangers, piping anchors, and all other equipment supports. All additional structural members shall be furnished and installed to support equipment without excessive stress or strain on the building construction. Structural beams and other structural members shall be furnished and installed under this Contract where the building steel is not available or capable of supporting or anchoring pipe lines and equipment.

B. All equipment and materials furnished and installed under this Contract which are not mounted on bases or floors shall be securely attached and supported from the main supporting structure of the building by metal hangers, clamps and/or brackets. Metal hangers, clamps and/or brackets shall be of suitable design and of sufficient strength to properly and safely support the materials and equipment involved. Lag screws and bolts shall be used where required at wood construction.

C. Materials - Structural steel members for the support of equipment installed under this Contract shall conform to ASTM Specifications A-36 and shall comply with the latest requirements of the American Institute of Steel Construction. Structural steel shall be of standard sections as given in the structural steel manufacturers' handbooks.

D. Priming - All steel and iron work shall be primed with Rust-Oleum red primer, Glidden, or PPG. Before priming, all metal shall be thoroughly cleaned free from scale, rust, and dirt.

E. Anchors - The .3 Contractor shall provide all anchors, bolts, screws, dowels, and connecting members and do all cutting and fitting necessary to secure the work to adjoining construction. Build in connecting members to masonry, concrete, and structural steel as the work progresses.

F. Supports and Brackets - Supports and brackets shall be neatly constructed of structural shapes to adequately support the equipment intended. All supports must be approved prior to installation. Field conditions will regulate the type of support.

3.18 COORDINATION DRAWINGS

A. Coordination

1. Each Contractor shall familiarize himself with the drawings and specifications of the other contracts relating to this project and shall coordinate with and be held responsible for his Work which is affected by or dependent on, other contracts.

2. Each Contractor shall provide any dimension, coordination, sleeve, insert, embedded or built-in item, and/or information which is required to be built into, or to complete, the work of another contract in a manner consistent with the Approved Project Schedule. Any additional cost or delay damages arising from a contractor’s failure to so furnish or provide shall be borne by that contractor.

B. Coordination meetings to resolve interferences in the Work will be held at the site in an area to be provided by the Professional. Representatives of each Contractor shall be present at each meeting. Each Contractor shall provide the necessary resources to insure, that the coordination process described herein does not delay the Approved Project Schedule.

C. Each Contractor acknowledges that there may be items of Work which have not been drawn, coordinated, clarified or specified with complete detail in the Contract Documents but which are required for the completion of the Work, as inferable from the Contractor Documents. Any such item, when identified as part of the development of the Work, shall be drawn, coordinated, clarified or specified by the Professional in a manner consistent with contemplated kind, quality and customary standards and provided to the Contractor. When such drawing, coordination, clarification or specification is approved by the Client Agency, the drawing, coordination, clarification or specification so approved shall thereupon be part of the Contract Documents and the item of Work shall be performed by the Contractor as part of the Work without further action or order of the Client Agency and without any increase in the Contract amount or time as if such drawing, coordination, clarification or specification were originally included in the Contract Documents

3.19 MERCURY PROHIBITION

A. The use of mercury as a component of any equipment installed as part of this work is strictly prohibited. Mercury substitutes shall be used in switches and other equipment which might commonly contain mercury.

3.20 CLEARANCE REQUIREMENT

A. Ceiling area directly below heating equipment must be kept clear of all piping, conduit, and other utilities, including fire suppression components, to allow for unit access for servicing and/or removal.

END OF SECTION

SECTION 210300

HANGERS AND SUPPORTS - FIRE SUPPRESSION

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The hangers and supports for the various fire suppression systems shall be as hereinafter described in this section.

B. Hangers and supports shall be arranged to distribute the weight of the piping and equipment uniformly on the building structure.

PART 2 – PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. All pipe hangers, riser clamps, and supports shall be as manufactured by Anvil International, Inc., Tolco Co., or Erico Corp. Hangers shall be adjustable type pattern.

B. All vertical runs of piping shall be supported at each floor and/or at specified intervals, by means of riser clamps. Riser clamps placed on floor construction in finished areas, including stairwells, will not be permitted. Supports shall be placed at minimum ten (10) foot intervals for vertical pipe, except as otherwise dictated by NFPA recommendations for fire suppression piping. Pipe hangers and hanger spacing for the fire suppression systems shall conform to NFPA recommendations. Hangers for the fire suppression system shall be UL Listed, FM approved.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All piping shall be supported from the building construction by the use of fixed or adjustable beam clamps, concrete inserts, lag bolts and lag screws from wood construction, brackets, extension rods, adjustable band ring pipe hangers, or other equipment as dictated by the type of building construction.

B. The .3 Contractor shall place all hanger and support inserts in concrete. Special studs “shot” into concrete will not be permitted.

C. Perforated band iron, strap, split ring, wire, chain or pipe hooks will not be permitted for hangers or supports of pipe.

D. Piping shall not be supported from any other piping systems, ductwork, conduit, etc. Piping shall only be supported by code approved and manufacturer recommended hanger systems connected directly to the building’s structure.

E. Trapeze type hangers may be used for multiple parallel line installations. The .3 Contractor shall submit sketches for the proposed hangers indicating the type of construction, number and size of piping, and maximum spacing to the Professional for approval.

END OF SECTION

SECTION 210553

FIRE SUPPRESSION IDENTIFICATION

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 EQUIPMENT IDENTIFICATION, VALVE TAGS

A. Where valves, flow switches, tamper switches, and similar equipment is located above removable tile ceilings or above access panels, the .3 Contractor shall furnish and install identification labels on the corners of the access panels or removable ceilings tiles. Labels shall be provided with the words "VALVES," “FLOW SWITCHES,” “TAMPER SWITCHES”, and similar wording, so that the equipment may be readily located in the future.

B. Identification labels shall not exceed 3" in length and 1" in height. Black letters shall be 1/8" high on white background. Labels shall be manufactured of engraved Micarta or Bakelite with pressure-sensitive backing and shall be nonabsorbent, nonporous and colorfast. Adhesive backing shall be chemically compounded to hold tight and fast at wide temperature extremes. Labels shall be as manufactured by Seton Name Plate Company, Brady Co., or MSI Services. Labels shall be additionally secured with screws or rivets. Flexible plastic punched tapes will not be acceptable. Labels shall be coordinated with those being installed under other contracts.

C. All major pieces of fire suppression equipment shall include, at a suitable and accessible observation point on the equipment, a manufacturer's stamped brass or aluminum identification plate, with all pertinent capacity data stamped on the plate. Identification plate shall include all specific data, such as model number, serial number, capacities, sizes, amperes, power consumption, flows in GPM, temperatures, working pressures, operating pressures, and similar factors as applicable.

D. The .3 Contractor shall be responsible for furnishing and attaching an identification plate for the above mentioned, major equipment if not provided by the equipment manufacturer.

E. The installations will not be considered acceptable unless identification plates and nameplates are attached.

F. All piping and equipment installed throughout this Contract, shall be stenciled with the name of the service and with an arrow indicating the direction of flow. Stenciling in exposed locations in finished areas must be coordinated with the Professional prior to installation.

G. Snap-around pipe markers shall, in general, shall be located near each branch connection, at each valve, at each change in direction, on each side of walls or floors, and at least every 30' on straight runs of pipe. On smaller runs of piping, center the designations. Snap-around pipe markers by Seton Nameplate Co. "Set Mark," Brady, MSI Services, or approved equivalent may be utilized. Identification and colors shall comply with ANSI A13.1. Snap – around markers shall be suitable for exterior use where utilized, when not exposed to vandalism.

H. Where pipes are adjacent to each other, markings shall be neatly lined up. All markings shall be located in such a manner as to be easily legible from the floor. Markings on black pipes above ceiling shall be white. Markings on fire suppression lines in exposed areas, such as meter rooms, equipment rooms, and storage rooms, shall be yellow on “all red” piping; in finished areas, fire suppression lines shall conform to Professional’s requirements for painting.

PART 2 – PRODUCTS

2.01 VALVE DIRECTORY

A. The .3 Contractor shall prepare a type written valve directory (and required copies) showing the number, location, use and normal position of each valve installed under the Contract. Tag each

valve controlling mains and branches. Valve directory shall be a white print schedule enclosed in metal frame with glass front.

B. Each valve listed in the directory shall have a corresponding number 1-1/2" diameter brass or aluminum tag attached to the valve by means of a brass or aluminum "S" hook or chain. Numbers and code letters shall be as large as possible for identifying each service. Valve tag numbers shall not be repetitious.

C. Provide two (2) additional copies of valve schedules in a hardback binder to the Client **Agency.**

2.02 ELECTRICAL EQUIPMENT LABELS

A. All electrical equipment and items consisting primarily of electrical components shall bear a label of an independent testing laboratory, such as Underwriters' Laboratory (UL).

PART 3 – EXECUTION

3.01 INSTALLATION

A. Valve directory shall be installed in Mechanical Room at the location designated by the Professional.

END OF SECTION

SECTION 21 08 00

COMMISSIONING OF FIRE SUPPRESSION SYSTEMS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions of the Construction Contract”, “Special Conditions”, and “Division 1 – General Requirements” form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 DESCRIPTION

A. The requirements of this Section apply to all sections of Division 21.

This project will have selected building systems commissioned. The complete list of equipment and systems to be commissioned is specified in Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS. The commissioning process, which the Contractor is responsible to execute, is defined in Section 01 91 13 GENERAL COMMISSIONING REQUIRMENTS. A Commissioning Agent (CxA) appointed by the Client Agency will direct the commissioning process.

1.3 RELATED WORK

A. Section 01 00 00 GENERAL REQUIREMENTS.

B. Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS.

C. Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.

1.4 SUMMARY

A. This Section includes requirements for commissioning the Fire Suppression systems, sub-systems and equipment. This Section supplements the general requirements specified in Section 01 91 13 General Commissioning Requirements.

B. The commissioning activities have been developed to support the client Agency requirements to meet guidelines for Federal Leadership in Environmental, Energy, and Economic Performance.

1.5 DEFINITIONS

A. Refer to Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS for definitions.

1.6 COMMISSIONED SYSTEMS

Commissioning of a system or systems specified in this Division is part of the construction process. Documentation and testing of these systems, as well as training of the Client Agency’s Operation and Maintenance personnel, is required in cooperation with the Client Agency and the Commissioning Agent.

A. The following Fire Suppression systems will be commissioned:

B. Fire Protection System (Fire pump, jockey pump, fire pump automatic transfer switch/controller, Wet-pipe fire suppression, Dry-pipe fire suppression, Pre-action fire suppression, dry system air compressors and motors, and clean agent fire suppression).

1.7 SUBMITTALS

A. The commissioning process requires review of selected Submittals. The Commissioning Agent will provide a list of submittals that will be reviewed by the Commissioning Agent. This list will be reviewed and approved by the Client Agency prior to forwarding to the Contractor. Refer to Section 01 33 23 SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES for further details.

B. The commissioning process requires Submittal review simultaneously with engineering review. Specific submittal requirements related to the commissioning process are specified in Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 SYSTEMS READINESS CHECKLISTS

The Contractor shall complete Systems Readiness Checklists to verify systems, sub-systems, and equipment installation is complete and systems are ready for Systems Functional Testing. The Commissioning Agent will prepare Systems Readiness Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be submitted to the Client Agency and to the Commissioning Agent for review. The Commissioning Agent may spot-check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and re-submission. If the Commissioning Agent determines that a significant number of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of checklists for review. If the Commissioning Agent determines that a significant number of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and re-submission. Refer to SECTION 01 91 13 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for System Readiness Checklists, Equipment Startup Reports, and other commissioning documents.

3.2 CONTRACTORS TESTS

Contractor tests as required by other sections of Division 21 shall be scheduled and documented in accordance with Section 01 00 00 GENERAL REQUIREMENTS. The Commissioning Agent will witness selected Contractor tests. The CxA shall provide a list of select tests that will be witnessed. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

3.3 SYSTEMS FUNCTIONAL PERFORMANCE TESTING:

The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by the Engineer. The Contractor shall review and comment on the tests prior to approval. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will direct and

document the testing. The Contractor shall sign the test reports to verify tests were performed. See Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

3.4 TRAINING OF CLIENT AGENCY PERSONNEL

3.5 Training of the Client Agency operation and maintenance personnel is required in cooperation with the Client Agency's Representative and Commissioning Agent. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with the Client Agency Resident Engineer after submission and approval of formal training plans. Refer to Section 01 91 13 GENERAL COMMISSIONING REQUIREMENTS and Division 21 Sections for additional Contractor training requirements.

END OF SECTION 21 08 00

SECTION 211313

WET-PIPE FIRE SUPPRESSION SYSTEM

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

B. The General and Special Conditions and Section 210100, "Basic Fire Suppression Materials and Methods" are included as a part of this section as though written in full in this specification. All fire suppression system work shall be completed by a licensed, certified, .3 Contractor. All work shall be directly coordinated with the local Fire Department.

C. All pipe materials shall be subject to the acceptability of that material with the prevailing local fire and plumbing codes and NFPA 13.

D. The Drawings and Specifications for this project are generally schematic and are intended for bidding purposes only and are not intended to cover each item required for a total system as outlined in NFPA 13. The minimum spacing, quantity and arrangement of proposed sprinkler locations, equipment, piping, and standpipes indicated on the Drawings generally are diagrammatic. The exact arrangement, sizes, quantity and spacing required by the agencies having jurisdiction shall be indicated on the Working Drawings that are to be prepared by the .3 Contractor.

E. Piping drawings shall be prepared under the supervision of a qualified fire protection engineer or designer having at least a NICET level III certification in Automatic Sprinkler Systems Layout or higher.

1.02 SCOPE

A. The sprinkler fire suppression work to be performed, shall include the following, but not necessarily limited to:

1. Furnish and install .3 Contractor-hydraulically designed wet pipe fire suppression systems, including all required drain piping and accessories, complete in every detail.

2. Directly after award of Contract, regardless of dates of existing flow tests; or flow test data obtained or shown on any drawings; and prior to any submittal, the .3 Contractor shall be responsible for conducting and obtaining new flow test data. Obtain water flow, pressure, capacity data, elevations, and other related pertinent information from the nearest available fire hydrant(s), and as arranged with the Water Authority serving the building. Arrange any times and dates with the Water Authority. Water flow test data obtained from the Water Authority will not be acceptable, regardless of when such flow tests were performed. Include all costs involved with obtaining the flow test data, including the use of special tools, equipment, and accessories and include in the Contract Bid. Typed copies of confirmed flow test results shall be furnished by the .3 Contractor to the Professional. Approval by the Professional of .3 Contractor's test results is necessary prior to forwarding submittals or beginning any work.

3. Include all tests, permits, and fees, including all costs involved.

4. .3 Contractor shall complete all Contractor's Material and Test Certificates for above ground and below ground installations.

1.03 CODE COMPLIANCE

A. All fire suppression work, and materials herein described shall comply with all applicable federal, state, county, health, and local laws, ordinances, rules and regulations, and all other local authorities having jurisdiction and shall be subject to the approval of these authorities, notwithstanding anything in these specifications to the contrary. In addition, all work and materials to be provided under this Section of the Specification shall conform to the applicable

requirements of the National Board of Fire Underwriters Standards, and the National Fire Protection Association Standards; special reference is made to NFPA 13, Standard for the Installation of Sprinkler Systems. All threads shall conform to the local Fire Department Standards; confirm prior to ordering.

1.04 SHOP DRAWINGS

A. Product Data: Submit manufacturer's technical product data and installation instructions for all fire suppression materials and products.

B. Approval Drawings: All fees for this approval shall be by the .3 Contractor. Prepare approval drawings of the fire suppression systems coordinated with electrical and general building drawings, of the fire suppression systems proposed by the .3 Contractor and submit prints of the drawings to the appropriate governmental, health, and underwriting agencies for their review and approval. Prints bearing the approval stamp of the Underwriting Agency, authorized Fire Marshal and other Authorities having jurisdiction shall be submitted to the Professional prior to the commencement of any fabrication or installation of any portion of the system. The drawings shall include all of the following information and whatever additional information that may be required by the authority having jurisdiction.

1. All sets of drawings with appropriate NFPA standards listed.
2. System type.
3. Total number of risers.
4. Sprinkler spacing and locations with dimensions showing all lighting fixtures, diffusers and return air grilles.
5. Occupancy type.
6. Hazard classification.
7. Hangers, types and details.
8. Temperature and type of sprinklers.
9. Dry barrel sprinklers.
10. Water flow indicators and monitor (tamper) switches.
11. Riser check valve assembly with associated trim.
12. Wet system main line air vent.
13. Fire Department inlet connection.
14. Double check detector assembly.
15. Sprinkler system accessories and specialties.

C. The .3 Contractor shall submit deferred submissions of Fire Suppression Systems plans and calculations to the Department of Labor and Industry once shop drawings are submitted and reviewed by the Professional. The submission to the Department of Labor and Industry must occur at least two weeks prior to installation. A statement signed by the Design Professional in Responsible Charge must be included with plans for either of these systems. The statement should indicate that the design professional has reviewed the shop drawings and found them to be in general conformance with the design of the building.

D. Approval Calculations: Prepare hydraulic calculations of fire suppression systems to determine all pipe sizes. Submit to Agency having jurisdiction for approval. Submit one (1) approved copy, bearing stamp and/or signature of Agency having jurisdiction to the Professional before proceeding with the installation.

E. Certificate of Installation: Submit certificates upon completion of fire suppression work which indicates that work has been installed and tested in accordance with NFPA 13, and also that system is operational, complete and has no defects.

F. Record Drawings: At project closeout, submit record as-built drawings of installed fire suppression piping and products.

G. Maintenance Data: Submit maintenance data and parts lists for fire suppression materials and products. Include this data, product data, shop drawings, approval drawings, approval calculations, certificate of installation and record drawings in maintenance manual.

PART 2 – PRODUCTS

2.01 FIRE SUPPRESSION PIPING AND EQUIPMENT INSIDE BUILDING

A. Pipe:

1. All wet pipe system piping herein specified shall be UL Listed and FM Approved. Pipe shall be as manufactured by Allied Tube & Conduit, Youngstown Tube Co., or Wheatland Tube Company. For the wet-pipe systems only, all piping that utilizes threaded fittings shall be Schedule 40 black steel. “Plain-end” pipe/fittings and threadable light-wall pipe are not permitted. Sprinkler piping 1-1/4” in diameter or larger, connected by welded, flanged fittings or roll grooved fittings, shall be Schedule 40 or Schedule 10 as permitted by NFPA 13. Cut grooves are not permitted. All sprinkler piping 2” in diameter and smaller (that is not roll grooved or welded) shall be Schedule 40 utilizing screwed fittings (plain end fittings will not be accepted). All miscellaneous drain and test piping and fittings shall be Schedule 40, internally and externally galvanized. All piping shall include factory coating of the inner wall of piping, to guard against MIC (microbiologically influenced corrosion). The coating shall adhere to the wall of the pipe, thereby providing protection against contamination and pipe deterioration by impeding the attachment of microbes to the pipe wall.

B. Hangers: Hangers for the fire suppression system shall be UL Listed, FM approved adjustable type pattern. .3 Contractor’s attention is directed to “Unsupported Armover Lengths”, for pipe hanger installations for pressures above and below 100 psi, in accordance with NFPA 13. Argco hangers used as basis of design.

C. Fittings:

1. For wet-pipe system, 150 psi, screwed malleable iron, or Victaulic FireLock ductile iron fittings and FireLock EZ ductile iron, Nibco Steelok, or Tyco couplings for grooved end piping. Grooved end fittings and couplings shall be UL Listed and FM approved and shall be the products of a single manufacturer. Grooving tools shall be supplied by the same manufacturer as the grooved components

2. Grooved mechanical rigid type couplings 1-1/4” and larger shall be Victaulic Firelock EZ Style 009V “Installation Ready”, as basis of design, standard rigid couplings.

3. Coupling gaskets shall be pressure responsive, synthetic rubber, Grade “E” EPDM Type A, pre-lubricated for wet systems.

4. Flange adapters shall be ductile iron, flat faced, designed for incorporating flanged components with ANSI Class 125 and 150 bolt-hole patterns to a grooved piping system. Victaulic Style 741 or 744, as basis of design.

D. Valves: Valves shall be as manufactured by Nibco, Victaulic, or Tyco.

1. For sizes 2" and smaller, valves shall be bronze ball type, 175 pound WWP minimum, UL, FM, threaded or grooved body style. For sizes 2-1/2" and larger, valves shall have iron body, 175 pound WWP minimum, UL, FM, with resilient wedge, flanged ends.

2. Butterfly valves will be acceptable, UL, FM. Milwaukee “Butterball” butterfly valves, as basis of design, UL, FM, will be acceptable. The valve shall have a pressure responsive seat, and the stem shall be offset from the disc centerline to provide complete 360-degree circumferential seating. Grooved end butterfly valves UL, FM, with weather-proof actuator and pre-wired supervisory switches monitoring the valve in the open position.

3. Check valves 2" and smaller shall be bronze, 175 pound WWP minimum, threaded, renewable rubber disc. Check valves 2-1/2" and larger shall have iron body, renewable seat and rubber disc, 175 pound WWP minimum, flanged, UL, FM. Grooved end check valves shall have ductile iron body, stainless steel or EPDM coated ductile iron disc, UL, FM.

4. Inspector's test and drain valves shall be 175 pound WWP minimum, bronze screwed, angle, or straight globe valves, UL Listed, rubber disc.

5. The AGF Model 1011A Test and Drain, UL, FM approved, Victaulic Styles 720 TestMaster Alarm Test Module, Tyco Fire Suppression Products Model F350 Sectional Test & Drain, or Sure-Test shall be utilized for drain systems.

E. Riser Check Valve Assembly: Wet system valve assembly shall be Viking F-1 Easy Riser Swing Check Valve & Trim, as a basis of design, Reliable, Victaulic, or approved equivalent. The riser check valve shall be UL Listed and FM Approved. The riser check valve shall be a spring-loaded check valve having a rated working pressure of 250 psi and factory hydrostatic tested to a pressure of 500 psi. Valve body casting shall be gray iron per ASTM-A48 Class 30A, containing a bronze seat and stainless steel clapper per ASTM A240 with rubber gasket and EPDM rubber facing seal. Grooved end connections per ANSI/AWWA C606. The riser check valve shall be factory tapped for a NPT main drain in accordance with NFPA 13 and plugged 1/2" NPT system connection with additional 1/4" NPT supply connections. All parts of the clapper assembly to consist of stainless steel. Trim components shall consist of a bronze angle valve for the main drain connection, and a 300 psi pressure gauge connection with 3-way bronze globe valve located on both the upstream and downstream side of the riser check

F. Wet System Main Line Air Vent for wet-pipe systems shall be UL Listed and FM Approved. Provide a single in-line automatic air venting valve to allow air to be removed from each wet-pipe system utilizing metallic pipe in accordance with NFPA 13, Purge-N-Vent Model 7950ILV, as basis of design. The separation chamber and air scoop are designed to force a separation of air from the water as the system fills.

G. Monitor (Tamper) Switches: Provide monitor switches on all shut-off valves. Monitor switches shall be as manufactured by System Sensor Model OSY2 and PIBV2, Viking Model OSYSU, PCVS, or Potter-Roemer, Inc. Electrical contacts shall be such as to perform the functions required or described under the "Fire Alarm" section of the Electrical Construction Specifications. Switches will be wired and connected to the Fire Alarm System by the .4 Contractor.

H. Flow Indicators: Water flow indicators must be located a minimum of 18 inches from any elbow or tee to minimize flow turbulence. The flow switches shall be as manufactured by Viking, Model VSR, System Sensor, or Potter-Roemer, Inc. The flow switch shall have contacts such as to perform the functions required or described under the "Fire Alarm" Section of the Electrical Construction Specifications. Flow indicators will be wired and connected to the Fire Alarm System by the .4 Contractor.

I. Sprinklers: All sprinklers shall be the product of a single manufacturer, UL Listed, and FM approved. All sprinklers shall be the same model year and style throughout. The Professional must approve any deviations. Sprinklers shall be of a type, upright, pendent, or sidewall that is best suited to the conditions in which they are installed and shall have a minimum working pressure rating of not less than 250 psi. Sprinklers shall be as manufactured by Reliable, Viking, or Victaulic. Provide quick response sprinklers where required, in accordance with NFPA requirements. Sprinklers which must be painted, shall be factory-painted only. Where required, sprinklers shall be of a design suited to the protection of areas having irregular building design and structural arrangements such as cornices, soffits, beams and columns or building environmental systems such as light fixtures, grilles and diffusers, or building furnishings and equipment. Full consideration shall be given in the spacing of sprinklers, of the type of sprinkler, and the arrangement of the piping to afford the protection required to be installed. Temperature ratings of all sprinklers shall be coordinated with the NFPA 13 requirements. Provide higher temperature sprinklers near heat – producing equipment. The Victaulic "strapless" style sprinklers will not be acceptable. The finish and type of sprinklers in finished areas must be approved by the Professional.

1. In general, sprinklers in finished areas with ceilings shall be fully recessed, concealed type, quick response. Sprinklers shall include finished flat coverplate installed flush with ceiling, the Viking (QR, 5.6K, VK4621), Reliable, Tyco, or approved equivalent. Finish and

color of flat coverplate shall be as selected by the Professional.

2. Sprinkler in unfinished areas installed on exposed piping shall generally be of the upright type having rough bronze finish, the Viking (QR, 5.6 K, VK3001), Reliable, Tyco, or approved equivalent.
3. Sidewall sprinklers shall be quick response, having a bronze finish or chrome finish, and shall be the Viking (QR, 5.6 K, VK319), Reliable, Tyco, or approved equivalent.
4. Sprinklers in cooler or freezer shall be adjustable standard style, dry barrel, pendent type, quick response. Sprinklers shall include adjustable escutcheon installed flush with ceiling, the Viking Dry Model (QR, 5.6 K, VK176), Reliable, Tyco, or approved equivalent.
5. Dry sidewall sprinklers shall be recessed, dry barrel, quick response, having a white or chrome finish, and shall be the Viking (QR, 5.6 K, VK162), Reliable, Tyco, or approved equivalent.
6. In areas subject to corrosive atmosphere, sprinklers shall be lead coated, Stainless Steel, Nickel-Teflon coated, or wax coated as required.
7. Guards shall be provided on all sprinklers subject to mechanical damage where normal movement of equipment or products would present a hazard to the sprinkler, Viking Model D-1 Guard, Reliable Model F-1 Guard, Tyco Models G1/G2/G3/G4, or approved equivalent, such as equipment rooms, storage rooms, and similar areas. Guards shall also be provided where indicated on the drawings. All sprinklers in areas throughout the building that are below 7 foot clearance shall be equipped with sprinkler guards. Sprinkler guards shall be listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.
8. Coordinate installation of sprinklers with surface mounted lighting fixtures for proper clearances.
9. Install sprinklers under all ducts or obstructions greater than 48” in width in accordance with NFPA 13.

J. In accordance with UL listing requirements, protective caps or straps shall be required for all new glass bulb sprinklers. The caps or straps shall be removed from the sprinklers only when the system is “placed in service”, in accordance with NFPA definitions. Protective caps and straps shall be removed only using means in accordance with manufacturer’s installation instructions. “Dropped” glass sprinklers, with or without protection, shall be replaced. Solder element sprinklers are not required to be protected with caps or straps.

K. Fire Department Inlet Connections: Potter Roemer, Inc., 5710 Series, 4” x 2-1/2” x 2-1/2”, Reliable, or Elkhart, double inlet with caps and chains and ball drip device. All polished chrome plated or brass with round identification plate marked “Auto Sprinkler” OR “AUTO SPKR”. Coordinate finish of Siamese inlet connections with the Professional prior to ordering the equipment. Extend ball drip piping in accordance with applicable local code requirements. Coordinate type lettering, threads (Pittsburgh 6), and mounting with the Fire Department before ordering the equipment.

L. Double Detector Check Assembly: Watts No. 774-DCDA-OSY, with main body: 300 Series stainless steel; all internal metal parts: 300 Series stainless steel; UL, FM, with O.S. & Y. gate valves, Ames, or Wilkins. Provide meter reading in CFM or GPM and any remote meter reading per local Water Authority requirements.

M. Flushing: Completely flush out all piping systems included under this Contract.

N. Splashblocks: Where shown or required, terminate fire suppression system test and drain lines over splashblocks at the exterior of the building. Refer to Section 21 02 00 for specifications.

O. Escutcheons: All pipe escutcheons shall be chrome, cast brass, set screw type.

P. Pressure Gauges: Potter-Roemer Inc. Model 6240, Reliable, or Viking, 0-300 psi, 3-1/2" minimum diameter, with T-handle gauge cock. Provide pressure gauges at each fire main service entrance, at top of each main riser, and at any other locations shown.

Q. Signs: Furnish and place operation signs and other signs where required, Potter-Roemer, Inc., Tyco, or Viking.

PART 3 – EXECUTION

3.01 SPRINKLER SYSTEM INSTALLATIONS

A. All sprinkler systems shall be fully automatic, shall be complete in all detail, and shall be provided with all the required components and devices necessary to install approved systems.

B. The layout of the sprinkler system, the arrangements of the sprinklers; and the location and size of main and branch piping shall be developed from the design requirements of the applicable sprinkler criteria and the limitations imposed by the structural and architectural design. However, the degree of protection, hence the exact spacing and arrangement of the sprinklers and pipe sizes in any area shall be as required by the authority having jurisdiction.

C. Rearrangement of branch piping and adjustment of the pipe sizes, where proven by hydraulic calculations and when approved by the authorities having jurisdiction, and where compatible with the building design, may be made in the preparation of the Shop Drawings.

D. In finished areas, sprinklers shall be uniformly spaced and patterned to suit the ceiling finishes, decorations and interferences. In unfinished areas, the pattern of spacing and the coverage shall be as determined by the shape of the space and the interferences caused by construction details and the furnishings of the space. Maximum spacing shall not exceed that permitted by the authority having jurisdiction. Sprinklers in “lay-in” ceilings shall be centered in both directions.

E. Additional spare sprinklers of each type shall be provided to the Client Agency. Not less than six (6) sprinklers or 2% of the total number of each type of sprinkler shall be furnished to the Client Agency for storage. Furnish and install a metal wall storage cabinet, of required capacity, mounted where directed by the Professional. Storage cabinet shall be as manufactured by Tyco, Victualic, or Viking. A wrench suited to each type of sprinkler shall also be provided in the cabinet.

F. Test pipes with control valves shall be provided as required in the sprinkler fire suppression system.

G. All flow switches, monitor switches, and similar equipment must be accessible to local fire officials, regardless of location, exposed or concealed.

H. Upon installation, the double detector check valve shall be tested under the Fire Protection Subcontract, in accordance with manufacturer’s installation standards, or in accordance with local authorities or utility company having jurisdiction over the installation. All testing shall be completed by persons certified in this type of work. All costs, fees, or charges required for testing shall be included in the Contract price.

3.02 FIRE SUPPRESSION SYSTEM TESTS

A. Before the completed sprinkler fire suppression systems are accepted by the Client Agency, the entire affected systems included under this Contract shall be pressure tested by the .3 Contractor and approved in the presence of representatives of the Client Agency, the Professional, local Fire Department, local authorities, the Insurance Underwriters, and any other parties directly concerned.

B. The .3 Contractor shall furnish all labor and equipment and shall conduct and bear the cost of all required tests of the fire suppression system. The .3 Contractor shall give all concerned parties three days advance notice of scheduled tests; 48 hours to Water Authority.

C. The entire fire suppression system included under this Contract shall be tested under a hydrostatic pressure of not less than 200 lbs. for at least two (2) hours, or at 50 psi in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi, or as otherwise required or directed by the local Fire Department. Testing of underground service main piping shall conform to NFPA 24 requirements. All defective work shall be promptly repaired or replaced with new pipe and fittings, etc.

D. Tests shall be repeated until the installation receives the approval of the Professional and all parties concerned.

E. Any damage resulting from the tests shall be repaired and/or damaged materials replaced, all to the satisfaction of the Professional, at the expense of this .3 Contractor.

END OF SECTION

SECTION 214000

FIRE SUPPRESSION TESTING, ADJUSTING, BALANCING

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE OF WORK

A. The .3 Contractor shall make all preliminary and final tests at the site on piping systems included under this Contract, including, but not limited to fire suppression service piping, and wet sprinkler piping system. .3 Contractor shall provide all testing instruments, gauges and other equipment for all tests, and the services of competent mechanics for conducting the same. .3 Contractor shall also pay all fees required by the local Authorities in connection with such tests. All tests shall conform with the requirements of the prevailing local plumbing and fire suppression codes. All documentation of completed tests and a report shall be provided upon completion of the testing.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION

3.01 PROCEDURES – PIPING SYSTEMS

A. Testing procedures for piping systems shall be as specified in the various Sections.

B. All tests shall be made in the presence of a representative of the Professional, and in the presence of representatives of the local Authorities having jurisdiction, and Insurance Authorities, whose presence is required. Except as herein specified, this .3 Contractor shall notify the Professional and all Authorities at least three (3) days in advance of such tests; 48 hours to Water Authority. Preliminary tests shall be made before giving such notification.

C. All systems shall be left in good operating condition. If defects of material or workmanship in piping systems or equipment are disclosed as a result of these tests and operations, repairs shall be made by the .3 Contractor, using new materials; and all defective materials shall be removed from the site immediately. Tests shall be repeated until a satisfactory test has been made.

D. No caulking of screwed joints, cracks or holes will be acceptable. Replacing shall be the full length of defective sections of pipe. Defective apparatus shall be removed from the site and replaced by apparatus conforming to the requirements of these Specifications. The entire cost of repairs shall be borne by this .3 Contractor.

3.02 EQUIPMENT

A. The entire fire protection system included under this Contract shall be tested under a hydrostatic pressure of not less than 200 lbs. for at least two hours, or at 50 psi in excess of the maximum static pressure when the maximum static pressure is in excess of 150 psi, or as otherwise required or directed by the local Fire Department. All defective work shall be promptly repaired or replaced with new pipe and fittings, etc.

B. The .3 Contractor shall notify the Professional and the Authority Having Jurisdiction three (3) weeks or more in advance of all tests to be conducted. .3 Contractor’s Material and Test Certificates shall be completed, signed, and dated and included in the Operations and Maintenance Manuals. The .3 Contractor is responsible for obtaining copies of the Contractor’s Material and Test Certificates for the Underground piping installed by the .1 Contractor. If such certificates cannot be obtained, the .3 Contractor shall be responsible for performing the tests and preparing the certificates.

C. Test the fire suppression backflow preventers as specified.

D. All underground piping must be flushed by the .3 Contractor and the .1 Contractor prior to connection to the fire service assembly in accordance with NFPA 24 and documented as such. Inform contractors of this requirement.

E. Any retesting that is required due to failure, for any reason, of any test shall be conducted at no additional costs to the Client Agency. Any corrections or repairs to the system or building necessary due to such failure and retesting of the system shall be performed at no cost to the Client Agency.

END OF SECTION

SECTION 220499

PLUMBING SCOPE

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION OF WORK

A. The work to be performed under these Specifications shall include providing all labor, materials, and equipment necessary to furnish and install, complete, properly, and fully all plumbing work as shown on the Drawings or herein specified. It is the intent of these Specifications that a complete operating system be installed; this Contractor shall carefully examine the site, drawings, and Specifications, and shall include all items necessary to accomplish this purpose. The work, in general, shall include, but shall not be limited to the following:

1. Provide interior sanitary and vent drainage system as indicated, including floor drains, cleanouts, traps, and vents.
2. Provide interior domestic hot and cold water distribution systems as indicated. Provide valves and backflow preventers.
3. Provide interior/exterior natural gas distribution system as indicated. Provide valves, pressure regulators, and roof pipe supports.
4. Existing domestic hot water heating equipment to be reused.
5. Provide plumbing fixtures and equipment shown.
6. Provide grease interceptor, solids interceptors
7. Provide elevator sump pumps with alarm systems.
8. Provide plumbing services and final connections for equipment furnished under various Contracts or by the Client Agency as indicated.
9. Provide insulation for piping and equipment as specified.
10. Testing, adjusting and balancing all plumbing piping and equipment.
11. Furnish combination starter/disconnects, magnetic starters, manual starters, and fused disconnect switches, to the .4 Contractor for installation on all plumbing equipment. Coordinate all electrical requirements with the .4 Contractor before ordering such equipment.
12. Type “RK” fuses for the starter/disconnect switches shall be furnished and installed under the Plumbing Contract as specified. The .3 Contractor shall properly size and select overloads and disconnect switch fuses in accordance with the National Electrical Code requirements. The .3 Contractor shall furnish to the .4 Contractor the equipment manufacturer’s circuit protection data.
13. All control and interlock wiring shall be by the .3 Contractor.
14. Provide all necessary demolition of existing piping, fixtures, and equipment as indicated.

1.03 PLUMBING WORK INCLUDED IN FOOD SERVICE EQUIPMENT WORK

A. Refer to the Food Service Equipment drawings.

B. Furnish and install piping and fittings, including all necessary ball valves, check valves, vacuum breakers, gauges, gas and water pressure reducers, shock arrestors, flexible connectors, traps, tailpieces, strainers, and solenoid valves, unless otherwise noted.

C. Furnish and install ball shut-off valves or loose key stops on all hot and cold water piping and gas shut-off valves on gas piping at equipment rough-in locations.

D. Make all interconnections to equipment after equipment is placed. This shall include furnishing and installing all necessary materials to make rough-ins, interconnections, and final connections.

E. Furnish and install automatic natural gas shut-off valves in main gas piping as indicated for hood fire extinguishing system. Refer to Section 221124 for gas solenoid valves. Do not penetrate hood enclosures with piping.

F. Furnish and install drain piping from cooler/freezer evaporators to drain as shown on Plumbing and/or Food Service Equipment drawings. Furnish and install drain piping from cooler and freezer coils after walk-ins are installed. Insulate piping as specified.

G. Provide double check backflow preventer for all ice maker, dishwasher, and pre-rinse sink water connections.

H. Certain water filters, such as on cold water supplies to ice maker/bin, etc. will be furnished by the Food Service Equipment Contractor to the .3 Contractor for installation. Coordinate specific requirements with Equipment Supplier.

I. Make final gas connections using gas quick disconnect hoses furnished by the Food Service Equipment Contractor, at required locations.

J. Flexible hoses for gas and water are included under this Contract and not furnished by the Food Service Equipment Contractor, shall be as manufactured by T & S Brass “Safe-T-Link”, Lorenz, or Sioux Chief.

K. For individual hand-washing sink or appliance mixing valves, refer to Section 220523.

L. Kitchen booster heater will be furnished and installed by the Food Service Equipment Contractor. Refer to the drawing details for .3 Contractor piping requirements.

M. Paint exposed uninsulated drain, vent, water, and gas piping in the Kitchen, Dishwashing, and such associated areas with two (2) coats of silver colored paint, one (1) prime coat and one (1) finish coat; in a manner acceptable to the Professional; or of colors selected by the Professional.

1.04 WORK BY OTHER TRADES

A. Cutting, patching, painting, electrical, plumbing, fire protection, etc., shall be done by the affected trade at this Contractor’s expense for changes required in work already installed or work required by other trades for changes made by this Contractor in type or size of equipment purchased.

1.05 WORK NOT INCLUDED

A. The following construction and equipment related to the work under this Contract will be provided by others:

1. Furring around piping. (.1 Contractor)
2. Final painting of interior surfaces. (.1 Contractor)
3. Recesses and openings in construction for plumbing piping and equipment. (.1 Contractor) Chases for piping where specifically shown on the Drawings. (.1 Contractor)
4. All electric power wiring to all electrically-operated plumbing equipment. (.4 Contractor) The .4 Contractor will be responsible for all power wiring and associated terminations to line and load side of equipment as well as mounting of all combination starter/disconnects, magnetic starters, manual starters, fused disconnect switches, etc. furnished by the .3 Contractor and external to equipment they are designated to serve, except where such items are factory installed as an integral part of the equipment. The .4 Contractor will make final connections to all equipment as directed by the .3 Contractor.
5. Openings, patching, restoring, and flashing in existing roof by .1 Contractor at .3 Contractor’s expense.
6. HVAC condensate drainage, except for certain condensate drain piping installed under the Plumbing Contract, as indicated. (.2 Contractor)

7. Building fire protection system. (Separate .5 Contract)

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 220500

BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 PLUMBING WORK

A. These Specifications are issued to cover all work in connection with the complete installation of the plumbing work. Plumbing work is hereby defined to include work as herein specified and as shown on the Drawings issued in connection with this project. Any reference in these Specifications to the Contractor shall hereby be considered a reference to the .3 Contractor. Any reference or letting of work to subcontractors or manufacturers in these Specifications does not relieve the Contractor of his responsibility for the work, materials, and equipment under this Contract. The .3 Contractor is responsible for the work and performance of his subcontractors.

B. The word “building” used throughout these Specifications shall be interpreted to mean the entire Building Complex.

C. The actual runs and locations of all piping, equipment, and materials shall be determined at the site and shall be installed to meet the various conditions at the building. It is, however, the Contractor's responsibility to predetermine the exact locations of piping and equipment, and to notify the other contractors accordingly and prior to any installation to avoid confliction with other piping and equipment. Any changes necessary to conceal pipes or clear pipes and equipment of other trades shall be made without additional expense to the Client Agency.

D. All work shall be executed and all equipment constructed and installed in accordance with the requirements of the State Department of Labor and Industry, applicable IBC Codes, the State Department of Environmental Protection, ASME, the Department of Labor, Safety and Health Regulations for Construction, OSHA, the National Fire Protection Association, the National Electrical Code as amended to date of bidding, and all applicable federal, state, county and local ordinances and regulations. Nothing contained in these Specifications or shown on the Drawings shall be construed to conflict with the aforesaid codes, ordinances, or regulations. Certificates of approval shall be obtained from any department issuing same and shall be turned over to the Client Agency at the completion of the work. All fees and permits required shall be satisfied and obtained by the Contractor and the cost shall be included in the Contract price.

E. The Contractor shall carefully examine the general building drawings, all mechanical and electrical drawings, and carry on his work so as not to delay or interfere with the work of other trades. The Contractor shall obtain in writing from the other contractors such data as is necessary to coordinate his work with other branches. This coordination must take place prior to any piping or equipment installation. As the work in the building nears completion, all threading, cutting, and similar work shall be done where directed by the Professional. Upon completion of the work, all remaining waste materials and rubbish resulting from the Contract work shall be removed from the building and premises.

F. Where the phrase "or approved equivalent," "or equivalent," or "approved" appears in these Specifications, it shall refer to the prior to bidding approval of the Professional on the material or equipment involved. Substitutions of non-named suppliers after bidding shall be summarily rejected.

G. The term "Provide" means to furnish and install. The term "Furnish", used separately, means to obtain and deliver on the job for installation by other trades.

H. The .1 Contractor will provide chases and openings in walls, floors, ceilings, and partitions of new construction to receive pipe piping, risers, and other equipment insofar as it is possible to predetermine the exact location, but the Contractor shall install his work sufficiently in advance

of the building construction to permit his work to be built into place. The Contractor shall advise the .1 Contractor of the exact size and location of all chases and openings required for the installation of his work and shall check size and location of all such chases and openings provided by the .1 Contractor.

I. The Contractor shall furnish and place all sleeves required for pipes passing through new floors, walls and ceilings before such general construction work is built into place. The Contractor shall place all inserts required for hangers and supports, as the construction work progresses, so that unnecessary cutting of construction work will be eliminated.

J. Equipment and materials of similar types shall be of the same manufacturer unless specifically indicated otherwise on the Drawings or herein specified. The Contractor shall make final connections between all equipment furnished under this Contract and equipment furnished under other contracts, except as otherwise specified herein.

K. The materials used throughout shall be those of reputable manufacturers and shall be the best of their respective kinds. All equipment, components and materials shall be installed in a neat and workmanlike manner in accordance with best trade practices, manufacturer's recommendations, and applicable codes and standards and by persons skilled in each particular branch of the work assigned to them. All work shall be installed subject to the approval of the Professional.

L. All piping work shall be installed plumb, level, and square per code requirements. All piping shall be run in straight horizontal or vertical sections, outside of sloped drainage piping, and shall be under inspection during installation. Any piping, fittings, hangers, and/or systems deemed unacceptable per inspection during installation shall be repaired, replaced, and corrected with no additional cost to the project.

M. A complete list of materials proposed for each installation shall be submitted to the Professional for approval before delivery to the site. The Contractor shall submit samples of materials for approval at the site as requested by the Professional. Such materials may be incorporated into the structures after serving their purpose as samples.

N. Where the Contractor elects to substitute approved materials or equipment for materials or equipment specified, the Contractor will be held responsible for all Architectural, structural, mechanical, and electrical changes required for their installation at no additional cost to the Client Agency. If additional engineering design is required, the Contractor shall reimburse the design Professional all costs.

O. The Contractor shall be entirely responsible for all apparatus, equipment and appurtenances furnished by him or his Subcontractors in connection with the work, and special care shall be taken to protect all parts thereof in such manner as may be necessary or as may be directed. Protection shall include covers, crating, sheds, or other means to prevent dirt, grit, plaster, or other foreign substances from entering the working parts of machinery or equipment. Special care shall be taken to keep all open ends of pipes, etc., closed while in storage and during installation. Where equipment must be stored outside the building, it shall be totally covered and secured with heavy waterproof tarps and kept dry at all times. Where equipment has been subject to moisture, it shall be suitably dried out before placed in service. Rusted piping, interior or exterior of piping, will not be permitted for installation. Equipment with rusted finishes will not be permitted before or after installation. Materials and equipment shall be stored in areas designated by the Professional.

P. The Contractor or his subcontractors will not be permitted to use corridors as storage areas for their piping, materials, or equipment. Piping, materials, and equipment shall be stored in areas as coordinated with the Professional.

Q. Grades, elevations and locations shown on the Drawings are approximately correct; however, the Contractor shall field check and otherwise verify all such data at the site before proceeding with the work. The Contractor shall make necessary survey equipment available at all times and shall make use of such equipment wherever necessary to properly install his piping or equipment.

R. The Contractor shall visit the site and thoroughly acquaint himself with conditions existing at the site before submitting his proposal as will be held responsible for the installation of the work complete in every detail. The Contractor shall especially review the Professional's phasing schedule and ensure compliance with this schedule.

S. All work shown on the Drawings and not specifically included in the Specifications shall be considered a part of the Contract work. All work included in the Specifications and not specifically included on the Drawings shall also be considered a part of the Contract work.

T. Carefully examine all Drawings and Specifications included under this Contract and Drawings and Specifications included under other contracts and report any discrepancies noticed to the Professional.

U. Due to the small scale of the Drawings, it is not possible to indicate all offsets, fittings, valves, access panels, adapters, and similar parts which may be required. The Drawings are diagrammatic generally indicative of the work to be installed. The Contractor shall carefully investigate the structural and finish conditions affecting the work and arrange all work accordingly, furnishing necessary parts and equipment as may be required to meet the various conditions.

V. The Contractor shall layout his work from dimensions of Architectural and Structural Drawings and actual dimensions of equipment being installed. Layouts in congested areas should not be scaled from Plumbing, Fire Protection, HVAC and Electrical Drawings. Clearances shall be provided on all sides of equipment as required for proper maintenance purposes and as required by the State Department of Labor and Industry.

W. The Contractor shall furnish the services of manufacturers' representatives for all equipment furnished under these Contract Documents. The amount of factory service provided by the Contractor shall be as normally recommended and furnished by the various equipment manufacturers unless specified otherwise. Testing of such systems and equipment shall be made under the direct supervision of competent authorized service representatives. Any and all expenses incurred by the equipment manufacturers' representatives shall be borne by the Contractor.

X. All equipment and materials shall be manufactured in accordance with national standards established by manufacturer's associations, engineering and testing societies, such as NBMA, NEMA, ASTM, AMCA, ASME, ANSI, ACI, FM, U.L., where such standards have been established. The standards shall be construed to mean their correct specifications and designations as amended, as of the date of bid opening.

Y. When the installation is reported in writing by the Contractor to be complete and ready for acceptance, tests and inspection shall be made by the Contractor in the presence of the Professional to ascertain whether it complies with the Specifications and Contract, and upon its failure to do so, the Contractor shall at once remedy all defects and shortcomings and any additional tests that may be required shall be entirely at the Contractor's expense. All of the testing work shall be done when and as directed by the Professional before the system is accepted.

Z. Include any excavation and backfill as required for work included under this Contract, as herein specified. Work shall conform to all applicable federal, state, county, and local regulations governing safety provisions at excavation sites.

AA. The .1 Contractor will install insulation with vapor barrier in certain areas of the building. Where the building insulation or vapor barrier is broken due to the installation of piping and equipment, the Contractor shall properly repair all insulation and seal all openings with vapor barrier covering and vapor barrier adhesive, of types installed with the insulation.

BB. The Professional reserves the right to revise locations of piping and equipment within the building, as long as sizes remain the same. The Contractor should include suitable allowance in his bid price for the above.

CC. In all cases where equipment and materials are specified in the singular or plural number, it is intended that such reference shall apply to as many such items as are required to complete the

installation.

DD. Where piping or other equipment passes through fire or smoke barrier stops, walls, floors, or ceilings, this Contractor shall furnish and install sleeves and shall thoroughly seal openings around sleeves, pipes, and equipment with fire and smoke resistant materials. Materials shall be furnished by the .3 Contractor as required to maintain the fire rating of the walls, partitions, ceilings and floors in accordance with the requirements of NFPA, the State Department of Labor and Industry, and other applicable codes.

EE. All moving parts of equipment and appurtenances installed shall be properly lubricated by the Contractor.

FF. The Contractor will be responsible for the completion of all work included under this Contract and shall employ skilled and qualified tradespeople as necessary to satisfy all work and trades.

GG. All capped or plugged connections shall be suitable for permanent, gastight installations.

1.03 CODE COMPLIANCE

A. All plumbing work and materials shall comply with all applicable codes. Energy conservation shall be provided for plumbing systems as described in The International Energy Conservation Code.

1.04 ROUGH-IN

A. This Contractor shall verify roughing-in dimensions for all fixtures and equipment prior to roughing-in for such fixtures and equipment.

1.05 SHOP DRAWINGS

A. Shop drawings submittals shall not be regarded as installation manuals. It is the responsibility of the Contractor to obtain installation recommendations from the manufacturer of each item of the equipment.

B. This Contractor shall submit prints of shop drawings and manufacturers' data for approval in the manner prescribed. Refer to this section for "Required Submittals".

1.06 RESPONSIBILITIES OF BIDDERS

A. Before ordering any material or doing any work, this Contractor shall verify all measurements at the site and shall be responsible for the correctness of same. Any differences encountered between the site measurements and those shown on the Drawings shall be submitted to the Professional for consideration before proceeding with the work.

B. This Contractor is assumed to be skilled in the trade and is solely responsible for compliance with health and safety regulations, performing the work in a safe and competent manner, and installation procedures required for the work as outlined in these documents.

C. This Contract is all-inclusive of the work indicated on the Drawings and herein specified, and no separate Contract work, supplementary labor or service will be provided by the Client Agency, except as otherwise noted on the Drawings or herein specified.

D. If any part of the installation specified or shown on the Drawings to be executed under this Contract requires a trade or classification of mechanics other than is normally directly employed by this Contractor, it shall be expressly understood that this Contractor shall sublet or engage mechanics experienced in each explicit trade involved to execute the work for the Contractor.

1.07 SCAFFOLDING AND RIGGING

A. This Contractor shall provide all the scaffolding required to do the work included in this Contract. All necessary precautions must be taken in high risk areas. Provide temporary rigging, as required, to install work.

1.08 DRAWINGS

A. The drawings are intended to be diagrammatic and are based on one (1) manufacturer's equipment. They are not intended to show every item in its exact location, the exact dimensions, or all the details of the equipment. The Contractor shall verify the actual

dimensions of any substituted materials and equipment to ensure that they will fit in the available space. All apparatus shall be located, and all pipes run in the manner and locations shown thereon as closely as conditions will permit, and deviations therefrom shall be made only with the consent of the Professional, and without additional charge to the Client Agency.

1.09 TEN-DAY PRIOR APPROVAL

A. Any equipment or components proposed for this project, other than model numbers named in the bid documents, shall have pertinent submittal data and descriptive cover sheet submitted to the Professional ten (10) days prior to the bid date for inclusion in an addendum, if and when, reviewed and accepted for bidding.

B. This is for prebid review and is not to be regarded as submittals required for construction.

C. Bidder shall base the bid on items of equipment actually named in bid documents or addendums issued prior to bidding. Verbal acceptance will not be recognized unless verified in writing. It is the Bidders' responsibility to ascertain that all equipment has been accepted by requiring copies of the Professional's written acceptance from the Equipment **Suppliers.**

1.10 WARRANTIES

A. The Contractor shall warrant that the materials and workmanship used in the erection of this installation are as herein specified, and he shall provide all labor and materials required to make good any defects in same which become apparent within one year from date of acceptance of beneficial, permanent use of completed work in writing, providing such defects are due to faulty materials or workmanship and not to misuse of apparatus by the Client Agency, its employees, or tenants. Certain equipment shall be warranted or guaranteed for longer than one year from date of final acceptance where specifically mentioned in these specifications. This warranty shall be in writing and shall include written copies of factory warranties and expiration dates on items of equipment where the warranty date might differ from the acceptance date. No warranty shall start before the acceptance date. The acceptance will be for complete sections. No partial acceptance will be approved.

B. The equipment and materials manufacturers are expected to recognize that they are responsible for the failure of their products to perform in accordance with data furnished by them or their authorized representatives as well as misrepresentations of such data. When the products have been installed in accordance with the manufacturer's published or written instructions and recommendations and such products fail, then the Contractor and the manufacturers are responsible for replacement of the products and all associated work and materials without additional cost to the Client Agency. This warranty applies to all items supplied on the equipment and not just those that are the product of the manufacturer.

C. The Contractors' warranty shall include at least two (2) inspections of the system to repair and replace any items found to be defective during this period. The first shall be approximately six (6) months after the acceptance of the system and the second at the end of the first year.

1.11 SHOP DRAWINGS AND SUBMITTALS

A. Refer to Professional's Front End for submittal requirements.

B. At the close of the job, prior to final review, five (5) bound copies of operations and maintenance (O&M) manuals shall be submitted by transmittal to the Professional for review and acceptance. In lieu of hard copy O&M manuals, the Contractor may submit two (2) copies on CD format containing PDF files. O&M manuals, regardless of format, shall include the following:

1. Equipment warranties.
2. Contractors' warranties.
3. Parts list and manuals for all equipment.
4. Operating instructions (in writing).
5. Written instructions on maintenance and care of the systems.

C. Prior to the installation of any equipment or materials, submit shop drawings and manufacturer's data for the items listed in the Submittal Log (Attachment A) in accordance with the Contract Documents. Submittal Log (Attachment A) shall serve as the Contractor's checklist to assure the complete submission of all required shop drawings and manufacturer's data. Additionally, all equipment and materials furnished as part of this Contract shall be submitted for review regardless of whether it is listed on Submittal Log (Attachment A) or not.

D. The submissions are the Contractor's documents, and the Professional's review or acceptance constitutes an acknowledgment that the documents have been submitted and nothing more. It is the Contractor's responsibility to check his own submissions for compliance with the Contract Documents and job conditions.

E. Any deviations from the design documents must be clearly identified so that the Professional may properly review such items. It shall not be the Professional's responsibility to search out these discrepancies. If such changes are not properly flagged for the Professional 's review, the Contractor shall be completely responsible for all consequences said changes may result in on the project.

F. Submit Record (As-Built) Drawings. Refer to Paragraph 3.3

1.12 UTILITIES AND PROTECTION OF SERVICES

A. Do not interrupt any utility or service without adequate previous notice and schedule.

B. The Contractor shall, at his own expense, repair, replace and maintain in service any utilities, facilities or services (underground, overground, interior or exterior) damaged, broken or otherwise rendered inoperative during the course of construction. The material used by the Contractor shall be approved by the Professional.

1.13 INSTRUCTIONS TO CLIENT AGENCY'S OPERATING PERSONNEL

A. The Contractor and his subcontractors shall satisfactorily complete the systems so that they are functional and operating to the satisfaction of the Professional. All systems, their controls and their sequencing must be demonstrated to the satisfaction of the Professional.

B. The Contractor shall furnish the services of qualified personnel, approved by the Professional and thoroughly familiar with the completed installation, to instruct the Client Agency's permanent operating personnel in the proper operation of all systems included under this Contract and the proper care of all equipment and apparatus. These services shall be furnished for a period of two (2) 8- hour days after the operation of the building has been taken over by the Client Agency.

C. When instructions are provided under this Contract, the Contractor shall have in his possession three copies of an identifying letter which shall list the names of the Contractor's qualified instruction personnel, including manufacturer's representatives and subcontractors that will be giving instructions. Likewise, on the same letter, spaces shall be provided for the Client Agency's personnel who will receive the instructions. After instructions have been given and received for each system, the Contractor's representatives and subcontractors shall sign and date the letter, and the Client Agency's personnel shall sign and date the letter acknowledging that they have received adequate instructions for operating and maintaining the systems and equipment. One signed copy shall be delivered to the Client Agency, one copy to the Professional, and one copy shall be retained by the Contractor.

D. It is the intent that the entire systems with their complement of equipment and auxiliary equipment operate properly in accordance with the design concept and functional intent. It is also the intent that the Client Agency be given complete instructions for the proper operation and maintenance of all systems.

PART 2 - PRODUCTS

2.01 GENERAL

A. All products shall be first-line quality, of grade and type shown on the Drawings, and specified or equivalents accepted by the Professional in writing.

B. All products shall be in current production with no notice having been given that this product is to be drastically changed, modified or discontinued from production.

C. The Supplier, by submitting, certifies that the equipment being proposed is proper for the application intended and that it has the capacity called for on the Drawings or in the Specifications.

2.02 COMPLETE SYSTEM

A. All products, materials, and accessories shall be furnished, and installed as required, for a complete system ready for the Client Agency's beneficial use.

2.03 EQUIPMENT AND MATERIALS DEVIATIONS

A. When any material or equipment is identified on the drawings or in the Specifications by reference to a manufacturer's name or model number; it is intended to establish a required standard of design and quality; and it is not intended to limit competition.

B. When the Drawings and/or Specifications indicate one or more manufacturers' names for materials or equipment, the Bidder may submit a bid based on materials or equipment of manufacturers not named but considered by the Bidder to be equivalent to the standard of design and quality specified; however, such substitutions must be accepted by the Professional as equivalent. If the Bidder elects to bid on a substitution without securing written consent of the Professional prior to receipt of the bids, then it will be understood that proof of compliance with the specified requirements is the direct responsibility of the Bidder, and no such materials or equipment may be purchased or installed without written acceptance.

C. Bidders are advised to ascertain such acceptance from their Suppliers by requesting copies of acceptance in writing signed by the Professional from their Suppliers.

D. Where the equipment's electrical characteristics (i.e. horsepower, wattage, voltage, amperage draw, etc.) deviate from the plumbing and/or the electrical design, it is the responsibility of the .3 Contractor to strictly coordinate all electrical requirements prior to submittal, to meet the specific electrical requirements without a change order. Confirmation of coordination shall be included with the appropriate submittal. No change orders shall be awarded due to lack of coordination between trades.

2.04 ELECTRICAL WORK FOR PLUMBING EQUIPMENT

A. Electric Motors - All electrical motors furnished and installed under this Contract shall be manufactured by Reliance, General Electric, U.S. Motors, or approved equivalent, and shall be of the proper type and frame of the services involved in accordance with the NEMA and Equipment Manufacturer's recommendations. Motors shall be "energy efficiency" type with 1.15 service factor. Motor windings shall be all copper. Where possible, motors shall be permanently lubricated. Where motors must be lubricated, the manufacturer shall furnish the services of a representative to review the lubrication procedure with the Contractor and the Client Agency and turn over to both of them all of the necessary maintenance literature. Motors and installation shall conform to all applicable requirements of the National Electrical Code. Motors shall be suitable for across-the-line or reduced voltage starting as applicable in each instance. Furnish the .4 Contractor with all motor data so the .4 Contractor may size wiring. The .3 Contractor shall be responsible for any additional costs to the .4 Contractor resulting from any changes in motor sizes initiated by the Contractor, from sizes scheduled on the Drawings. Motors located in conditioned space shall be selected for quiet operation and shall not produce an objectionable "Motor Noise" in the space.

B. Manual Motor Starters - Manual motor starters (disconnect switches/thermal overload switches) shall be furnished by this Contractor, for installation by the .4 Contractor, for single phase fractional horsepower (1/2 horsepower and smaller) motors, Square D, Allen-Bradley, Siemens, or approved equivalent. Furnish all motor electrical characteristics to the .4 Contractor so the .4 Contractor may size wiring. The .3 Contractor shall size the manual motor starter overload devices for the loads served.

C. Magnetic Motor Starters - Full Voltage - Furnish and deliver to the .4 Contractor for installation,

combination full voltage magnetic starters and fused disconnect switches for all 3 phase motors with service factors of 1.15. Starters shall have three (3) current overload relays and low-voltage release. Starters shall be furnished with hand-off-automatic switch, red run light, overload reset, a set of extra auxiliary contacts consisting of one (1) normally open contact and one (1) normally closed contact and a control transformer with 120 volt fused secondary control circuit and fused primary circuit. Starter enclosure shall be NEMA Type 1 enclosures. Furnish Allen-Bradley Bulletin 512 starters, or equal as manufactured by Square D, Siemens, or approved equivalent. Disconnect switches shall be horsepower rated to match the horsepower of the motors plus 1.15 service factors connected thereto as required. Fuses shall be furnished and installed by the .3 Contractor as herein specified. Where starters are separately mounted, they shall be of the magnetic type as herein specified. All magnetic motor starters for motors connected to the normal/emergency electrical distribution system shall be furnished with an adjustable time delay unit. Time delay unit shall be capable of delaying motor starting from 0 to 180 seconds.

D. Hand-Off Automatic (H.O.A.) Selector Switches - Furnish and install hand-off-automatic selector switches where shown or required and shall be the type that can be changed in the field from two positions and vice versa. Switches shall have padlocking attachment that will permit locking in either the manual or automatic positions. Switches shall be furnished with NEMA Type 1 enclosures where installed remote from starter. Furnish and install Allen-Bradley three (3) position switches, Bulletin 800S-R35X with 800S-N1 padlocking attachment, or equal as manufactured by Square D, Siemens, or approved equivalent.

E. Safety Switches - Safety switches shall be furnished by the .3 Contractor for installation by the .4 Contractor.

1. Safety switches shall be of the fusible type, quick-make, quick-break, in NEMA Type 1 sheet steel enclosure unless otherwise noted. Switches shall be horsepower rated, and of size and number of poles as indicated on the Drawings. Safety switches shall be of type having a direct mechanical linkage between contacts and operating handle. Safety switches shall be as manufactured by Cutler-Hammer, General Electric, Square D Company, or approved equivalent. Fuses for all switches shall be of the UL Class RK-1 Low Peak, as manufactured by the Bussmann Mfg. Division of the McGraw-Edison Company, or Little Fuse. Fuses for motors shall be sized to conform with the motor running current and in strict accordance with the recommendations of the fuse manufacturer.
2. Where switches are located at the exterior of the Building or in wet locations, they shall be provided with NEMA 3R or 4 weather tight and weather resistant enclosures. Enclosures for switches located in hazardous areas shall be of the appropriate explosion proof type.
3. Switches used as service entrance switches shall be Underwriters Laboratories listed, suitable for Service Entrance Equipment.

F. Electrical characteristics shall be determined from the Drawings and Specifications and verified on the job.

1. All power wiring by .4 Contractor; all control wiring by .3 Contractor, except as herein specified; refer to “Control Wiring”, this section. All power wiring and connections for all motors, including starters, controllers, and breakers will be furnished and installed under the Electrical Contract.
2. In general, rigid conduit or tubing for control wiring shall be used, but equipment that requires movement or that would transmit vibration to conduit shall be wired with flexible (liquid tight) steel conduit, not over eighteen (18") inches long. Provide surface raceways at finish locations.
3. All equipment with control wiring shall be grounded with a green-covered ground wire run inside the conduit and connected to the equipment frame on one (1) end and to grounding system on the other end.
4. All electrical work required in the Contract shall conform to all applicable requirements of

Division 26 of these Specifications.

5. The .3 Contractor shall employ an approved, licensed Electrical Subcontractor, fully qualified in the trade, to perform all electrical control work required under the Contract.
6. This Contractor shall not run piping above motors, switchboards, or panelboards in accordance with the National Electrical Code. Before piping is installed, coordinate exact locations with the .4 Contractor. Failure to comply with this requirement shall be cause for the piping to be removed and relocated at no additional cost to the Client Agency.

2.05 CONTROL WIRING

A. Furnish and install control wiring as indicated on the drawings or as specified in various portions of the specifications. All control wiring is the responsibility of the .3 Contractor, who provides the particular equipment, except as herein specified.

1. Power and Control wiring and conduit from all sump pump junction boxes to sump pumps shall be included under the Plumbing Contract.
2. For all packaged systems of skid-mounted equipment, the .4 Contractor shall provide a single point power connection to the system. All associated power and control wiring within the packaged system to equipment skid shall be by the .3 Contractor. Refer to drawings for specific wiring scopes of work.

B. Control wiring, in general, shall mean “low voltage” wiring, such as 24 volt, 12 volt, and 6 volt wiring, and shall include the providing of all required motor controls, relays, pilot devices, all related raceway systems, all related conductors, and all final electrical connections other than three phase power connections.

C. For 120V or 277V line voltage equipment provided under the Plumbing Contract, the .4 Contractor will provide single phase feeders and make final connections.

D. All control wiring shall be extended in conduit. Use "plenum wire" without conduit where runs are in conditioned spaces such as relief, air conditioned, or return plenums.

E. Control wiring shall be run in conduit, and shall be copper conductors provided with Type THHN or dual rated THHN-THWN insulation and protective covering, not less than No. 12 AWG, run in accordance with the National Electrical Code; and in general, conforming to Division 26 specifications for this project.

F. Conduit above ground for control wiring shall be rigid steel conduit or electrical metallic tubing, run in accordance with the National Electrical Code; and in general, conforming to Division 26 specifications for this project.

G. Conduit below ground or below slab for control wiring shall be Schedule 40 PVC, UL rated for 90 degrees C., run in accordance with the National Electrical Code; and, in general, conforming to Division 26 specifications for this project.

2.06 VIBRATION AND NOISE CONTROL

A. Furnish and install vibration isolators, flexible connectors, and other safety measures to prevent noise and vibration from being transmitted to occupied areas.

B. Following installation, make proper adjustments to eliminate excessive noise and vibration.

C. All equipment shall operate without objectionable noise or vibrations within Noise Criteria Curves listed in Sound Control Fundamentals of the latest edition of the ASHRAE Handbook of Systems and Applications. Sound and vibration measurements shall conform to the ASHRAE Handbook of Fundamentals. If such objectionable noise or vibration shall be produced and transmitted to occupied portions of the building by apparatus, piping, or other parts of this work, any necessary changes, as approved by the Professional, shall be made without cost to the Client Agency. Noise levels shall conform to the requirements of OSHA.

2.07 TAMPERPROOF SCREWS

A. All screws exposed to view on plumbing equipment installed under this Contract, such as on wall access panels, fixtures and trim, floor drains, cleanouts, water coolers, and similar equipment,

shall be tamperproof type. Screws shall be vandalproof slot type, Holt head, Allen head, or similar types. Phillips head screws are not regarded as tamperproof.

B. Finish of screws shall match the finish of equipment in which they are being installed.

2.08 ACCESS PANELS

A. The .3 Contractor shall furnish factory-fabricated access panels for access to all concealed valves, shock absorbers, air vents, traps, trap primers, strainers, cleanouts, plumbing equipment, and other items where no other means of access is available. Access panels shall be of appropriate size but not less than 18", except as otherwise noted on the drawings, flush type, hinged to drop down and out, concealed hinge and vandalproof operated spanner head cam lock, stainless steel in tile work and prime coated sheet steel in plaster or acoustical tile of all types. The .3 Contractor shall deliver access panels to the .1 Contractor for installation. Exact locations of panels shall be determined by the .3 Contractor, but panels shall be located for a symmetrical appearance. Access panels are not required at lift-out removable tile ceilings.

B. At locations where indirect waste access is required, access panel doors shall be louvered. Louvered panel doors shall be as manufactured by Cierra Products, or approved equivalent.

C. At locations where access panels are installed in fire-rated construction, access panels shall contain the 1-1/2 hour fire-rated "B" label; and in addition, shall also be provided with layers of gypsum wall board in thicknesses which will supply additional fire ratings equal to the fire ratings of adjacent construction.

D. Coordinate with the .1 Contractor on fire ratings of construction.

E. Access panels shall be Cierra Products, Acudor, or Zurn or equivalent as approved by the Professional.

2.09 SLEEVES AND ESCUTCHEONS

A. The Contractor shall provide sleeves for all piping and equipment passing through walls, floors and foundations. Sleeves, in general, shall be constructed of Schedule 40 steel pipe. Space between pipe and sleeve shall be sealed with a fire stopping material. Sleeves are not required for vertical core-drilled holes (i.e. fixture drainage piping); however, openings shall be filled with firestopping. Sleeves for large sewer piping which may pass through grade beams shall be Schedule 40 PVC. Provide openings through grade beams in accordance with Professional’s requirements.

B. All sleeves shall be of sufficient size to allow continuous passage of insulation where required.

C. Where pipe motion, due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe.

D. Sleeve installations in exterior and designated interior walls, foundations and slab on grade floors shall consist of steel sleeves with the annular space between the carrier pipe and sleeve continuously filled with modular, mechanical type, inter-locking synthetic rubber links. Sleeves shall be Model WS and links, Model LS, all as manufactured by LINK-SEAL Division, Thunderline Corporation, Advance Products & Systems, Inc., or Metraflex, or equivalent as approved by the Professional.

E. Sleeves through fire rated construction shall be sealed as specified under the "Fire Stopping" section of this Specification.

F. Escutcheons, including at fixtures, floor, wall, and ceiling plates, shall be chrome, cast brass, setscrew type. Provide “deep type” escutcheons where required to conceal connections; use split ring backup escutcheons beneath deep escutcheons for extra depth where necessary. For insulated pipes, the escutcheon shall surround the outside of the insulation.

2.10 FIRE STOPPING

A. Seal openings of fire rated construction with a material or product that has been tested at an independent testing laboratory, such as UL, FM, etc. Fire stopping shall conform to ASTM E-814, UL 1479, or UL 2079, with fire ratings equal to or exceeding the fire rating of the construction involved (Refer to General Construction Documents). Fire stopping shall be UL

classified, and shall be similar to RectorSeal Metacaulk, 3M brand Fire Barrier Penetration Sealing Systems, or Hilti **o**r equivalent as approved by the Professional. Fire stopping of this type shall also be utilized for openings through smoke/fire rated construction. Refer also to applicable International Building Code Standards.

B. If desired by the Contractor and approved by local codes, the “Hydro Flame” pipe sleeving system will be acceptable, by Presealed Systems, 3M, or Hilti or equivalent as approved by the Professional. Penetration system shall be UL certified, a water/fire stop system, tested to ASTM E814. Flame Through/F-Rating: up to 3 hours. System shall be secure, waterproof, fire rated, smokeproof, protects against gases, prevents mold intrusion, and shall allow for pipe expansion and contraction.

C. If desired by the Contractor and approved by local codes, the "Pro Set" water/fire stop piping penetration systems also may be utilized. Penetration systems shall be UL certified and shall be the "Pro Set" System A, System B, or System C, 3M, or Hilti or equivalent as approved by the Professional

D. Surfaces to which firestop materials will be applied shall be free of dirt, grease, oil, rust, release agents, water repellents, and any other substances that may affect proper adhesion.

E. Comply with manufacturer’s recommendations for temperature and humidity conditions before, during, and after installation of firestopping.

2.11 PROTECTION FROM NAILS, SCREWS, AND OTHER FASTENERS

A. Plastic and copper piping running though framing members to within one (1) inch of the edge of the framing shall be protected by steel plates not thinner than 16 gauge. Where such piping penetrates top plates or sole plates of the framing, the nail plate shall extend at least two (2) inches below top plates and two (2) inches above sole plates.

B. Where plastic and copper piping runs through metal framing members, it shall be protected from abrasion caused by expansion and contraction of the piping or movement of the framing.

PART 3 - EXECUTION

3.01 WORKMANSHIP

A. All work shall be performed by competent mechanics using proper tools and equipment to produce first-quality work. All work shall be neatly installed, accessible for maintenance, and complete with all accessories required.

3.02 ACCESSIBILITY

A. All equipment shall be installed in such away that all components requiring access (control operators, motors, drives, belts, valves, etc.) are so located and installed that they may be serviced, reset, replaced or recalibrated, etc. by service people with normal service tools and equipment. If any equipment or components are shown in such a position that this Contractor cannot comply with the above, the Contractor shall notify the Professional.

3.03 RECORD (AS-BUILT) DRAWINGS

A. The Contractor shall maintain a complete set of Contract Drawings at the site and shall record all deviations in his work **(in red ink or pencil**) from that indicated on the Contract Drawings. Deviations shall be clearly and accurately recorded so that the Professional can prepare final record (as-built) drawings using the Contractor’s marked-up drawings. Dimensions shall be recorded using permanent reference points such as columns, building walls and like items. As-built documents shall include all valve locations and valve tags. These record drawings shall be submitted to the Professional prior to final acceptance.

3.04 FOUNDATIONS AND SPECIAL SUPPORTS

A. For concrete bases for equipment included under this Contract, the .3 Contractor shall establish sizes and locations of the various bolts, together with the templates for holding these bolts in position. Anchor bolts shall be placed in steel pipe sleeves to allow for adjustment, with suitable plate at bottom end of sleeve to hold the bolt. Each piece of equipment designated to have a base shall have a concrete base of not less than four (4") inches high, which shall project four

(4") inches on all sides beyond the equipment. Bases shall have greater depths of height where so noted on the drawings. Refer to “Concrete Work”.

3.05 CODES, STANDARDS, AND REGULATIONS

A. All materials and workmanship shall comply with all applicable codes, federal and state laws, Specifications, local and county codes and ordinances, industry standards, utility company regulations, NFPA, and NEC. In case of a difference between codes, Specifications, federal and state laws, local and county codes and ordinances, industry standards, utility company regulations, NFPA, and NEC, and the Contract documents, the most stringent shall govern. The Contractor shall promptly notify the Professional in writing of any such difference.

B. Reference to the following codes shall mean:

REFERENCE	DEFINITION
ASTM	American Society for Testing Materials
NFPA	National Fire Protection Association
UL	Underwriters Laboratories, Inc.
NEMA	National Electric Manufacturers Association
ANSI	American National Standards Institute
IBC	International Building Code
IPC	International Plumbing Code
NEC	National Electrical Code

C. Should the Contractor perform any work that does not comply within the requirements of the applicable building codes, state laws and federal laws, local and county codes and ordinances, industry standards, utility company regulations, NFPA, and NEC, the Contractor shall bear all costs arising in correcting the deficiencies.

D. This Contractor is assumed to be skilled in the trade and is solely responsible for compliance with OSHA regulations, performing the work in a safe and competent manner, and in installation procedures required for this work. All supervision assigned to this project shall be experienced in this type of work. This Contractor’s superintendent shall be designated as Safety Inspector, unless the Contractor designates another person and notifies the Professional of this change.

3.06 PERMITS, FEES, TESTS AND INSPECTIONS

A. The Contractor shall give all requisite notices, obtain and pay all deposits, permits, and fees, including connection fees, necessary for the installation, tests, and inspections of all work provided under this Specification, and included under this Contract. All tests shall be conducted in the presence of the Professional.

3.07 REVIEW BY PROFESSIONAL

A. This Contractor shall notify the Professional at the following stages of construction so that the Professional may visit the site for review and consultation:

1. When equipment installation starts.
2. When ceiling installation will cover any work not reviewed.
3. When any piping is to be permanently concealed by construction.
4. When any piping is to be permanently concealed by backfilling of trenches.
5. When testing is started.

B. Should the Contractor fail to notify the Professional at the times prescribed above, it shall then be the Contractor’s responsibility and cost to expose any concealed piping or demonstrate the acceptability of any part of the system. Any extra cost, caused by the removal of work by other trades, shall be borne by this Contractor, at no cost to the Client Agency.

3.08 EARLY START-UP

A. This Contractor shall do all possible to see that the plumbing equipment is connected with electrical power as early as possible, so that final testing can be started. Should this Contractor be ready for operation and power is not available, the .4 Contractor and the Professional shall be notified.

3.09 CLEANING AND PAINTING

A. Periodically remove from the building site all rubbish and accumulated materials.

B. At the completion of the project, thoroughly clean all equipment and remove all trash, cartons, and similar debris from the area. Make any necessary corrections or repair/replace any damaged materials or equipment. Leave the entire systems in a thoroughly clean and orderly manner.

C. Where welding of pipe destroys factory pipe coating, piping shall be repainted. Any finished surfaces that have been scratched or discolored shall be touched up or repainted with paint to match the original color, to the satisfaction of the Professional. If any part has been bent, broken or otherwise damaged, it shall be replaced new prior to final review.

D. The following items of equipment and piping being furnished under this Contract shall be prime coated and finish painted by the .3 Contractor. Painting shall be in strict accordance with the requirements and recommendations of OSHA.

1. All equipment and piping installed outside the building exposed to weather, including on roof areas. Colors shall be as selected by the Professional. Finish paint cast iron roof drains of color selected by the Professional.

2. All non-galvanized and unpainted support steel, brackets, hangers, and other miscellaneous metals, including in crawl spaces, tunnels, walkways, above ceilings, loft spaces, prefabricated floor trenches, mezzanine spaces, and accessible pipe spaces.

E. Insulated piping is not required to be painted, unless requirements provided by the Client Agency and Professional. All Piping shall be painted in accordance with Client Agency and Professional requirements. Coordinate painting procedures and requirements prior to bidding. Painting of piping may include, but not limited to, the following:

1. All insulated piping and equipment exposed to public view.

2. All uninsulated piping in Mechanical Equipment Rooms.

F. Surfaces required to be finished painted shall be painted as follows:

1. All uninsulated piping shall be painted with one (1) coat of rust inhibitive red primer and one (1) coat of gloss enamel.

2. All other ferrous metals shall be painted with one (1) prime coat of equipment and machinery primer and one (1) finish coat of gloss enamel.

3. Coated cast iron or coated black steel piping need not be painted above ceilings; however, rusted or scraped piping shall be touched up, to keep a like new finish.

4. All galvanized surfaces shall be painted with one (1) prime coat of galvanized steel primer and one (1) finish coat of gloss enamel. All aluminum surfaces shall be painted one (1) prime coat of aluminum primer and one (1) finish coat of gloss enamel. Paint shall be of types specifically made for these surfaces.

5. All other copper and brass surfaces shall be painted with one (1) prime coat of zinc chromate primer and one (1) finish coat of gloss enamel.

G. Color code and/or label all natural gas piping per Gas Company's and/or Client Agency/Professional's requirements.

H. Paint shall be of colors selected by the Professional.

I. Finish paint color samples shall be submitted to the Professional for approval.

J. Paint shall be as manufactured by Glidden, PPG, Rust-Oleum, or Sherwin-Williams or equivalent as approved by the Professional.

K. All painting shall be done in a careful, neat and workmanlike manner with particular care being exercised to protect building equipment and finishes. All surfaces shall be thoroughly cleaned of rust, scale, dirt, grease, dust, and like items, and sanded so as to provide bond for new paint. The Contractor shall be entirely responsible for cleaning all surfaces and should evidence appear to the Professional that the surface was not properly prepared, the Contractor shall remove paint, prepare surface and repaint as required at no additional cost.

L. The Contractor shall be responsible for painting his piping and equipment installed in finished areas after these areas have received finish painting by the .1 Contractor or in areas where the .1 Contractor is not painting.

M. Refer to “Plumbing Identification”, Section 220553, for stenciling and labeling.

3.10 FINAL CONNECTIONS

A. All equipment noted as furnished and installed by other contractors or by the Client Agency, that requires plumbing services, will be furnished and installed complete with trim by that party, except as herein specified. The .3 Contractor shall coordinate type and location of equipment, rough-in services noted or required and make final connections. Final connections shall include items such as drain tailpieces, “P”-traps, running traps, water, air, and gas shut-offs, interconnecting piping extensions, piping within and around cabinetry, combination waste assemblies where required, piping adapters, and like items.

3.11 MAINTENANCE

A. Contractor shall be responsible for maintenance of all equipment and apparatus included under this Contract until final project completion.

3.12 PLUMBING PLANS

A. The plumbing plans are intended to be diagrammatic and are based on one (1) manufacturer’s equipment. They are not intended to show every item in its exact location, the exact dimensions, or all the details of the equipment. The Contractor shall verify the actual dimensions of any specified or substituted materials and equipment to ensure that they will fit in the available space. All apparatus shall be located as closely as conditions will permit and deviations therefrom shall be made only with the consent of the Professional and without additional charge to the Client Agency. The right is reserved by the Professional to make any reasonable changes in the location of the equipment prior to rough-in without invoking additional expense to the Client Agency.

3.13 QUESTIONS AND CLARIFICATIONS OF BID DOCUMENTS

A. **Bidders shall not rely on any verbal clarification of the drawings and specifications. Any questions or clarifications shall be referred to** Professional **at least seven (7) working days prior to bidding to allow for issuance of an addendum.**

3.14 CHANGE ORDERS

A. If change orders are not justified or rejected repeatedly by the Professional and the Client Agency, the Contractor shall be required to reimburse the Professional and the Professional for time spent in excess of eight (8) hours to review change orders that are not justified.

3.15 SUBSTITUTIONS

A. Throughout the Specifications, types of materials may be specified by manufacturer's name and catalog number in order to establish standards of quality and performance and not for the purpose of limiting competition. Unless specifically stated otherwise, the bidder may assume the phrase "or approved equivalent," except that the burden is upon the bidder to prove such equality. If the bidder elects to prove such equality, he must request the Professional's approval in writing to substitute such item for the specified item, and shall submit supporting data, and samples if required, to permit a fair evaluation of the proposed substitution with respect to quality, serviceability and warranty. All data pertinent to the proposed substitution shall be submitted to the Professional at least 10 days prior to the bid date for evaluation and review purposes. If the Professional accepts the proposed substitution, an addendum will be issued to all bidders advising all bidders that this substitution will be acceptable from all bidders.

B. Substitutions of equipment other than that specified must be very carefully checked to assure that no problems will occur due to dimensional differences, code requirements, connection points, weights, etc. Where the Contractor elects to substitute materials or equipment approved by the Professional for those specified, the Contractor will be held responsible for all Architectural, structural, mechanical, and electrical changes required for the installation of the substituted materials at no additional cost to the Client Agency. All tests required to substantiate the equivalence of the material will be the obligation of the Contractor.

C. When this Contractor desires to furnish equipment of a manufacturer other than that specified or intended, he shall include a complete specification of the substituted item, along with each submission copy of shop drawings, indicating the necessary modifications to the substituted product to satisfy the requirements of the Contract Specifications. Manufacturer's specifications shall be written as close as possible over the Contract Specifications and each paragraph shall bear the same paragraph number as the Contract Specifications so that close comparison can be made. All submissions will be rejected should they not include the comparison specification. Comparison specification shall be submitted for approval 10 days prior to the Bid Date. If prior approval is not obtained, no substitutions will be considered and the Professional reimbursed for time spent to reject and return such submission.

D. The verification specification shall include the exact wording of the Contract Specification and the revised wording identified properly indicating all the deviations proposed. If no deviations are noted, the Contractor must furnish the material or equipment in accordance with the Contract Specifications.

E. Should the Contractor elect to propose a substitution after the project has been awarded, the Contractor will be billed for the time spent by the Professional and his consultants in evaluating the proposed substitution. This billing shall occur whether the proposed substitution is accepted or rejected and shall be at the rate of the direct cost to the Professional times a 2.5 multiplier.

F. The submissions are the Contractor's documents, and the Professional's approval constitutes an acknowledgment that the documents have been submitted and nothing more. It is the Contractor's responsibility to check his own submissions for compliance with the Contract Documents and job conditions.

3.16 COORDINATION FOR CONTRACTORS

A. Actual location of pipe and equipment shall be determined at site. IN GENERAL, ROUTINGS OF THE .2 CONTRACTOR SHALL TAKE PRECEDENCE. Contractor shall confer with other contractors as to locations of pipes, ducts, electrical and equipment provided under their contracts, before erecting any work. In case of confliction, the Professional shall have the final decision, with no cost to Client Agency.

B. Contractor shall furnish .4 Contractor information on electrical requirements of equipment provided under Contract. Equipment connections shall be made in neat and workmanlike manner, placing equipment in proper operating condition, with provisions for maintenance or replacement. Equipment manufacturer's recommendations shall be followed for final connections.

3.17 FLASHINGS

A. The .1 Contractor will furnish and install all new roof flashings for roof drains and vents. Roof gas pipe flashing will be completed in a similar fashion. The .3 Contractor shall provide wall and floor flashings as specified. All existing roof flashing shall be under this Contract.

B. For interior floor drain installations and concrete slab concealment in above-floor slab locations, epoxy concrete grout shall be used as manufactured by Nor-Mar Enterprises, F-101 Ease-A-Crete, or approved equal. Refer to Drawing Details.

3.18 EXCAVATION AND BACKFILL

A. The Contractor shall do all necessary excavation and backfill required for the proper installation of work under the Contract. Excavation and backfill shall be for work included under the Plumbing Contract, and such items as seeding, detectable strips in trenches, piping terminal

ends, paving, and similar items described herein shall be directly coordinated with the Site Contractor prior to ordering or installation. Determine exact start/stop construction points and final connections before proceeding with the work.

B. The excavation shall be unclassified. All excavation shall mean the removal of all materials necessary to obtain proper grade for all piping and work installed under the Contract.

C. Unless noted otherwise in these Specifications, trenching shall be excavated 6" below pipe invert and backfilled with thoroughly mechanically tamped crushed stone having a maximum size of 1/2". After the work has been inspected and/or tested, the excavation shall be backfilled around and up to 12" over the pipes with the same material as pipe bedding. The balance of the excavation/trenching shall be backfilled as follows:

1. Interior Areas – Backfill shall be 2RC stone up to the level of the pavement stone base.
2. In all cases, backfill shall be thoroughly mechanically tamped and placed in layers not exceeding 6" in depth. Compact each lift until a dry density is obtained, which is equal to or exceeds 95% "Proctor" for pavement areas and building slab on grade areas; 90% "Proctor" elsewhere. Maximum dry density shall be obtained by testing a representative sample of fill in accordance with ASTM D-1557. Submit laboratory test reports which shall indicate compliance with these Specifications. Tests shall be performed at the following locations and frequencies, or as otherwise directed by the Professional:
   a. Paved and building slab on grade areas: In no case fewer than three (3) tests- at subgrade and at two (2) selected compacted fill and backfill layers.
   b. Foundation wall backfill: In no case fewer than two (2) tests – at compacted initial and final backfill layers.
   c. Trench backfill: In no case fewer than two (2) tests-at compacted initial and final backfill layers, at least one test for each 150 feet or less of trench length.
3. Provide a 6” wide detectable metallic caution type foil marking strip for each exterior underground utility line installed under this Contract, continuously, all locations. Marking strip shall be a minimum of 12” below finished grade, except 6” below subgrade under pavements and slabs; color coded, with appropriate applicable wording. Marking strip shall be as manufactured by Seton Name Plate Company, Brady Co., or MSI Services. Marking strip shall be placed before finished grading procedures and shall be directly coordinated with site utility marking strips provided by others.

D. The excavation shall be kept free of water. No piping, equipment or concrete shall be installed in water. The Contractor shall provide necessary pumping and drainage for the protection of the installation.

E. All excavation or trenching which occurs under wall foundations shall be backfilled up to the level of the wall foundation using concrete as herein specified.

F. Where ground is found to be unsuitable to support pipe, provide concrete cradles. When laying pipe in concrete cradles, deposit concrete full width of cradle continuously to bottom of pipe, before concrete is set, embed pipe evenly, deposit remainder of concrete and tamp in a manner to avoid disturbing pipe. Provide concrete bridging in trenches in roadways in strict accordance with utility company or sewer authority requirements.

G. The Contractor shall maintain the work safe to human life and property in conformance with all Local, County, State and Federal Safety Regulations.

H. Any structures and existing services damaged in the course of the work shall be repaired by the Contractor in kind equal to or surpassing the existing installation.

I. All excess excavation material shall be removed from the site, properly and legally disposed of, at an approved land fill area, unless arrangements are made with the Client Agency for on-site disposal.

3.19 SPECIAL ENGINEERING SERVICES

A. In the instance of Mechanical and Control systems, such as all major and special equipment,

controls, or similar miscellaneous systems and equipment, the installations, final connections and testing of such systems shall be made under the direct supervision of competent authorized service Professionals who shall be employed by the respective equipment manufacturer and/or an authorized representative. Any and all expenses incurred by these equipment manufacturers' representatives shall be borne by the Contractor.

3.20 TESTS AND ADJUSTMENTS - GENERAL REQUIREMENTS

A. The Contractor shall furnish all labor, material, and equipment necessary for performance of all tests required by any of the agencies having jurisdiction. Testing procedures shall be outlined hereinafter under the respective sections of these specifications.

B. All tests shall be conducted in the presence of the Professional. No piping shall be concealed until the system has been approved.

C. At the completion of the work, all equipment, valves, fixtures, fixture trim, mixing valves, regulators, hose bibbs, wall hydrants, sprinkler heads, etc., shall be adjusted for proper operation.

D. The Contractor shall obtain certificates of approval, acceptance and compliance with regulations of all agencies having jurisdiction. Work shall not be deemed complete until such certificates have been delivered to the Professional.

3.21 EQUIPMENT GUARDS

A. Equipment guards shall be provided for protection at all belts, chains, gears, or other moving parts of equipment and machinery installed under this Contract. Guards shall be made up of suitable structural shapes and heavy gauge steel welded together and attached to equipment by removable clips and bolts. Guards shall be neat and substantial and shall be securely attached to equipment. After fabrication, guards shall be cleaned of rust and scale and painted with one coat of metal primer followed by one coat of enamel to match the equipment. Guards shall be easily removable for maintenance and service of equipment. All equipment guards shall conform with ANSI/OSHA requirements.

3.22 CONCRETE WORK

A. For each piece of floor mounted equipment shown or specified to have a concrete base or pier built on the new or existing floor slab, the Contractor shall install a floor slab of suitable size for the equipment to rest thereon. Each foundation shall extend 4" above the floor line (unless otherwise indicated on the Drawings), and shall extend a minimum of 4" on each side of the equipment. Conform with specific equipment manufacturer's recommendations for construction of bases and foundations in each instance.

1. Refer to “Excavation and Backfill” for interior concrete floor slab replacement, such as for new sewer work.

B. Furnish and install all concrete work related to work included under this Contract. Construct concrete forms and bases for the equipment installed under this Contract. Bases and forms shall be of suitable dimensions for all equipment. All concrete work shall be constructed subject to the approval of the Professional.

C. Bases shall be reinforced with 6 x 6 x #10 gauge wire mesh unless detailed otherwise and anchored through floor construction with 3/4" diameter bolts or rods. Anchor bolts for equipment shall be placed in base before equipment is set.

D. Concrete shall attain a minimum compressive strength of 3,300 psi at the age of 28 days, unless otherwise specified or indicated on the Drawings, such as for manufacturer’s precast concrete construction. Tests shall be made by an approved laboratory if in the opinion of the Professional the concrete is not satisfactory. All costs in connection with tests of concrete shall be borne by the Contractor.

E. All materials used for plain and reinforced concrete and the measuring, mixing, handling, placing and curing shall conform to current specifications of the American Concrete Institute (ACI 304 and ACI 318-71). Cement shall be normal Portland cement, Type I or Type II, conforming to ASTM Designation C-150.

F. Aggregates shall consist of sand of approved quality, crushed stone, and washed gravel conforming to ASTM Standard Specification Designation C-33, and shall be supplied from a source approved by the Professional. The maximum size of the aggregate shall be no larger than 1/5 of the narrowest dimensions between forms of the members for which the concrete is to be used, no larger than 3/4 of the minimum clear spacing between reinforcing bars. All water for concrete shall be clean and free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

G. Slag in any form will not be permitted as an aggregate.

H. Proportions shall be in accordance with American Concrete Institute Standard "Recommended Practice for the Design of Concrete Mixes ACI 211.1."

I. Metal reinforcement shall be deformed steel bars, cold-drawn steel wire, or fabricated forms of these materials. All bars shall be deformed, intermediate grade new billet steel. These materials shall conform in quality to Standard Specifications of the American Society for Testing Materials of the following applicable titles and serial designations:

Bars	
Billet-Steel Bars for Concrete Reinforcement	A 615
Rail-Steel Bars for Concrete Reinforcement	A 616
Wire	
Cold Drawn Steel Wire for Concrete Reinforcement	A 82
Fabricated Materials	
Fabricated Steel Bar Mats for Concrete Reinforcement	A 184
Welded Steel Wire Fabric for Concrete Reinforcement	A 185

J. Forms shall be of steel or wood and shall conform to the shape, piping, grades and dimensions of the concrete. All formwork shall comply with ACI 347. They shall be sufficiently tight to prevent leakage of mortar and shall be properly braced and tied together so as to maintain the desired position and shape during and after placing concrete. Forms shall be removed in such a manner as to assure the complete safety of the structure. All exposed corners or edges shall be chamfered. All burrs, fins, irregularities of forming, or spillage shall be removed and the surface float or trowel finished to a smooth straight surface.

K. Concrete shall be integrally waterproofed with Rez-Seal, by Euclid Chemical Company, or approved equivalent additive.

L. Water stops of plastic, as manufactured by Ryerson, or approved equivalent, shall be installed in all concrete joints and between pours.

M. Any new piping routed below new or existing foundations shall be encased in concrete. Concrete shall extend a minimum as follows: to the underside of the foundation wall, on 1’-0” on each side of the interior and exterior foundation walls, and 1’-0” below the pipe. Concrete below piping shall be set on 2’-0” of 2RC, or equivalent, stone base.

3.23 MISCELLANEOUS IRON WORK

A. Furnish and install all miscellaneous iron work including, but not limited to, piping hangers, piping anchors and guides, and all other equipment supports. All additional structural members shall be furnished and installed to support equipment without excessive stress or strain on the building construction. Structural beams and other structural members shall be furnished and installed under this Contract where the building steel is not available or capable of supporting or anchoring pipe piping and equipment.

B. All equipment and materials furnished and installed under this Contract which are not mounted on bases or floors shall be securely attached and supported from the main supporting structure of the building by metal hangers, clamps and/or brackets. Metal hangers, clamps and/or brackets shall be of suitable design and of sufficient strength to properly and safely support the materials and equipment involved. Lag screws and bolts shall be used where required at wood

construction.

C. Materials - Structural steel members for the support of equipment installed under this Contract shall conform to ASTM Specifications A-36 and shall comply with the latest requirements of the American Institute of Steel Construction. Structural steel shall be of standard sections as given in the structural steel manufacturers' handbooks.

D. Priming - All steel and iron work shall be primed with Rust-Oleum red primer, Glidden, PPG, Sherwin-Williams, or approved equivalent. Before priming, all metal shall be thoroughly cleaned free from scale, rust, and dirt.

E. Anchors - The Contractor shall provide all anchors, bolts, screws, dowels, and connecting members and do all cutting and fitting necessary to secure the work to adjoining construction. Build in connecting members to masonry, concrete, and structural steel as the work progresses.

F. Supports and Brackets - Supports and brackets shall be neatly constructed of structural shapes to adequately support the equipment intended. All supports must be approved prior to installation. Field conditions will regulate the type of support.

3.24 COORDINATION DRAWINGS

A. Coordination

1. Each Contractor shall familiarize himself with the drawings and specifications of all other contracts relating to this project and shall coordinate with, and be held responsible for his Work which is affected by or dependent on, other contracts.

2. Each Contractor shall provide any dimension, coordination, sleeve, insert, embedded or built-in item, and/or information which is required to be built into, or to complete, the work of another contract in a manner consistent with the Approved Project Schedule. Any additional cost or delay damages arising from a contractor’s failure to so furnish or provide shall be borne by that contractor.

B. Coordination Drawings and Procedures

1. Each Contractor shall prepare composite shop drawings and field installation layouts for his work as directed by the Professional to solve tight field conditions except as modified in Paragraph 3 below. Such drawings shall consist of dimensioned plans and elevations and shall give complete information, particularly to size and location of sleeves, attachments, openings, conduits, ducts, boxes and structural interferences.

2. These composite shop drawings and field installation layouts shall be coordinated in the field among the Contractors to verify the proper relationship to the work of other Contractors based on field conditions, and shall be checked for accuracy and approved by the Contractors as directed by the Professional before submission to the Professional for final approval.

3. HVAC, Plumbing, Fire Protection and Electrical Work shall be coordinated as indicated by the following procedure. Each Contractor shall sign each coordination drawing after all work has been laid out and conflicts resolved. The preparation of coordination drawings and layout Work on the coordination drawings shall be performed at the site by each Contractor.

a. The .2 Contractor shall prepare a drawing of each area, at a scale of 1/4 inch equal 1’-0”, showing his work plan and elevation. The Professional can provide CAD Backgrounds of the entire project to the .2 Contractor for his use. The .2 Contractor shall layout and show light fixtures on the drawings.

b. The drawings referred to in 3. a. above shall then be forwarded to the next succeeding Contractor for layout of their work in the field in the following order: (a) PLUMBING (b) FIRE PROTECTION; (c) ELECTRICAL; (d) INTERIOR CONSTRUCTION.

c. By use of color coding, each succeeding Contractor shall show his work on the referenced drawings and shall sign same to indicate his satisfaction that there is no

interference between his work and that of other Contractors. Colors will be assigned by the Professional.

d. When all work has been shown and signed off, the .2 Contractor shall forward each CAD Drawing to the Professional. Copies of approved CAD drawings shall be distributed to the contractors, Professional, and the Client Agency by the .2 Contractor.

e. The color coded transparency shall be kept at the Professional's field office for future reference in the event of conflict between the trades. At the completion of the project, all color coded transparencies shall be delivered to the Client Agency for his records.

f. Coordination drawings shall be completed within 30 days of the start of Contract. No installation work will proceed until ALL contractors have signed off and agreed to the coordination drawings.

C. Meetings

1. Coordination meetings to resolve interferences in the Work will be held at the site in an area to be provided by the Professional. Representatives of each Contractor shall be present at each meeting. Each Contractor shall provide all necessary resources to insure that the coordination process described herein does not delay the Approved Project Schedule.

D. Each Contractor acknowledges that there may be items of Work which have not been drawn, coordinated, clarified or specified with complete detail in the Contract Documents but which are required for the completion of the Work, as inferable from the Contractor Documents. Any such item, when identified as part of the development of the Work, shall be drawn, coordinated, clarified or specified by the Professional in a manner consistent with contemplated kind, quality and customary standards and provided to the Contractor. When such drawing, coordination, clarification or specification is approved by the Client Agency, the drawing, coordination, clarification or specification so approved shall thereupon be part of the Contract Documents and the item of Work shall be performed by the Contractor as part of the Work without further action or order of the Client Agency and without any increase in the Contract amount or time as if such drawing, coordination, clarification or specification were originally included in the Contract Documents.

3.25 MERCURY PROHIBITION

A. The use of mercury as a component of any equipment installed as part of this work is strictly prohibited. Mercury substitutes shall be used in thermometers, switches, and other equipment, which might commonly contain mercury.

3.26 ACOUSTIC SEALING

A. Seal openings of acoustic-rated ceilings, walls, floors, or other construction, or acoustic area separation requirements with a material or product specially made for these types of applications. Acoustical sealants shall be as manufactured by Arcat, Inc., Acoustical Surfaces, Inc., or American Acoustical Products or equivalent as approved by the Professional. Refer to Architectural Drawings for acoustic sealing locations required.

3.27 CLEARANCE REQUIREMENT

A. Ceiling areas directly below heating equipment must be kept clear of all piping, conduit, and other utilities, to allow for unit access for servicing and/or removal.

END OF SECTION

Submittal Log (Attachment A)

Project Name: _____

CJL Project No.: _____ **Trade:** _____

Engineer's Review: A = Reviewed, B = Rejected, C = Furnish as Corrected, D = Comments Attached

Contractor's Required Response: E = Confirm, F = Resubmit

No.	Specification Number	Description	Manufacturer	Date Received	Action Taken	Date Returned
	220500	O&M Manuals				
	220500	As-Built Drawings				
	220500	Pipe Specialties (Fire Wrap, Access Panels, etc.)				
	220523	Domestic Water Valves				
	220523	Domestic Hot Water Return Balancing Report				
	220529	Plumbing Hangers and Supports				
	220553	Plumbing Identification Labels				
	220700	Plumbing Insulation				
	221116	Domestic Water Piping and Fittings				
	221116	Domestic Water Pipe Accessories (strainers, gauges, etc.)				
	221124	Natural Gas Piping and Fittings				
	221124	Natural Gas Valves				
	221124	Natural Gas Regulators				
	221124	Kitchen Solenoid Valve				
	221316	Sanitary and Vent Piping and Fittings				
	221316	Sanitary Drains of all types				
	221316	Sanitary Cleanouts of all types				

Submittal Log (Attachment A)

Project Name: _____

CJL Project No.: _____ **Trade:** _____

Engineer's Review: A = Reviewed, B = Rejected, C = Furnish as Corrected, D = Comments Attached

Contractor's Required Response: E = Confirm, F = Resubmit

	221316	Trap Seals				
	221316	Interceptors of all types and sizes				
	221429	Hot Water Circulating Pumps				
	224000	Plumbing Fixtures and Trim – Complete				

SECTION 220510

PLUMBING RESTORATION AND RETROFIT

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 WORK IN PRESENT BUILDING AND AT THE SITE

A. All work shall be coordinated with the work of other trades and shall be performed in accordance with the Schedule of Work of the .1 Contractor and as required by the Professional and the Client Agency.

B. The .1 Contractor will remodel the Present Building in all areas shown on the Drawings. The .3 Contractor shall refer to the general construction drawings to determine the extent of the remodeling in each area. The .1 Contractor shall disconnect and remove existing plumbing no longer required and furnish and install new plumbing as shown, herein specified and as required to form complete new systems. Plumbing removal shall include existing fixtures, equipment, piping, insulation, supports, hangers, structural supports, concrete pads, bases, foundations, piers, and like appurtenances or accessories unless noted or required to remain as part of the remodeled system.

C. The Contractor shall visit the site to determine exact locations, sizes and quantities of present equipment and piping which must be removed or connected thereto. The .3 Contractor will be held responsible for the complete disconnection and removal of all existing systems and the installation of all new piping and equipment complete in every detail. The Contractor shall provide “Demolition/Renovation Notification” as required by the Pennsylvania Department of Environmental Protection, Bureau of Air Quality Control.

D. All domestic water branch piping shall be disconnected and removed as noted on the drawings and shall be removed in their entirety, back to the water main.

E. Existing piping no longer required and concealed in walls, below floors, or above fixed ceilings and not interfering with new construction or remodeled work may remain and shall be capped, abandoned and rendered “dead”. All water piping, drain piping, medical gas piping, and other piping systems exposed to view as a result of related work under this Contract shall be disconnected and removed, or relocated. Cap or plug existing water, medical gas, drain, and other lines as necessary to keep lines or equipment in operation.

F. The Contractor shall arrange the new hangers and supports so that new piping and other equipment are not suspended from the same joists and structural members as present piping and equipment. Hangers and supports shall be arranged to distribute the weight of the new piping and equipment uniformly on the present structure. Additional new structural members shall be furnished and installed as necessary to safely support the new piping and equipment. After equipment or piping is removed, existing remaining equipment or piping shall be properly supported.

G. At certain locations, existing piping and equipment shall be disconnected and removed, and new piping and equipment shall be furnished and installed under this Contract above existing ceilings. The .3 Contractor will be responsible for restoring the existing ceilings (and grid work) to their present condition where they are removed or damaged by the work included under this Contract, and when the ceilings are not being replaced with new ceilings by the .1 Contractor. .3 Contractor shall temporarily remove existing ceiling tile and grid work, and upon completion of the Contractor’s work, the Contractor shall reset ceiling tile and grid work, replacing damaged tile/grid work in kind. The .3 Contractor shall also be responsible for repair work to all existing remaining ceilings, as required to maintain the fire ratings of the existing ceilings.

H. The Contractor shall clean up the areas as the work progresses and remove all waste and debris daily or when directed. Immediately remove water present in the area resulting from the work.

I. The Contractor shall perform all cutting and patching required for installation of new piping and equipment, and for the removal of present piping and equipment as herein specified. Cutting of concrete work shall be completed by the “saw-cut” method, or shall be core drilled. Certain cutting and patching will be performed under the General Contract as specified under “Work Not Included”. The .3 Contractor shall be responsible for maintaining the structural integrity of the Existing Building where areas such as load bearing walls, roofs, and floor construction are patched and repaired under this Contract. All patching shall be done subject to the approval of the Professional. The .3 Contractor will be responsible for entrance of all new equipment into the building, and for the removal of existing equipment from the building, and for the related cutting, patching and repairing of existing construction.

J. Existing removed fixtures, fixture trim, flush valves, other valves, fixture carriers, wall hydrants, floor drains, hose bibbs, water heating equipment, copper piping and tubing, and other similar useful equipment and materials tagged by the Client Agency shall remain the property of the Client Agency and shall be loaded, handled, unloaded, and stored at the site by the Contractor where directed by the Client Agency and Professional. Equipment shall be stored as complete units with all associated accessories and auxiliary equipment. Equipment shall be disconnected and carefully removed under this Contract and shall be transported to the storage areas as directed. Equipment shall be stored in a neat and workmanlike manner, tagged and identified for future use. Equipment not desired by the Client Agency shall become the Contractor’s property and shall be immediately removed from the site.

K. Removed other piping, fittings, hangers, insulation, traps, toilet seats, structural supports, and other miscellaneous materials and equipment no longer required, or desired by the Client Agency, shall not be reused as part of the new installation, but shall become the property of the Contractor and shall be immediately removed from the site. The .3 Contractor shall give due consideration and credit in his proposal for present materials and equipment which will become his property. Existing removed equipment remaining the property of the Contractor shall be dismantled and cut in sections as required for removal from building.

    1. Existing removed water or gas metering or regulating equipment shall be transported and returned to the respective utility companies. Coordinate all such work with the utility companies.

L. Provide and later remove temporary piping services and equipment as required to keep systems operating during construction.

1.03 REMOVAL AND DISPOSAL OF HEALTH HAZARDOUS MATERIALS

A. All asbestos removal work will be performed by a contractor prior to the start of this construction.

B. This Contractor shall immediately report the presence of any asbestos to the Professional. No asbestos removal or disposal is to be included under this Contract.

1.04 CUTTING AND PATCHING – NEW CONSTRUCTION

A. All openings or chases required for the installation of the work in the building will be provided by the .1 Contractor, providing this Contractor notifies the .1 Contractor of the size and location of the required openings or chases in sufficient time before the work is closed in, so that the work of the .1 Contractor will not be delayed.

B. If this Contractor fails to notify the .1 Contractor in sufficient time, this Contractor shall cut, patch, finish, and paint the openings at his expense.

C. This Contractor shall set all sleeves, hangers and anchors required for his work and shall be responsible for their proper and permanent location.

D. This Contractor shall seal all openings he has utilized in fire rated floors, ceilings or partitions after his work has been installed. The material used for sealing the openings shall have a fire rating equal to or greater than the rating of the floor, ceiling or partition material.

1.05 CUTTING AND PATCHING – EXISTING CONSTRUCTION

A. The Contractor shall do all cutting and patching for the removal of existing piping and equipment and the installation of new piping and equipment in the Existing Building. Certain cutting and patching will be performed under the General Contract as specified under “Work Not Included”. Also, coordinate all work with “Cutting and Patching” as outlined in Architectural Sections.

B. New openings in roof, interior and exterior walls, floors, ceilings, and partitions for pipe piping, hangers, supports, and other equipment in the Existing Building shall be provided by this Contractor for the new and remodeled installation. New openings in the existing construction and repair of such openings for the entrance of new plumbing equipment into the building or for the removal of plumbing equipment from the building shall be included in the Plumbing Contract. All cutting and patching required for existing roof work shall conform to the Roof Bonding Agency’s requirements. Contact the Agency for provisions regarding the work. Openings in existing roof shall be the responsibility of this Contractor. Openings and patching in existing roof will be completed by the Roofing Contractor at the Plumbing Contractor’s expense. Patch all fireproof roof deck penetrations.

C. Wherever it becomes necessary to cut out any portions of roof, interior and exterior walls, floors, ceilings, or other portions of the building as may be required to perform the work under this Contract, the Contractor shall do all necessary cutting and fitting, shall remove all excess material, and shall replace all damaged work, so as to leave the premises in a finished condition. No cutting shall be done which may in any way affect the building structurally or Architecturally without first securing the consent and approval of the Professional. Any damage incident to cutting or other causes in the performance of this Contract shall be made good by replacement or repairs in a manner satisfactory to the Professional. The Contractor must use extra precaution so as not to disturb the bearing quality of existing walls or other construction.

D. Where present equipment is removed and unused openings remain in roof, walls, floors, ceilings, partitions, etc., the .3 Contractor shall properly patch all such openings to match their immediate surroundings, unless specifically shown to be included under the .1 Contractor’s scope of work. Openings remaining in exterior brick construction shall be patched with matching brick, not just masonry concrete or cement, as directed by the Professional.

E. All patching and repairing shall be done by workers skilled in this type of work and shall identically match present or new finishes. If identical materials are not available or cannot be used for existing construction, use substitute materials that match existing materials to the fullest extent possible with regard to visual effect and performance.

F. All cutting performed under this Contract shall be done in a neat and workmanlike manner. The size of each new opening shall be kept to minimum size. The location of each new opening must be approved by the Professional before the opening is drilled or cut.

G. Where existing ceilings and walls and similar construction are penetrated for the installation of new hangers, supports, and other equipment, the Contractor shall repair the openings with fireproof materials to maintain the fire rating of the ceiling or wall construction, or similar construction.

H. The Contractor’s attention is directed to the Architectural Drawings to determine areas in which the .1 Contractor will perform extensive remodeling work. All cutting and patching shall be directly coordinated with remodeling work performed under the General Contract. This Contractor shall cooperate with the .1 Contractor in every manner in making the installations.

I. Patching and repairing shall be done to match present construction and finishes in materials, color, and texture. Painting shall be as herein specified. All cutting, patching, repairing, and painting shall be performed by workers skilled in that type of work. All patching shall be completed to a neat, finished condition. Where the .1 Contractor applies new finishes, except painting, on existing walls, floors, ceilings, and similar locations, it will not be necessary for the .3 Contractor to apply finished patching and painting to the remodeled surfaces; however, the Contractor shall rough patch the areas for the final finish. Where the existing areas are to be repainted by the .1 Contractor, the .3 Contractor must repair his openings and provide a prime coat and one finish coat of paint to be ready for the .1 Contractor's final coat of paint. The Contractor's attention is directed to the .1 Construction Drawings to determine exact locations where new finishes on walls, floors, ceilings, and similar locations will be provided under the General Contract. There will be many areas where the .1 Contractor is not performing any work. The .3 Contractor shall repair and finish all openings where the .1 Contractor is not providing new finishes. When providing final painting of patching areas, entire wall or ceiling shall be painted corner to corner and top to bottom so that the entire wall or ceiling is painted. Paint shall be good quality type, as manufactured by Glidden, Sherwin-Williams, PPG, or approved equivalent.

1.06 DUST, DIRT, AND NOISE

A. The Contractor shall do all cutting and patching and shall make all changes, relocations, and installations with a minimum of noise.

B. All present and new equipment, floors, walls, etc., shall be adequately protected from dust and dirt caused by the work. Protection shall include suitable temporary barriers or coverings. The exterior and interior premises of the building shall be kept as clean as possible during construction. At no time shall the Contractor interfere with the normal operation of the building by allowing debris, etc., to remain on the premises. The Contractor shall use industrial type vacuum cleaners for removal of plaster, dust, etc. in the Building.

1.07 SCHEDULE OF WORK AND CONTINUITY OF SERVICE

A. It is the Client Agency's desire to maintain the operation of the existing building with a minimum of disruption; therefore, the Contractor shall closely coordinate the scheduling of his work as well as equipment deliveries with the Schedule of Work prepared by the Professional. The schedule of work may be revised periodically during the course of construction, but each revised schedule must be approved by the Professional.

B. When it becomes necessary to interrupt any part of the operation of the plumbing system or fire protection system, the Contractor shall notify the Professional and Client Agency five (5) working days in advance of the proposed interruption. The plumbing system or fire protection system shall only be interrupted when absolutely necessary and at a time to conform to the Client Agency's schedule.

C. Long interruptions of the plumbing system, due to faulty workmanship or improper scheduling of work will not be tolerated.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 220523

DOMESTIC WATER VALVES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The valves for the domestic water systems shall be as hereinafter described in this section.

B. Lead Free: Refers to the wetted surface of pipe, fittings and fixtures in potable water systems that have a weighted average lead content ≤ 0.25% per Safe Drinking Water Act as amended January 4th 2011 Section 1417. Valve requirements to meet all State and Local requirements.

1.03 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 for ferrous valve dimensions.
2. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF/ANSI 61 and/or NSF/ANSI 372 for valve materials for potable-water service. Valves for domestic water must be 3rd Party Certified.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set angle, and globe valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.01 GENERAL USE VALVES

A. The domestic water supply system shall be fitted with valves at points specified or indicated on the Drawings. Provide minimum 3/4” hose end drain ball valves with vacuum breakers and threaded caps at all low points of the water system to provide for drainage.

B. Lead Free silicon bronze (ASTM listed) valves shall be made with corrosion-resistant materials. Manufacturer shall provide third party certification tested in accordance with EN ISO 6509 regarding dezincification corrosion resistance and stress corrosion cracking.

C. Valves 2” and smaller shall be Bronze Valves, ball type, with threaded or solder ends, unless otherwise indicated. Valves 2-1/2” and larger shall be Ferrous Valves, butterfly type, with flanged ends, unless otherwise indicated.

D. All valves for general use shall be Victaulic for grooved systems, Nibco Inc., Jomar, Apollo, Viega, Zurn, Wilkins, or Watts, or equivalent as approved by the Professional. All valves shall be designated for a minimum 125 pounds per square inch (S.W.P.), 200 pounds per square inch (W.O.G.).

E. Bronze or brass valves, including check valves and balancing valves, shall be made to be “dezincification resistant”, with metal components in the waterway, or not containing more than 15% zinc in their chemical makeup.

F. The name or trademark of the manufacturer and the guaranteed working pressure shall be cast or stamped on the body, as well as ‘Lead Free’ marked handle.

G. Valves in Insulated Piping: With 2-inch stem extensions:

1. Ball Valves: With extended operating handle of non-thermal-conductive material that meets UL 2043 approved for inside air plenum, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation and memory stops that are fully adjustable after insulation is applied.

    a. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO NIB-SEAL (-NS suffix in figure no.), handle extension or approved equal.

H. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.
4. Threaded: With threads according to ASME B1.20.1.
5. Copper Press: With sockets according to ASME B16.22/ASTM B75

I. Bronze Ball Valves

1. Two-piece, full port, silicon bronze ball valves with the capability of accepting extended operating handles. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T/S/PC-585-80-LF (-NS).

    a. Standard: MSS SP-110 and ASME A1124.14

    b. CWP Rating: 600 psig

    c. Body Design: Two piece bronze with threaded body packnut design (no threaded stem designs allowed) with adjustable stem packing.

    d. Body Material: Silicon bronze (ASTM Listed), corrosion resistant.

    e. Ends: Threaded, soldered or pressed.

    f. Seats: Reinforced PTFE or TFE.

    g. Ball & Stem: Silicon Bronze ‘Lead Free’ Material

    h. Port: Full.

J. Automatic Air Vents:

1. Automatic air vents on lines at locations shown shall be the Armstrong No. 1-AV with petcock, Spirax Sarco No. 13WS, Apco No. 50, or approved equivalent. Air vents shall have 150 PSI cast bodies and stainless steel trim.

K. Drain Valves:

1. Each down fed unit or other equipment shall be provided with drain valves.
2. Drain valves shall be ½” with hose end and cap similar to NIBCO No. T-585-70-66-HC or S-585-70-66-HC, or approved equivalent.

L. Vacuum Relief Valve:

1. A Vacuum Relief Valve shall be installed on domestic hot water tanks as indicated on

plans. The vacuum relief valve shall be ANSI Z21.22 rated and CSA certified. The vacuum relief valve shall have an all brass body and include a protective cap. Watts Model N36-M1 or approved equal.

2.02 CHECK VALVES AND BACKFLOW PREVENTERS

A. For condensate drain line “light spring” check valves, refer to Section 221413, “Condensate Drain System”.

B. Silicon Bronze Lift Check Valves

1. 200 CWP, Lift Check Valves with Nonmetallic TFE Disc. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T/S-480-Y-LF.
    a. Standard: MSS SP-139
    b. CWP Rating: 200 psig
    c. Body Design: Vertical or Horizontal Flow
    d. Body Material: Silicon Bronze (ASTM Listed), corrosion resistant.
    e. Ends: Threaded or Soldered.
    f. Disc: FTE

C. Silicon Bronze Swing Check Valve

1. 300 CWP, Bronze Swing Check Valves with Nonmetallic TFE Disc. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model T/S-413-Y-LF.
    a. Standard: MSS SP-139
    b. CWP Rating: 300 psig
    c. Body Design: Vertical (flow in upward direction) or Horizontal Flow
    d. Body Material: Silicon Bronze (ASTM Listed), corrosion resistant.
    e. Ends: Threaded or Soldered.
    f. Disc: PTFE or TFE

D. Iron Swing Check Valve

1. Class 125, Iron Swing Check Valves with Metal Seats. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model F-918-LF.
    a. Standard: MSS SP-71, Type I
    b. CWP Rating: 200 psig
    c. Body Design: Clear of full waterway
    d. Body Material: ASTM A 126, gray iron
    e. Ends: Flanged.
    f. Trim: Stainless Steel or Silicon bronze (ASTM listed), corrosion resistant.
    g. Gasket: Asbestos free.

E. Iron Twin Disc Check Valve

1. Class 125, Iron Double Door Check Valves with Resilient Seats. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model W-920-W-LF.
    a. Standard: NSF/ANSI 372
    b. CWP Rating: 200 psig
    c. Body Material: ASTM A 126 Class B
    d. Ends: Wafer
    e. Trim: Silicon bronze (ASTM listed), corrosion resistant.
    f. Seat: Silicone bronze

F. Iron Twin Disc Check Valve

1. Class 125, Iron, Grooved Check Valves with Resilient Seat. Basis-of-Design Product: Subject to compliance with requirements, provide NIBCO Model G-920-W-LF.
    a. Standard: NSF/ANSI 372
    b. CWP Rating: 250 psig
    c. Body Material: Ductile Iron, ASTM 536
    d. Ends: Grooved
    e. Trim: Silicon bronze (ASTM listed), corrosion resistant.
    f. Seat: Buna N

G. Reduced Pressure Zone (RPZ) Backflow Preventer

1. For sizes 1/2" thru 2", Wilkins Model 375XL-FT-SAG, 'Lead Free', with full port quarter turn ball valves, integral male 45 degree flare SAE test fitting, and Lead-Free bronze 'Y' strainer and air gap fitting piped to nearest drain, Watts, or Apollo.

H. Double Check Valve Backflow Preventers

1. For sizes 3/4" thru 2", Wilkins Model 350XL-S-FT, 'Lead Free', with full port quarter turn ball valves, integral male 45 degree flare SAE test fitting, Watts or Apollo. Valve shall include lever handle ball shutoffs, replaceable seats and seat discs, and test cocks. A stainless steel backflow preventer will be acceptable.
2. For sizes 2-1/2" thru 12", Wilkins Model 350-FS-OSY, 'Lead Free', 'Lead Free', OS & Y gate valves, Watts or Apollo. Unit shall have ductile iron body, stainless steel internals, and EPDM seal ring. Wilkins Model 350AST will be acceptable.
3. Dishwasher, Ice Maker, and Pre-Rinse Sink Dual Check Backflow Preventer shall be all bronze body, the Watts Series 007, Wilkins, or Apollo with plastic check modules, silicone discs, Buna-N seals, and stainless steel springs. Provide strainer ahead.

2.03 DOMESTIC WATER SYSTEM VALVES

A. Balancing Valve Assembly: Balancing valve assembly shall be Circuit Solver. Valve shall be Circuit Solver as manufactured by ThermOmegaTech. Furnish and install as indicated on the plans, Circuit Solver in the domestic hot water piping. Circuit Solver shall be self-contained and fully automatic without additional piping or control mechanisms.

1. Circuit Solver shall regulate the flow of recirculated domestic hot water based on water temperature entering Circuit Solver regardless of system operating pressure.
    a. When fully closed, Circuit Solver shall bypass a minimum flow to maintain dynamic control of the recirculating loop and provide a means for system sanitizing.
    b. Circuit Solver shall be factory adjustable from 105F to 140F as required by project conditions. (other setpoints available, consult factory)
    c. Circuit Solver shall modulate between open and closed position within a 10F range.
2. Circuit Solver body and all internal components shall be constructed of stainless steel with major components constructed of type 303 stainless steel.
    a. Circuit Solver sizes ½ inch through 2 inch shall be rated to 200 PSIG maximum working pressure. All Circuit Solvers shall be standard tapered female pipe thread, NPT.
    b. All Circuit Solvers shall be rated to 300F (121C) maximum working temperature.
    c. Circuit Solver shall be ANSI/AWWA C800 compliant.
    d. All Circuit Solvers shall be NSF-61 certified with zero lead content for use in all domestic water systems.
    e. Thermal actuator shall be spring operated and self-cleaning, delivering closing thrust sufficient to keep orifice opening free of scale deposits.

f. Thermal actuator shall be rated for a minimum of 200,000 cycles.

B. Hydrants

1. WH-1 - Exterior Wall Hydrants: Zurn No. Z1300-CL Series, encased Ecolotrol "anti-siphon" automatic draining wall hydrant for flush installation, Josam, Smith, Wade, or Watts. Complete with non-freeze type integral backflow preventer, bronze casing, all bronze interior parts, non-turning operating rod with free-floating compression closure valve, replaceable bronze seat and seat washer, 3/4" inlet/outlet, and key-operated control valve. Nickel-bronze box and hinged cover with cylinder lock and "WATER" cast on cover. Nickel-bronze cover with polished face. A stainless-steel wall hydrant will not be acceptable. Mount wall hydrants with centerline 2'-0" above finished grade.

2. Furnish six (6) spare operating keys for all hydrants to the Client Agency.

C. Balancing Stations (BS) consists of a check valve, balancing valve, and 2 thermometers, one at the beginning of the Hot Water loop, the other after the check valve. The Contractor shall balance the various hot water piping systems to maintain no more than 3 degrees temperature differential between all loops. Provide a balancing report for each and every domestic hot water loop balanced, detailing what temperature the system was balanced at, at what locations, and what thermometer readings were at the time of balancing.

D. Vacuum Breakers: For exposed vacuum breakers, 1/2” size, vacuum breaker shall be T&S Brass B-0929-A, wall-mounted elevated atmospheric vacuum breaker with polished chrome plated brass body. For vacuum breakers, 3/4” to 1” size, vacuum breaker shall be Watts Series LF800M4FR, lead free, pressure anti-siphon vacuum breaker, with built-in relief valve.

E. Vacuum Relief Valve: Vacuum relief valves shall be installed on domestic hot water tanks as indicated on plans. The vacuum relief valve shall be ANSI Z21.22 rated and CSA certified. The vacuum relief valve shall have an all brass body and include a protective cap. Watts Model N36-M1 or approved equal.

F. Water Dispensing Valves (WDV) shall be Oatey “Moda” Supply Box System Series, PVC body, Guy Gray, Viega or equivalent as approved by the Professional. Specific type and version of Box System that is to be installed is to occur during the submittal process. Box shall include quarter turn valve with appropriate fitting connections for application. Provide fire-rated box system where applicable.

G. Unions shall be wrot copper, ground joints, and solder ends, Nibco, or approved equivalent.

H. Wall-Mounted Hose Reels shall be Global Industrial steel hose reel with 3/8” ID 50’ hose, Model #T9A534173. Coordinate with client agency prior to submittal for type of hose end unit that is to be supplied and installed with the hose reel.

2.04 PRESSURE REDUCING VALVES

A. Pressure reducing valves of 2.5” and larger shall be the Victaulic/Bermad Series 972 Valve, lead free with NSF 61/372 approval, flanged or grooved per manufacturer’s recommendations. All valve stations shall have low flow bypass with either internal auxiliary Series 935-H direct acting valve, or separate leg with Victaulic Series 972 Valve.

B. Pressure reducing valves of size 2” and smaller shall be Victaulic/Bermad Series 935-H direct acting valve, bronze construction, NSF 61/372 approval, with internal low flow bypass feature.

C. Victaulic Series 386 Pressure Reducing Stations may be used. All components shall be classified in accordance with NSF 61/372. Station should be composed of Victaulic/Bermad Style 972 PRV valves, Victaulic Installation Ready Couplings, Wye strainers and Series 461 Stainless Steel Butterfly Valves. Sizing shall be confirmed with Victaulic Engineering Services.

D. Comparable pressure reducing valves will be determined by engineer.

E. Provide a pressure gauge on inlet and outlet of each pressure reducing valve.

2.05 HOT WATER SYSTEM THERMOSTATIC MIXING VALVES

A. TMV-1 - Provide Leonard ‘Proton’ Model PNV-LF series, Powers IntelliStation Jr, or Acorn

Controls BASyC, digital mixing valve, 0.25 gpm minimum, 'Lead Free' master mixing valve. Set Control points, valve size, and size of inlet/outlet connections per Drawing Schedules. Contractor to pipe the valve as directed by the Manufacturer.

2.06 HOT WATER SYSTEM THERMOSTATIC MIXING VALVES

A. TMV-1 - Provide Leonard 'Nucleus' Model NV-LF series, digital mixing valve, Powers IntelliStation, or Acorn BASyC, 0.25 gpm minimum, 'Lead Free' master mixing valve. Set Control points, valve size, and size of inlet/outlet connections per Drawing Schedules. Contractor to pipe the valve as directed by the Manufacturer.

2.07 POINT-OF-USE MIXING VALVES

A. TMV-2 - Individual thermostatic point-of-use mixing valves shall be provided at each sink, lavatory, bank of fixtures, or other appliance requiring hot water. Mixing valves shall be Leonard Model 270-LF-BRKT-CP. Valve shall be of brass and bronze body construction, 'Lead Free', minimum flow rate, .5 GPM; brass and stainless steel flow control components, vandal-resistant temperature handle adjustment, integral checks/strainers, rough bronze finish, and wall mounting bracket. Mixing valve shall conform to ASSE 1070. Zurn, Lawler, Acorn, or Symmons, shall also be acceptable, as approved by the Professional, shall also be acceptable. Each valve installed must meet fixtures/equipment's maximum flow rate. Valve shall be required to be chrome-plated ONLY when exposed to view. Coordinate with fixture/equipment supplier prior to submittal.

1. For Kitchen Areas, set outlet temperatures of mixing valves in accordance with the requirements of the Client Agency's Kitchen Staff Director, or the Kitchen Consultants.
2. For other locations, set outlet temperatures of mixers as shown or as otherwise directed by the Client Agency.
3. Furnish and install shutoff valves on inlet and outlet piping of each mixing valve. Refer to the mixing valve schedule and piping schematic shown on the drawings.

2.08 EMERGENCY FIXTURE THERMOSTATIC MIXING VALVES

A. TMV-3 – Emergency Eyewash Mixing Valve shall be Leonard DURA-trol TA-300-CP-IT, Bradley, Guardian, Acorn, or Haws, shall also be acceptable as approved by the Professional, Chrome plated finish with Inlet Thermometers, with internal cold water bypass and internal check stops. Mixing valve installation shall conform to ANSI Z358.1 Standard and ASSE 1071. Valve shall be required to be chrome-plated ONLY when exposed to view.

2.09 STOPS

A. Each plumbing fixture furnished under this Contract and each piece of special equipment furnished under other contracts or by the Client Agency shall, unless otherwise shown or specified, be provided with compression stop valves on the water supply piping. On copper or PEX piping, ball valves shall be installed on branch water piping to equipment. Stops shall be finished brass, chrome-plated where exposed and shall be provided with stop control as shown or specified.

2.10 RELIEF VALVES

A. Relief valves shall be ASME, pressure relief type or combination temperature/pressure relief type, as manufactured by Watts, Kunkle, or Apollo **o**r equivalent as approved by the Professional. Extend each relief valve outlet to nearest funnel/floor drain or safe waste.

PART 3 – EXECUTION

3.01 INSTALLATION

A. All valves must be accessible.

B. Provide a shutoff valve at the base of upfed water risers and at the top of downfed water risers with a minimum 3/4" hose end ball drain valve with vacuum breaker and threaded cap at the base of all water risers.

C. Each piece of equipment that may have to be removed from the system for repair shall be

connected by union or flange and provided with isolation valves.

D. Provide a shutoff valve on water supply to each exterior wall hydrant, regardless of whether shown or not.

E. Upon installation, all testable backflow preventers shall be tested under the Plumbing Contract, in accordance with manufacturer's installation standards, or in accordance with local authorities or utility company having jurisdiction over the installations. All testing shall be completed by persons certified in this type of work. All costs, fees, or charges required for testing shall be included in the Contract price.

END OF SECTION

SECTION 220529

PLUMBING HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The hangers and supports for the various plumbing systems shall be as hereinafter described in this section.

B. Hangers and supports shall be arranged to distribute the weight of the piping and equipment uniformly on the building structure.

PART 2 - PRODUCTS

2.01 PIPE HANGERS AND SUPPORTS

A. All pipe hangers, riser clamps, and supports shall be as manufactured by The Modern Pipe Supports Corp., Anvil International, Inc., Tolco Co., or Erico Corp, or equivalent as approved by the Professional. The following catalog numbers are taken from The Modern Pipe Supports Corp. Catalog to indicate the type of installation required.

B. Hangers for steel, iron, or plastic piping shall be The Modern Corp. Government ring type hanger, No. 404, complete with band hanger, Fig. No. 540 malleable iron adjuster and rod, or approved equivalent. Hanger bands shall be flat and suitable for application of insulation over the hanger and pipe.

C. Hangers for all copper piping shall be The Modern Corp. No. 48, complete with copper-plated band; No. 121 copper-plated, malleable iron adjuster, and rod, for pipe sizes 1/2” thru 6”, or approved equivalent. PVC coated or epoxy coated hangers will be acceptable. Use The Modern Corp. No. 10, with special PVC coated or padded band, and Fig. No. 540 copper plated, malleable iron adjuster, and rod, for pipe sizes larger than 6”.

D. Insulation shall be installed over band hangers and all openings shall be sealed.

E. Clevis and loop hangers are acceptable, provided that the hangers match the pipe materials. If clevis or loop hanger systems are utilized, insulation shields must be installed to maintain uniform insulation thickness and maintain insulation material characteristics.

F. Hanger rods installed in conjunction with hangers shall be not less than 3/8" for pipe sizes 1/2" to 2"; 1/2" for pipe sizes 2-1/2" and 3"; 5/8" for pipe sizes 4" and 5" pipe sizes. Hanger rods shall be larger where recommended by the hanger manufacturer.

G. Piping 2" and smaller supported on steel joists shall be hung from one joist with beam clamps. Piping over 2" and 3" in diameter shall be suspended from 1-1/4" steel pipe or steel angle, laid-in and hook-bolted to the web members of the joists. Piping 4" and 5" shall be supported from three joists.

H. Piping along walls shall be supported on substantial wall hangers securely attached to construction by means of inserts or expansion sleeves and bolts. Wall hangers shall be similar to Modern Corp. Fig. No. 284, or approved equivalent.

I. All expansion shells shall be of the self-drilling types, as manufactured by the Phillips Drill Company, Ramset, Rawlplug, or approved equivalent. Shells shall be hammer installed, special flush or hanger rod types. Shells shall be installed with a drill-hammer. Lead expansion shields or lead wedge type shields will not be permitted.

J. Vertical runs of exposed uninsulated piping shall be supported from walls with sections of Modern Corp. Chan-All channel-strut and strut clamps, or approved equivalent. For all insulated piping, use strut clamps sized to permit a continuous insulation installation.

1. “Klo-Shure” insulation couplings will be acceptable, as represented by Scott Industrial Systems (Tele No. 412-965-3279).

K. All supports directly in contact with copper piping shall be copper-plated, PVC coated, or epoxy coated, or equivalent. Ferrous metals shall not be used in contact with copper piping. Hangers for copper tubing 6” and smaller shall be copper-plated, PVC coated, or epoxy coated as herein specified; PVC coated or padded hangers for larger copper piping.

L. Hangers for pipe and tubing, installed horizontally, shall be spaced, at a maximum, as follows:

COPPER PIPE SUPPORT SPACING

Pipe Size	Copper, FT
Up to 1-1/2”	6
2” and Larger	8

STEEL PIPE SUPPORT SPACING

Pipe Size	Drainage Service, FT	Air & Gas Service, FT
1”	7	9
1-1/2”	9	12
2” & 2-1/2”	10	13
3”	12	15
4” & 5”	14	17
6”	17	21

M. All vertical runs of piping shall be supported at each floor and/or at specified intervals, by means of riser clamps. Copper tubing shall be protected against electrolysis, such as copper plating, PVC coating, or epoxy coating, or approved equivalent. Supports shall be placed at minimum ten (10) foot intervals for vertical pipe.

N. Where concentrated loads of valves, fittings, etc., occur, closer spacing may be necessary. Smaller pipe shall be provided with additional supports to prevent piping from sagging. Hangers must be installed not more than 12" from each change in direction of pipes.

O. Where cast iron pipe is suspended, a minimum of one (1) hanger shall be provided for each length of pipe at each fitting.

P. Brass chromium plated pipe shall be supported by suitable cast brass, chromium plated supports. All securing devices shall have all exposed heads, finished chromium plated.

Q. For cast iron drainage piping greater than 4”, anchorage is to be provided at change in direction locations and at locations of pipe size greater than two pipe sizes. Braces, blocks, rodding, and other suitable methods as recommended or required by the cast iron fitting manufacturer. Coordinate specific anchor requirements and specifics with cast iron manufacturer.

R. All pipe runs 3" or larger connected to mechanical equipment in Boiler Room and Chiller Room, shall be mounted with steel spring isolators. The first three pipe hangers in the main lines near the mechanical equipment shall be Mason Industries Type PC3ON, Anvil, Tolco, or Erico. Horizontal runs in all other locations shall be isolated by Mason Industries Type 30N hangers, Anvil, Tolco, or Erico. Floor supported piping shall rest on restrained mounts, Mason Industries Type SLR, Anvil, Tolco, or Erico. The first three hangers or mounts near the mechanical equipment shall have the same static deflection as specified for the mountings under the connected equipment. All other hangers and mounts shall have a minimum static deflection of 3/4".

PART 3 – EXECUTION

3.01 INSTALLATION

A. All piping shall be supported from the building construction by the use of fixed or adjustable beam clamps, concrete inserts, lag bolts and lag screws from wood construction, brackets, extension rods, adjustable band ring pipe hangers, or other equipment as dictated by the type of building construction.

B. The Contractor shall place all hanger and support inserts in concrete. Special studs “shot” into concrete will not be permitted.

C. Perforated band iron, strap, split ring, wire, chain, or pipe hooks will not be permitted for hangers or supports of pipe.

D. Piping shall not be supported from any other piping systems, ductwork, conduit, etc. Piping shall only be supported by code approved and manufacturer recommended hanger systems connected directly to the building’s structure.

E. ALL hanger and support locations shall be coordinated and reviewed with the Architect, Structural, HVAC, Electrical and Fire Protection Engineer Construction Representatives during construction. If any hanger locations or connection methods are unacceptable to any of the professional team (for example – penetrations of pre-cast concrete tees, from piping, uneven spacing or height, etc.), the Contractor shall relocate the support, at his own expense, to an approved location.

F. Attachments to, and penetrations of new or existing concrete structural tees for hanger connections **shall be not be permitted** until reviewed and approved by the Architect. The Contractor shall be responsible for the expense of all repairs required as a result of the installation of unauthorized attachments to, or penetrations of new or existing concrete structural tees.

G. Trapeze type hangers may be used for multiple parallel line installations. The Contractor shall submit sketches for the proposed hangers indicating the type of construction, number and size of piping, and maximum spacing to the Architect for approval. Include metal shielding for insulation to rest thereon to avoid crushing. Insulation must be continuous as specified. Electrolysis at pipe/hanger must be prevented.

3.02 UNACCEPTABLE HANGER AND SUPPORT INSTALLATIONS

A. It is unacceptable to support any pipe(s) or duct(s) from other pipe(s) or duct(s).

B. If unistrut is used to support piping, strap hangers are unacceptable since they do not allow for continuous insulation.

C. It is unacceptable for this Contractor to support his work from the hangers of other trades. All trades must install their own hangers.

D. Unacceptable hanger and support installations shall be corrected as directed by the Architect/Engineer at no cost to the Client Agency.

END OF SECTION

SECTION 220553

PLUMBING IDENTIFICATION

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

PART 2 – PRODUCTS

2.01 EQUIPMENT IDENTIFICATION, VALVE TAGS

A. Where valves, cleanouts, and similar equipment is located above removable tile ceilings or above access panels, the Contractor shall furnish and install identification labels on the corners of the access panels or removable ceiling tiles. Labels shall be provided with the words "VALVES," "CLEANOUT," and similar wording, so that the equipment may be readily located in the future.

B. Identification labels shall not exceed 3" in length and 1" in height. Black letters shall be 1/8" high on white background. Labels shall be manufactured of engraved Micarta or Bakelite with pressure-sensitive backing and shall be nonabsorbent, nonporous and colorfast. Adhesive backing shall be chemically compounded to hold tight and fast at wide temperature extremes. Labels shall be as manufactured by Seton Name Plate Company, Brady Co., MSI Services, or equivalent as approved by the Professional. Labels shall be additionally secured with screws or rivets. Flexible plastic punched tapes will not be acceptable. Labels shall be coordinated with those being installed under other contracts. **All piping and equipment, insulated and uninsulated, exposed or concealed, shall be labeled with system, flow direction, temperature, pressure, and/or any other system information under this contract.**

C. All major pieces of plumbing equipment shall include, at a suitable and accessible observation point on the equipment, a manufacturer's stamped brass or aluminum identification plate, with all pertinent capacity data stamped on the plate. Identification plate shall include all specific data, such as model number, serial number, motor data, horsepower, capacities, sizes, amperes, power consumption, speed, flows, temperatures, working pressures, operating pressures, and similar factors as applicable. In addition, pumps shall include total head in feet and impeller sizes.

D. The Contractor shall be responsible for furnishing and attaching an identification plate for the above mentioned major equipment if not provided by the equipment manufacturer.

E. Equipment marking tags shall be engraved phenolic, 1/16” thick, and four edges binded, black with white lettering. The tag shall be securely mounted to the equipment. Tags shall be as organized per the Equipment Schedules, and include “date of installation and project number.”

F. The installations will not be considered acceptable unless identification plates and nameplates are attached.

G. All piping and equipment insulated and uninsulated, installed throughout this Contract, shall be labeled with the name of the service and with an arrow indicating the direction of flow. Temperature of hot water systems shall also be included. Pressure of Natural Gas system and all compressed air piping shall be included. Labeling in exposed locations in finished areas must be coordinated with the Architect prior to installation.

H. Snap-around pipe markers shall, in general, shall be located near each branch connection, at each valve, at each change in direction, on each side of walls or floors, and at least every 30' on straight runs of pipe**.** On smaller runs of piping, center the designations. Snap-around pipe markers by Seton Nameplate Co. "Set Mark," Brady, MSI Services, or equivalent as approved by the Professional, may be utilized. Identification and colors shall comply with ANSI A13.1. Snap – around markers shall be suitable for exterior use where utilized.

I. Where pipes are adjacent to each other, markings shall be neatly piped up. All markings shall be located in such a manner as to be easily legible from the floor.

J. All labeling, color-coding, and identifying marks for all new piping and equipment shall match existing building's identifications patterns. Coordinate all labeling with Client Agency and Architect prior to start of work.

2.02 VALVE DIRECTORY

A. The Contractor shall prepare a type written valve directory (and required copies) showing the number, location, use and normal position of valves installed under the Contract. Tag each valve controlling mains and branches, but not individual shutoff or local control valves on fixtures and equipment.

B. Each valve listed in the directory shall have a corresponding number 1-1/2" diameter brass or aluminum tag attached to the valve by means of a brass or aluminum "S" hook or chain. Numbers and code letters shall be as large as possible for identifying each service. Numbers and tags shall be coordinated with those being installed under the HVAC Contract. Valve tag numbers shall not be repetitious.

2.03 ELECTRICAL EQUIPMENT LABELS

A. All electrical equipment and items consisting primarily of electrical components shall bear a label of an independent testing laboratory, such as Underwriters' Laboratory (UL).

PART 3 – EXECUTION

3.01 INSTALLATION

A. Valve directory shall be installed at the location designated by the Architect.

B. Any existing valve directories shall be updated with new information.

END OF SECTION

SECTION 220700

PLUMBING INSULATION

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The plumbing pipe insulation shall be as described in this section.

1.03 CODE COMPLIANCE

A. All insulation materials and installation procedures shall be in accordance with the minimum requirements of The International Energy Conservation Code.

PART 2 - PRODUCTS

2.01 INSULATION

A. Furnish and install insulation for the following piping systems and equipment. All insulation and insulating materials, except as herein specified, shall be as manufactured by Knauf, Owens-Corning Company, or Manville. Insulation adhesives, sealers, cements, mastics, and other similar items, except as herein specified, shall be manufactured by HB Fuller, Mon-Eco, Childers, or Vimasco, or equivalent as approved by the Professional. Same type insulation materials shall be used consistently throughout the entire installation. Thicknesses shall be as indicated below:

TYPE OF SYSTEM	INSULATION THICKNESS
Domestic Cold Water Piping, 2” and below	1/2”
Domestic Cold Water Piping, 2 1/2” and above	1”
Domestic Hot Water and Hot Water Return Piping, 1 1/4” and below	1”
Domestic Hot Water and Hot Water Return Piping, 1 1/2” and above	1 1/2”
Ice Maker and Water Cooler Drainage Piping	1/2”

B. Materials: All materials shall conform to the following:

1. Piping insulation shall be "heavy density," 1-piece molded fiberglass with factory applied type ASN/SSL "All Service" jacket with self-sealing lap. Average thermal conductivity shall not exceed .25 BTU-in. per square foot per degrees Fahrenheit per hour at a mean temperature of 75 degrees. Thickness shall conform to schedule for pipe size and service as specified herein.
2. Vapor-barrier jacket for the fiberglass system shall be white kraft paper bonded to aluminum foil and reinforced with glass fiber, and pressure sensitive, self-sealing lap adhesive conforming to the physical properties listed in next paragraph.
3. The fiberglass insulating system, including insulation, jacket adhesives, mastics and cements, shall have composite fire and smoke hazard ratings as tested under procedure ASTM E-84, NFPA 255, and UL 723, not exceeding: Flame Spread – 25, Fuel Contributed – 50, Smoke Developed – 50.
4. Fittings for the fiberglass system shall also be 25/50/50 rated as described in the preceding paragraph.
5. All products or their shipping cartons shall have label affixed indicating smoke and flame ratings.

C. Installation: Piping Systems

1. Insulation shall be applied on clean, dry surfaces after pressure testing and approval. All insulation shall be continuous, including through wall and ceiling openings and sleeves. Insulation on piping systems shall be maintained with a continuous unbroken vapor seal. Hangers, supports, anchors, guides and equipment shall be insulated and vapor sealed to prevent condensation.
2. All covered pipe shall be located a sufficient distance from walls, other pipes, ductwork, and other obstacles to permit the application of the full thickness of insulation specified; and if necessary, extra fittings and pipes shall be used.
3. All fiberglass insulation shall be installed with Bostitch outward clinched staples, one (1) every 3” and four (4) at each butt strap.

D. Fittings: Fiberglass systems operating below 60 degrees F: Fittings, valves, unions, and flanges shall be insulated with a fiberglass blanket, 1 pound per cubic foot density wrapped firmly under compression (minimum 2:1) to a thickness equal to the adjoining insulation, secured with No. 20 gauge galvanized annealed steel wire and given a smoothing coat of "asbestos-free" insulating and finishing cement and a vapor barrier sealer. Roof drain bodies and overflow roof drain bodies shall be insulated with fiberglass same as above.

E. Fiberglass systems Operating Above 60 Degrees F: Fittings, valves, unions, and flanges shall be insulated and finished with "asbestos-free" insulating and finishing cement to a thickness equal to the adjoining pipe insulation.

F. Services: All adhesives used for gluing insulations and insulating jackets shall be vermin and mildew-proof. The use of flour paste is prohibited.

G. Insulated fitting covers, as manufactured by Zeston, Proto, or Speedline will be acceptable for the fiberglass system.

H. Where new piping is connected to existing piping, and the insulation is removed, the piping shall be reinsulated and made continuous with the existing insulation.

PART 3 - EXECUTION

3.01 INSTALLATION

A. This Contractor shall furnish and install non-conducting covering on the following piping and apparatus installed under this Contract. For performing and completing this work, this Contractor shall employ an Insulation Subcontractor specializing and experienced in commercial covering work, responsible to the Plumbing Contractor.

B. The following work shall be insulated under the Plumbing Contract:

1. Complete domestic water distribution systems, exposed and concealed. Insulate water piping installed within and around cabinetry and casework. Insulate water meters, backflow preventers, pressure reducing valves, and strainers.
2. Branch drain piping from water coolers and ice machines, exposed and concealed.
3. All capped water piping with valves arranged for future extension shall be insulated.
4. All sanitary piping, horizontal & vertical (including traps), where indicated on the drawings to protect piping from freezing.
5. Condensate drain piping, this Contract, exposed, concealed, including check valves.
    a. Where condensate drain piping terminate over floor drains above floor level under the HVAC Contract or the Plumbing Contract, insulate the vertical and horizontal branch sanitary drain line from floor drain to a horizontal point approximately 10’ from the floor drain. Insulate entire vertical and horizontal branch run from floor drain if less than 10’.
6. All domestic water connections to existing piping. All insulation, new and existing, shall be continuous and all existing insulation that remains must be joined with new insulation for a continuous system.

C. Cover all exposed insulated piping in Finished areas with a .030” thick white PVC jacket, including below counters and fixtures, 25/50 flame/smoke rating, with “heavy duty” fittings, as manufactured by Zeston, Proto, or Speedline or equivalent as approved by the Professional,

D. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, sensors, switches, and transmitters on insulated pipes, vessels, and equipment. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

E. All exposed hot, cold, and drain piping below fixtures for ADA usage shall be insulated, Zurn, McGuire, or Truebro, or equivalent as approved by the Professional, vandal-resistant as possible. Include insulation of P-Trap. Refer to Section 224000.

F. Application of insulation materials to piping and fittings shall be done in strict accordance with the manufacturers' recommendations. Where thickness of insulation is not specified, use applicable thicknesses recommended by the manufacturer for the specific use. Piping and equipment exterior shall be clean and dry and approved tests shall be completed before any insulation is applied.

END OF SECTION

SECTION 22 08 00 – PLUMBING SYSTEM COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

B. General: This Section specifies Plumbing System commissioning requirements, administration, and procedures. See Specification Section 019100 General Commissioning Requirements for general commissioning requirements, administration, and procedures.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this section.

B. Specification 01 91 00 GENERAL COMMISSIONING REQUIREMENTS

C. All applicable Technical Specification sections.

1.3 REFERENCES

A. See Specification Section 019100 General Commissioning Requirements for a summary of the references.

1.4 PLUMBING SYSTEM COMMISSIONING DESCRIPTION

A. Commissioning: Plumbing System Commissioning is a systematic process of ensuring that the plumbing system has been installed in the prescribed manner to perform with the design intent and that verification of proper installation is documented. The Commissioning Agent shall provide the Department with an unbiased, objective view of the plumbing system's installation and performance. This process does not eliminate nor reduce the responsibility of the Design Professional to provide a complete design or Prime Contractors to provide a finished product. Commissioning is intended to enhance the quality of the plumbing system installation.

B. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
   1. Verify the plumbing system is installed according to the manufacturer's recommendations and to industry accepted minimum codes and standards.
   2. Verify the installation and operation of all system components, including but not limited to equipment, controls, supports, piping, and fixtures.

C. The Commissioning process shall be a team effort and shall encompass and coordinate the traditionally separate functions of plumbing system installation, testing, verification, and performance checkouts.

D. The Commissioning Agent will work closely with the construction team, cooperating and coordinating all commissioning activities with the Prime Contractor, Department's representative, sub-contractors, manufacturers, and equipment suppliers.

1. The commissioning process shall not reduce the responsibility of the Prime Contractor to comply with the Contract Documents.

1.5 PLUMBING SYSTEMS TO BE COMMISSIONED

A. The following Plumbing systems shall be commissioned. All parties associated with the design, installation and/or testing of these systems shall comply with commissioning requirements specified in this section, the individual Division commissioning sections and in the Commissioning Plan.

B. The systems that shall be commissioned in this project include but are not limited to the following:
   1. Domestic water heating equipment, piping, pumps, circulation, and balancing systems

1.6 PLUMBING SYSTEM COMMISSIONING AND CLOSEOUT SUBMITTALS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the general submittals and processes for reviews.

B. Contractor shall make additional submittals requested by Commissioning Agent for each piece of equipment or system indicated to be commissioned. Incorporate requested submittal information into related operation and maintenance manuals.

1.7 PLUMBING SYSTEM COMMISSIONING DOCUMENTATION AND REPORTS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the submittals, reports, and processes.

1.8 Plumbing System Commissioning Plan: A component of the overall Commissioning Plan document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the plumbing system commissioning process, and shall include, but is not limited to the following:
   1. All general requirements and documentation as noted in Specification Section 019100 General Commissioning Requirements.
   2. Description of expected performance for plumbing systems and subsystems.
   3. Identification of installed plumbing systems and subsystems including design changes that occurred during the construction phase.
   4. Step-by-step procedures for testing plumbing systems with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.
   5. Witness and verification of all plumbing quality assurance tests completed by the Contractor as specified in the contract documents.

1.9 SEQUENCING

A. See Specification Section 019100 General Commissioning Requirements for a summary of the sequencing requirements.

1.10 SCHEDULING

A. See Specification Section 019100 General Commissioning Requirements for a summary of the scheduling requirements.

B. Commissioning of systems shall proceed per the criteria established with activities to be performed on a timely basis. The Commissioning Agent shall be available to respond promptly to avoid construction delays.

C. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy or use.

1.11 OTHER REQUIREMENTS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the commissioning team responsibilities.

B. Commissioning requires support from the Prime Contractor and subcontractors. The commissioning process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner.

1.12 COMMISSIONING RESPONSIBILITIES

A. See Specification Section 019100 General Commissioning Requirements for a summary of the commissioning requirements of all parties involved.

B. Equipment or System Installer Commissioning Responsibilities:
   1. Attend commissioning meetings.
   2. Ensure controls installer performs assigned commissioning responsibilities as specified below.
   3. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
   4. Provide instructions and demonstrations for DGS's personnel.
   5. Ensure subcontractors perform assigned commissioning responsibilities.
   6. Provide factory supervised startup services for equipment and systems. Coordinate work with manufacturer and Commissioning Agent.
   7. Provide manufacturer’s representatives to execute starting of equipment as required. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
   8. Develop startup and initial checkout plan using manufacturer’s startup procedures and functional performance checklists for equipment and systems to be commissioned.
   9. During verification check and startup process, execute domestic water heating related portions of checklists for equipment and systems to be commissioned.
   10. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Agent.

11. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
12. Provide personnel to assist Commissioning Agent during equipment or system verification checks and functional performance tests.
13. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
14. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
15. Perform verification checks and startup on equipment and systems as specified.
16. Assist Commissioning Agent in performing functional performance tests on equipment and systems as specified.
17. Perform operation and maintenance training sessions scheduled by Commissioning Agent.
18. Conduct domestic water heating system orientation and inspection.

1.13 COMMISSIONING MEETINGS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the commissioning meeting requirements.

1.14 COORDINATION

A. Notify Commissioning Agent minimum of three weeks in advance of the following:
   1. Scheduled equipment and system startups.
   2. Scheduled automatic temperature control system checkout.
   3. Scheduled start of testing, adjusting, and balancing work.

PART 2 PRODUCTS (Not Used)

A. See Specification Section 019100 General Commissioning Requirements for a summary of the Product requirements.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. This Section establishes general requirements pertaining to plumbing system commissioning of equipment and appurtenances. These requirements apply to the Prime Contractors, Subcontractors, Material Supply Vendors, Commissioning Agents, and Design Professionals

B. Commissioning is intended to achieve the following specific objectives of the Contract Documents.
   1. Verify and document proper installation and design parameters of equipment, systems, and integrated systems.
   2. Ensure that operating and maintenance and Commissioning documentation requirements are complete.
   3. Provide DGS with functional buildings and systems that meet the Contract Document and DGS's operational requirements at Substantial Completion.

C. The Prime Contractor shall deliver a successful Commissioning process. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents and the specified operational requirements. During Commissioning, the Prime Contractor shall systematically demonstrate to the Commissioning Agent, Design Professional, and DGS that the operable systems are properly performing in strict accordance with the Contract Documents and DGS requirements.
   1. Commissioning requires cooperation and involvement of all parties throughout the construction process.
   2. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion, with the exception of deferred tests approved in advance.
   3. Commissioning will encompass and coordinate traditionally separate functions of system documentation, Inspection, Pre-functional Checklists and start-up, control system calibration and point-to-point checkout, Testing, Adjusting, and Balancing, Functional Performance Tests, Integrated System Tests, Prime and Sub Contractor demonstration to DGS, and Training of DGS's personnel. This requires assembling all related documentation into one Commissioning Manual.

D. Certify that plumbing systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents, manufacturer's specifications, DGS standards and specifications, and approved Shop Drawings and submittals.

E. Certify that plumbing instrumentation and control systems have been installed and calibrated, that they are operating according to the Contract Documents, DGS standards and specifications, and approved Shop Drawings and submittals, and that pretest set points have been recorded.

F. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

G. Set systems, subsystems, and equipment into operating modes to be tested according to approved test procedures. Modes required to be tested include normal start-up, (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions.).

H. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

I. Test systems, assemblies, subsystems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

J. Perform tests using design conditions, whenever possible.
   1. Simulated conditions may, with approval of DGS, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Agent and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
   2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.

3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

K. If tests cannot be completed because of a deficiency outside the scope of the plumbing system, document the deficiency and report it to DGS. After deficiencies are resolved, reschedule tests.

L. Include seasonal testing. Complete appropriate initial performance tests and documentation and schedule seasonal tests.

M. Coordinate schedule with and perform the commissioning activities at the direction of Commissioning Agent and DGS.

N. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying plumbing systems and equipment and the Commissioning Plan.

O. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
1. Performance tests.
2. Demonstration of a sample of performance tests.
3. Commissioning tests.
4. Commissioning test demonstrations.

3.2 INSTALLATION

A. Place domestic water and waste systems and equipment into full operation and continue operation during each working day of commissioning.

3.3 FIELD TESTS AND INSPECTIONS

A. Systems Readiness Checklists
1. The Contractor shall complete Systems Readiness Checklists to verify systems, sub-systems, and equipment installation is complete and systems are ready for Systems Functional Testing.
2. The Commissioning Agent will prepare Systems Readiness Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be uploaded to eBuilder for review.
3. The Commissioning Agent may spot-check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and re-submission. If the Commissioning Agent determines that 10% of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of 50% of checklists for review. If the Commissioning Agent determines that another 10% of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and re-submission.
4. Refer to SECTION 019100 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for System Readiness Checklists, Equipment Startup Reports, and other commissioning documents.

B. Contractors Tests

1. Contractor tests as required by other sections of Division 22 shall be scheduled and documented. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

C. Systems Functional Performance Testing:
   1. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions.
   2. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by Design Professional. The Contractor shall review and comment on the tests prior to approval.
   3. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will direct and document the testing.
   4. See Section 019100 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

D. Occupancy Sensitive Functional Performance Tests:
   1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
   2. Participate in testing delayed beyond Final Completion to test performance with actual occupancy conditions.

E. Training of Department Personnel
   1. Training of DGS operation and maintenance personnel is required in cooperation with the Design Professional and Commissioning Agent.
   2. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with DGS after submission and approval of formal training plans.
   3. Refer to Section 019100 GENERAL COMMISSIONING REQUIREMENTS and Division 22 Sections for additional Contractor training requirements.
   4. Participate in testing delayed beyond Final Acceptance to test performance at peak seasonal conditions.
   5. Participate in initial and alternate peak season test of systems required to demonstrate performance.

END OF SECTION

SECTION 221116

DOMESTIC WATER PIPING

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The domestic cold water, hot water, and hot water return piping shall be as hereinafter described in this section.

B. Refer to Section 220523 for interior water valves.

PART 2 – PRODUCTS

2.01 DOMESTIC WATER DISTRUBUTION PIPING INSIDE BUILDING

A. Interior domestic water piping above floor level shall be hard drawn copper tubing, Type "L", in accordance with ASTM B-88, with solder joint type wrot copper fittings. Copper tubing manufactured by Cambridge-Lee, Cerro, Mueller, Summit, or approved equivalent. Fittings by Nibco, Cambridge-Lee, Mueller, or approved equivalent. Water intended for human consumption must have pipes, fittings, and faucets that meet California AB1953 weighted average lead content of the wetted surface area not more than 0.25% lead.

B. All exposed piping and fittings at fixtures shall be polished chrome plated.

C. The use of any of the above listed materials shall be subject to the acceptability of that material with the prevailing local codes and utility company regulations. All water line installations shall conform with the requirements of the local Water Authority serving the building.

2.02 JOINTS AND CONNECTIONS

A. Joints in above-floor copper piping shall be assembled with lead-free solder using a non-corrosive flux. All copper tubing and fittings 2" and smaller shall be tinned prior to making solder joint. All solder joints on tubing 2-1/2" and larger shall be made with the use of a circular flame torch. To be considered “lead free”, solder and flux must not contain more than 0.2% lead, and must have solder and flux that meets California AB1953 standard (solder <0.2% lead & flux <0.25% lead for wetted surfaces). All solder joints comply with ASTM B828 2002 and use ASTM B813 2010 for flux.

1. For copper piping 2" and larger, a Type "L" copper grooved mechanical coupling system will be acceptable, Victaulic or approved equivalent. Coupling shall be rated to 250 deg F with off-setting, angle pattern bolt pads. Coupling shall be visually verifiable to ensure proper install. If coupling is not visually verifiable, a torque log shall be provided to engineer and client agency to verify it was installed to written manufacturer’s instructions. Basis of Design: Victaulic Style 607H. Use valves as specified only.

2. For copper piping 4” and smaller above floor level, the Viega ProPress System of mechanical joint copper tubing assembly will be acceptable, Nibco Press System, or approved equivalent. The ProPress System shall consist of an electro-hydraulic pressure crimping tool, with sets of interchangeable crimping jaws, and ProPress special copper fittings. The fittings shall include an O-sealing ring, and shall require no torches, solders, flux, or special pipe burnishing or preparation. A permanent, watertight seal is made by crimping the fittings. Rated at 200 psi; tested to 600 psi. The systems shall be installed in accordance with manufacturer’s installation instructions and governing code requirements. Pipe supports shall be installed so that interior horizontal piping is in uniform alignment.

3. All screw joint copper pipe shall be made with flake graphite and oil or other approved pipe compound applied to the male threads only and screwed tight with not more than 2

threads on the finished joint exposed, and where pipe and fittings are chrome plated, all threads shall be concealed.

B. Suitable adapters shall be used when necessary for connection to fittings, valves, or other accessories having threaded ends.

2.03 ELECTROLYSIS CONTROL

A. The installation of copper piping shall be accomplished in such a way as not to touch or come in contact in any way with ferrous metal. Where copper tubing, piping, or fittings are anchored, supported or may come in contact with metal construction, an insulating non-conductor spacer similar to lead, rubber, fiber or plastic shall be installed to assure prevention of electrolysis.

B. Hangers supporting copper tubing shall be all copper, copper-plated or be large enough to accommodate the insulating pipe covering. Copper tubing piping shall not be (even temporarily) supported or secured to ferrous metal.

C. Connections between ferrous and copper piping shall be with dielectric fittings, Watts, Wilkins, Clearflow, or approved equivalent.

2.04 WATER HAMMER ARRESTORS

A. Furnish and install at high points on domestic water risers, two (2) stories and above, automatic washers, dishwashing equipment, at kitchen booster heater, quick-closing valves, and where otherwise required, Zurn Z1700, Josam, Smith, Wade, or Watts or equivalent as approved by the Professional, factory-made water hammer arrestors, or approved equivalent, of stainless steel or minimum Type “K” or Type “L” copper. Vertical or horizontal pipe air chambers constructed by the Contractor will not be permitted.

B. Arrestors shall be certified, constructed, and tested in accordance with the recommendations of the Plumbing and Drainage Institute Standard PDI-WH-201 and shall bear their seal of approval.

C. Provide shocks associated with solenoid or other quick-closing valves serving heavy equipment, such as laundry machines. Shock shall be controlled by the installation of Zurn Z1712 Accumutrol water hammer arrestors, Josam, Smith, Wade, or Watts or equivalent as approved by the Professional. Shocks shall be complete with floating stainless steel spherical piston, bronze surge chamber, valve, and gauge assembly.

D. Use PVC or stainless steel water hammer arrestors for distilled or deionized water systems.

2.05 AUTOMATIC AIR VENTS

A. Automatic air vents (air eliminators) for hot water systems shall be brass, rated 150 psig, the Spirax-Sarco 13WS, Dole, or Hoffman or equivalent as approved by the Professional, installed where shown or required. Provide valve on inlet piping to each air vent.

2.06 STRAINERS

A. Backflow preventers, shall include strainers ahead, integral or separate.

B. All other strainers shall be cast bronze, “Y” type, tapped for closure plug; plug by Contractor; 20 mesh, Type 304 stainless steel screen, (3” – 3/64” perforated screen; 4” – 1/8” perforated screen), 200 psi WOG, minimum, the Watts No. 777S or No. S777S, Apollo, Watson McDaniel, or Spirax or equivalent as approved by the Professional.

2.07 GAUGES / THERMOMETERS

A. Thermometers shall be non-mercury type, the Weiss Instruments DVU 35 Digital Read-Out, or approved equivalent, Trerice or Ashcroft or equivalent as approved by the Professional, mounted on V-shaped aluminum 9” scale with bold black piping and numerals on white background. Range -50 degrees F. to 300 degrees F. Connection assembly shall include swivel nut. Scale size, 2 degrees. Accurate to + one scale division. Brass 3½” stem. Each thermometer shall be installed in a stainless steel or brass separable socket.

1. Thermometer Test Wells (thermowells) shall be Weksler Model 2SL, Trerice, or Ashcroft.

B. Pressure gauges for domestic water systems shall be Weiss Instruments DUGY3 Digital Read-Out, or approved equivalent, Trerice, or Ashcroft or equivalent as approved by the Professional, 4-1/2" dial, 0 – 1000 psi scale, stainless steel case, and bronze bourdon tube. Gauges of 6" dial type shall be the Weksler BA16, or approved equivalent, aluminum, Style "A", same scale, bottom outlet. Each gauge shall be installed with a Weksler Type A10, brass, 1/4" N.P.T., "T" handle gauge cock and Weksler No. WG42 brass, 1/4" N.P.T. snubber-filter, or equivalent.

1. Pressure gauges for secondary gas regulating equipment shall be of type as specified with that equipment; refer to Section 221124.

PART 3 – EXECUTION

3.01 WATER DISTRIBUTION

A. All piping shall be installed in spaces and adjacent to other surfaces with sufficient clearances to permit air relief of the hot water system. Air venting valves shall be installed at all trapped high points in the hot water piping. Air venting valves shall be as specified.

B. The water systems included under this Contract, interior and exterior, shall be thoroughly flushed upon completion of the installations. Clean out all strainers.

3.02 INSTALLATION OF PIPING AND VALVES

A. Wrapping threads or caulking screwed connections for tightness is prohibited. No horizontal piping shall be built-in or buried in partitions. No piping shall be erected over any motors, panelboards, switchboards, or other electrical equipment**.** Bending of piping will not be permitted; fittings for change of direction shall be utilized. All vertical piping shall be run plumb. All overhead horizontal piping and vertical piping in finished areas shall be concealed, except as otherwise indicated on the drawings.

B. Cut pipe accurately to measurements, and ream free of burrs and cutting splatter. Carefully align and grade pipe and work accurately into place. Fittings shall be used for any change in direction. Make adequate provisions for expansion and contraction. Install anchors to prevent pipe movement. Provide for expansion at every building expansion joint.

C. All buried pipe for underground service piping shall be installed to prevent any movement or blow-out of fittings due to pressure surges in the line. Provide concrete thrust blocking at all turns in the underground piping systems and restraining rods or other methods of support for piping included under this Contract, especially at building entrances, as directed by the Water Authority. Thrust blocking shall be installed at all tees, plugs and bends deviating from the straight run in excess of 15 degrees. Blocking shall be placed between the fitting to be anchored and solid, undisturbed earth. The entire installations shall conform with Water Authority requirements. Confirm requirements prior to bidding.

D. Protect open pipe ends to prevent trash from being placed in the piping during installation. Clean all dirt and cutting debris from pipes before making the next joint.

E. Small pipe shall be screwed or soldered as required to produce a tight system with full joints and no leaks. Pipe joints showing seepage and drips shall be dismantled and remade in proper way, as required for a substantial installation.

F. Copper pipe shall be carefully reamed back to full inside diameter and the mating surfaces shall be cleaned by brush or sandpaper. When clean, the paste flux shall be applied and the joint evenly heated and soldered. Any fittings discolored by heat shall be removed and replaced.

G. All valves to be soldered into piping shall be dismantled to prevent the heat from destroying packing and seats.

H. Valves installed in threaded or flanged piping shall be properly supported and pipes carefully installed to prevent damage or distortion of the valve.

I. Grooved Joints: Install in accordance with the manufacturer's latest published installation instructions. Pipe ends shall be clean and free from indentations, projections and roll marks in the area from pipe end to (and including) groove. Gasket shall be manufactured by the coupling manufacturer and verified as suitable for the intended service. A factory trained representative

(direct employee) of the coupling manufacturer shall provide on-site training for contractor's field personnel in the use of grooving tools, application of groove, and product installation. The representative shall periodically visit the job site and review installation to ensure best practices in grooved joint installation are being followed. Contractor shall remove and replace any improperly installed products.

J. Grooved Joint Lubricants: Lubricate gaskets with lubricant supplied by the coupling manufacturer in accordance with published installation instructions. The lubricant shall be approved for the gasket elastomer and system media. Installation instructions and lubricant selection shall be submitted to engineer for approval

K. Install minimum 3/4" ball valve drains with vacuum breakers and threaded caps at every low place and air vents at every high place. Pipe shall slope as shown on the Drawings or in the Specifications. If slope is not shown or specified, slope in the direction of flow one (1") inch per every forty (40') feet.

L. Install pressure gauges, thermowells, and thermometers as specified or shown in details on the Drawings.

M. All valves must be accessible.

N. Extend each air vent outlet and relief valve outlet full size to nearest funnel/floor drain or safe waste.

3.03 CLEANING AND TREATING OF PIPE SYSTEMS

A. Every pipe system shall be cleaned to remove trash, mill scale, cutting oil, welding, and burning splatter from the piping before any control devices are installed. If such debris has collected in valves, the valves shall be disassembled and cleaned prior to closing for the first time.

B. Brush and clean work prior to concealing, painting, and acceptance. Perform in stages if directed by the Architect.

C. Clean and repair painted exposed work, soiled or damaged, to match adjoining work before final acceptance.

D. After several hours of operation, each strainer shall be blown down. This shall be repeated as often as necessary to produce a clean discharge from the blowdown. Prior to turning the system over to the Client Agency, each strainer shall be cleaned, removed if necessary for this requirement.

3.04 INSTALLATION AND TESTING PROCEDURES

A. All domestic water distribution piping included under this Contract shall be hydrostatically tested to a pressure of one and one-half times the normal system pressure or 150 psi, whichever is greater, and maintained for a period of 2 hours with a pressure loss of not more than 5 psi. The exterior water distribution system included under this Contract shall be installed and tested in compliance with the local Water Authority. Confirm requirements prior to bidding.

3.05 DISINFECTION OF WATER SYSTEM

A. Before being placed in service, all water piping, interior and exterior, included under this Contract, shall be chlorinated to the satisfaction of the Architect.

B. Prior to chlorination, all dirt, foreign matter shall be removed by a thorough flushing.

C. A water mixture of hypochlorite solution shall be applied by means of a solution-feed device.

D. Treated water shall be retained in the pipe long enough to destroy all non-spore forming bacteria. This period shall be at least 3 hours and preferably longer as may be directed.

E. After the chlorine treated water has been retained for the required time, the chlorine residual at the pipe extremities and at other representative points shall be at least 5 parts million.

F. Following chlorination, all treated water shall be thoroughly flushed from the newly installed piping at its extremities until the replacement water throughout its length shall, upon test, be equal to the water quality served from the municipal water supply system.

G. Should the initial treatment, in the opinion of the Architect, prove ineffective, the chlorination procedure shall be repeated until confirmed tests show the water sampled from the newly installed piping conforms to the requirements.

3.06 EXPANSION COMPENSATION

A. Pipe installations shall allow for expansion due to temperature differences. Provide expansion offsets in piping where necessary to control expansion.

B. Provide for expansion at every building expansion joint.

C. Separate expansion joints shall be a braided bronze or stainless steel flexible pipe connector, as manufactured by Flex-Hose Co., Inc., Flexonics, or Flexible Metal, Inc., suitable for water service. Expansion joints must be accessible.

3.07 BRANCH PIPING TO FIXTURES AND EQUIPMENT

A. Branch piping shall be extended and connected to all fixtures and equipment requiring same. Sizes of such connections shall be as indicated on the drawings and the Fixture Schedule, or as required by the particular piece of equipment or fixture being served. If the sizes of such connections are not clearly indicated, the Contractor shall verify the sizes required with the Architect prior to commencement of any roughing-in work. Changes to piping necessitated due to the Contractors' failure to properly verify the required sizes shall be made at the Contractors' expense.

END OF SECTION

SECTION 221124

NATURAL GAS PIPING

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE OF WORK

A. The interior natural gas distribution systems shall be described in this section. All work shall conform to the National Fuel Gas Code, NFPA Standard 54.

B. Refer to Section 220500 for river sand installation around underground pipe included under this Contract.

C. Refer to Section 221300 for exterior natural gas distribution piping.

D. All work under this Contract shall conform to the requirements and regulations of the Gas Company serving the building.

E. Main gas metering and regulating equipment serving the building will be furnished and installed by the Gas Company.

PART 2 - PRODUCTS

2.01 NATURAL GAS PIPING

A. Gas piping 2" and larger above ground shall be Schedule 40 ASTM A-106 seamless black steel pipe, Schedule 40 ASTM A-53 black steel pipe acceptable. Gas piping 1 1/2" and smaller above ground shall be Schedule 40 ASTM A-53 black steel pipe.

B. Galvanized pipe and fittings not acceptable.

C. Exterior gas sediment traps shall be required for all exterior gas-fired equipment on ‘dry gas’ systems, and shall be installed per NFPA recommendations.

D. Provide gas drips legs as required per Gas Company requirements on ‘wet gas’ systems. Exterior gas drip legs not permitted per the National Fuel Gas Code; install gas legs at heated interior of building to avoid condensate freeze-up, in accordance with interpretation NFPA recommendations, or as otherwise directed by the Gas Company.

2.02 VALVES

A. Furnish and install all valves necessary to the proper operation of the system. A valve shall be placed where each branch leaves the main and at such points as required for the proper control and shut-off of all piping. Each piece of equipment that may have to be removed from the system for repair shall be connected by union or flange, and provided with isolation valves. Gas valves shall be of manufacturer and style as listed on the Gas Company approved materials list, as manufactured by Homestead, Nibco, Apollo, or Crane, or equivalent as approved by the Professional.

1. Gas shut-off valves in Science Rooms’ Instructor’s Tables shall be 1/4 lockable turn ball type only, and valves tagged “Student Use-Gas Supply”. Valves in Students’ Tables shall be lockable.

B. Furnish and install full port gas valves for the gas supply piping to all gas-fired equipment. Furnish and install main full port gas valves, sized to match the incoming gas main into the building. **All gas valves shown on the drawings and indicated in the specifications shall be full port valves. Restricted port gas valves will not be acceptable.**

2.03 EMERGENCY GENERATOR CONNECTION

A. A separate valved gas main shall be connected ahead of the building’s exterior main gas valve above grade (after the Gas Company’s main regulating equipment) and extended to serve the

emergency generator set. Final connection to the equipment shall be under this contract. Provide a shut-off valve and pressure regulator at the point of connection. Coordinate the pressure requirements with the Electrical Contractor and Equipment Supplier prior to installation.

1. This shutoff valve and associated gas piping must be marked or tagged as supplying the emergency generator. The building's main service gas valve must be marked or tagged with an alert as to the presence of a separate emergency power supply gas shutoff valve. Tags shall be custom printed plastic type, chemical resistant, permanent, weatherproof, white background, black letters, approximately 3-1/4" wide x 5-5/8" high, with nylon self-locking ties, by Seton Name Plate Company, Brady Co., or MSI Services. Gas valve tags must conform with Gas Company's approval. Tag for gas valve serving the generator shall read: "WARNING-DO NOT CLOSE THIS VALVE-SERVES EMERGENCY GENERATOR SET". Tag for building's main service gas valve shall read: "NOTICE-EMERGENCY GENERATOR SERVED BY A SEPARATE VALVED GAS SUPPLY".

2.04 GAS REGULATORS

A. Furnish and install interior gas regulators where shown, complete with pressure gauges, unions, and gas shut-off valves on inlet and outlet. Regulator shall be as manufactured by Maxitrol, Chaplin-Fulton, or Fisher, or equivalent as approved by the Professional, of type conforming to Gas Company requirements. Coordinate with manufacturer regarding specific sizing. Regulator shall conform to ANSI Standard Z21.80. Regulator must provide positive tight shutoff, or positive tight lock-up at zero flow. Provide documentation of BTU and pressure range at **FULL LOAD** on submittal.

1. Pressure gauges shall be 2-1/2" minimum diameter, with waterproof cases, the Weksler No. 25KL, Trerice, or Ashcroft. Pressure gauges shall include brass socket, plastic lens, phosphor bronze diaphragm, required pressure range, 1/4" N.P.T., suitable for reading natural gas.

B. Regulators located inside the building must be vented to the outside. The vent pipe shall be at least the same size as the relief vent outlet, and shall be designed to prevent the entry of water, insects or other foreign material. (The only exception is that a regulator containing a vent limiter that is listed as complying with ANSI Z2.18 may be installed inside, in a well ventilated location, without a vent to the outside).

1. For exterior regulators, pressure gauges shall include waterproof cases.

2.05 KITCHEN GAS SOLENOID VALVE

A. Furnish and install an electric–operated gas solenoid valve in Kitchen gas piping where indicated, of type and body suitable for natural gas service, UL Listed, FM Approved, 2-way normally closed operation, die-cast aluminum body, high force shut-off, ANSUL 13000 Series, or approved equivalent. Valve shall be provided with 1/8" NPT upstream and downstream pipe taps with plugs for testing. The gas solenoid valve will be interlock–wired with the Kitchen hood fire suppression system by the Electrical Contractor.

1. Valve shall close shut when loss of power occurs; valve shall have a manually-reset control on restoration of power. Confirm manually-reset operation on submittal.

B. Furnish and install a cast iron or bronze strainer ahead of the solenoid valve, Watts, Spirax – Sarco, Watson McDaniel, or Apollo or equivalent as approved by the Professional.

C. Provide ANSUL manual reset relay, Part #14702. ANSUL valve and manual reset relay is to provide a manual reset for when the valve would automatically close during power failure. All interconnecting wiring shall be a part of this contract. Install manual reset relay with strict coordination with the Kitchen Personnel and the Client Agency.

PART 3 - EXECUTION

3.01 JOINING NATURAL GAS PIPING

A. Gas piping, 2" and smaller, shall be installed by threaded pipe and fittings. Welded piping, 2-1/2" and larger, shall be welded with appropriate fittings and procedures. Welding shall be

performed by certified welders only. Threaded fittings shall be assembled with 150 lb. malleable iron screwed fittings. All gas pipe fitting installations MUST adhere to NFPA 54 requirements.

1. Where screw fittings are utilized, field threading shall meet the requirements of ANSI B2.1. Screw joints shall be made up tight using a non-hardening pipe joint compound applied to male threads only.

B. Natural Gas Press fittings may be used provided that local Gas Company approves of this procedure. Natural Gas Press fitting system shall be by Viega MegaPress G Natural Fuel Gas System or approved equivalent or equivalent as approved by the Professional. Press Fitting systems to meet all ASTM, NFPA, and all other appropriate code requirements. Installation of press fittings to follow manufacturer requirements and shall be installed by trained professionals. Contractor to provide written confirmation from local Gas Company as a part of the submittal process to confirm the use of Natural gas press fittings.

C. When installing piping which is to be concealed, the number of fittings shall be kept to a minimum.

D. Separate expansion joints shall be a braided bronze or stainless steel flexible pipe connector, as manufactured by Flex-Hose Co., Inc., Flexonics, or Flexible Metal, Inc., suitable for gas service, conforming to Gas Company requirements. Expansion joints must be accessible.

3.02 DEFECTIVE NATURAL GAS PIPING

A. When defective pipe or fittings are located in the system, the defective material shall be replaced. Under no circumstances shall defects in pipe or fittings be repaired.

3.03 PURGING NATURAL GAS

A. Prior to establishing service, all gas piping shall be fully purged. Piping shall not be purged into the combustion chamber of an appliance.

B. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are sources of ignition unless precautions are taken to perform this operation in a safe manner, by ventilation of the space, control of purging rate, and elimination of all hazardous conditions. Never leave the appliance while purging.

3.04 TESTING AND INSTALLATION REQUIREMENTS – NATURAL GAS

A. The gas piping included under this Contract shall be given a pressure test with air or an inert gas before being placed in service, in accordance with Gas Company requirements. Under no circumstances may oxygen, flammable gas or any liquid be used as the test medium. To locate leaks, piping joints should be covered with soapsuds or a leak-finder liquid. In no case shall ether, Freon, or any gas that will produce a toxic atmosphere when burned, be injected into the piping to locate leaks.

B. Gas piping, as shown by testing, must be free of leaks before being placed in service. All testing shall be done using an approved gauge.

C. All gas piping included under this Contract shall be installed and tested in strict accordance with requirements of the Gas Company. The Contractor shall contact the Gas Company before bidding for service and shall obtain and pay all fees required for work included under this Contract. All fees required by the Gas Company must be included.

3.05 NATURAL GAS COLOR CODING/LABELING

A. Color code and/or label interior and exterior exposed and accessible concealed gas piping, included under this Contract, per Gas Company and Client Agency requirements. Contractor shall primer and paint all exterior gas piping “yellow” by default unless directed otherwise by client agency or architect.

END OF SECTION

SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The sanitary waste and vent piping systems shall be as hereinafter described in this section. Make all required connections into the interior sanitary drainage systems.

1.03 CODE COMPLIANCE

A. All sanitary materials and installation methods shall be subject to the acceptability of that material with the prevailing local plumbing codes.

1.04 PIPE AND MATERIALS

A. This Contractor shall furnish and install sanitary sewer and vent piping as indicated on the Drawings. Pipe sizes indicated are minimum sizes. Minimum size below bottom floor or below ground, interior, 4". Pipe sizes shall be larger where required by local codes.

PART 2 – PRODUCTS

2.01 SANITARY SEWER AND VENT PIPING UNDERGROUND

A. High performance coated or Epoxy coated Cast Iron hub and spigot pipe and fittings – ASTM A74. Coated Cast iron pipe and fittings as manufactured by Charlotte, New Age, or Tyler or equivalent as approved by the Professional. Coating Performance: Pipe and Fitting Coatings must pass the performance specifications per EN 877.

B. Provide sanitary sewers exiting the building each with vents, house traps, and cleanouts within the limits of sewer construction included under this Contract work, as required by the prevailing plumbing code and /or the sewer authority having jurisdiction.

1. For sanitary mains that exit the building below structural components, piping shall be sleeved and encased in concrete a minimum of 2’-0” beyond of the structural component, on either side. Coordinate specific requirements with structural design prior to installation.

2. For sanitary mains that exit the building through structural components, piping shall be sleeved through the component. Installation, location, and depth of sleeves need to be strictly coordinated with General Contractor prior to installation.

2.02 SANITARY SOIL, WASTE, AND VENT PIPING ABOVE GROUND

A. High performance coated or Epoxy coated Cast Iron Hubless pipe and shall conform to ASTM A-888. Pipe and fittings as manufactured by Charlotte, New Age, or Tyler, or equivalent as approved by the Professional. Coating Performance: Pipe and Fitting Coatings must pass the performance specifications per EN 877.

1. Extra heavy weight coated cast iron hub and spigot soil pipe and fittings, ASTM A74, shall be utilized where required by local codes.

B. Automatic air vent or relief valve discharge piping shall be Type "L" copper with drainage pattern fittings. Plastic piping and fittings will not be permitted for this installation.

C. Vent piping to atmosphere shall be minimum 3” diameter and terminate a minimum of 12” above roof level. Terminate vent piping at a higher height above roof level where required by local codes. Rigidly support all vent piping extending through roof.

D. Where new vent piping is internally connected to existing vent piping which extends through roof, verify height of that existing vent pipe above roof and modify same as necessary to conform with local code and local Plumbing Inspector requirements for correct vent pipe height

above roof.

2.03 JOINTS AND CONNECTIONS

A. Joints for Hub and Spigot Cast Iron Pipe and Fittings Below Grade

1. Joints in cast iron hub and spigot shall be made with either (1) a caulked joint using pig lead and oakum with at least 12 ounces of lead per inch of pipe diameter. Lead shall be run in one pouring; (2) a compression joint using a lubricated neoprene gasket, Mission, Tyler "Ty-Seal"; Charlotte Foundry, New Age, or Tyler, or equivalent as approved by the Professional. Provide appropriate gaskets for connections and joints as needed, (for example EPDM gaskets) as required for pipe materials.
2. Joints between cast iron hub and spigot pipes and threaded pipes shall be made same as above using a caulking spigot.
3. Joints in threaded pipe shall be made with clean-cut uniform tapered threads, with suitable pipe joint compound.

B. Joints for Hubless Cast Iron Pipe and Fittings Above Grade

1. Joints in hubless cast iron pipe above floor level for building construction one (1) story and less, shall be made with a mechanical coupling composed of a heavy duty Type 304 stainless steel shield and neoprene slip-on gasket, ASTM C-1540, Husky HD 2000, Clamp-All 80, or equivalent as approved by the Professional. For building construction more than one (1) story, use Husky SD 4000, Clamp-All 80, or approved equivalent, heavy duty couplings. Gauges of equivalents must conform. Hubless cast iron pipe below bottom floor, below ground, below crawl space or walkway floors, or at exterior of building not permitted at any location.
2. Couplings for joining hubless cast iron soil pipe and fittings conforming to ASTM A-888, shall be 3 inches wide for nominal pipe sizes 1 ½ to 4 inches in diameter, 4 inches wide for nominal pipe sizes 5 to 10 inches in diameter, and 5 5/8 inches wide for couplings 12 and 15 inches in diameter. Couplings to be by Charlotte Foundry, New Age, or Tyler, or equivalent as approved by the Professional. Provide appropriate gaskets for connections and joints as needed, (for example EPDM gaskets) as required for pipe materials. Shields shall have a minimum thickness of .015 inches, (28 gage) type 304 stainless steel. Worm drive clamps shall be type 304 stainless steel with a minimum clamp torque of 80 in/lbs. Sealing Gasket shall be neoprene conforming to ASTM C-564. Couplings shall conform to Factory Mutual Standard 1680, Class 1, or ASTM C-1540, as manufactured by Clamp-All Products Models HI-TORQ 80 and HI-TORQ; or Huskey Technologies Model SD-4000.
    a. Alternative to above, cast iron split clamps secured by stainless steel bolts and nuts with neoprene gasket conforming to ASTM C-564; as manufactured by MG Coupling Company.
    b. Factory Mutual Approved Couplings may be hung with one hanger per length of pipe for 10 foot lengths and at every third fitting where they are contiguous in conformance with manufacturers installation instructions.

C. Joints between copper tubing and threaded pipe shall be made with brass soldered to screwed converter fittings. Fittings for copper tubing by Nibco, Cambridge-Lee, Mueller, Elkhart, or equivalent as approved by the Professional.

D. All transition joints in sewers between dissimilar materials or unequal sizes shall be made water and gas tight by means of an approved connection or adapter of the compression or mechanical seal type. The connector or adapter shall be manufactured of preformed Elastomeric Polyvinyl Chloride conforming to ASTM Standards C-425, C-594, C-564, and D-1869. Couplings of the mechanical seal type shall have tightening clamps or devices made of 305 stainless steel. The compression joint connector or adapter and flexible coupling shall be installed as recommended and specified by the manufacturer and each connector shall bear the manufacturer's name clearly visible when installed, such as manufactured by Fernco Joint Sealer Company, Indiana Seal, or Mission or equivalent as approved by the Professional.

E. All joints shall be made permanently gas and water tight.

F. The use of any of the above joints and connections shall be subject to their acceptability with the prevailing local plumbing codes.

G. For above and below ground drainage piping changes in direction - bends, sweeps, tees, and/or wyes shall be installed per the IPC, Section 706, or applicable local plumbing code, for horizontal-to-horizontal, vertical-to-horizontal, and horizontal-to-vertical direction changes. Fitting types shall be uniformly used throughout the project.

2.04 FLOOR DRAINS

A. The Contractor shall furnish and install the following types of floor drains, by Zurn, Josam, Smith, Mifab, Wade, or Watts or equivalent as approved by the Professional. Refer to "Tamperproof Screws", Section 220500. Coordinate all strainer shape, configuration, and design with floor finishes and architect prior to submittal. All drains shall have associated Trap Seals for evaporation protection.

1. FD-1 – Zurn ZN415-BZ1-VP Series, bottom outlet, coated cast iron body with polished nickel-bronze leveling strainer, ZN400BZ-VP, Type BZ, vandal-proof, or approved equivalent. Strainers in shower rooms and locker rooms shall be 8" size. All other strainers shall be 6" size. (Finished Areas)

2. FD-2 – Zurn Z551-Y Series, bottom outlet, coated cast iron body, 9" diameter top, with sediment bucket, or approved equivalent. Provide Z550-Y-P drains for drains above floor level or in areas requiring membrane flashing. Tamperproof screws not required. (Equipment Areas, Janitor Closets)

3. FD-3 – Same as FD-1, except with polished nickel-bronze round leveling strainer, ZN415-7E-VP, vandal-proof, or approved equivalent. Strainers shall be 7" size. Top of funnel shall be a maximum of 4" above finished floor. Provide a ZN329-7 nickel-bronze oval funnel assembly where round funnel is insufficient in size. (Finished Areas.)

4. FS-1 – Zurn No. ZN1851-KC-2-25, 12" x 12" x 8" deep, cast iron body and square light duty grate, with white acid-resisting porcelain enamel interior receptor with nickel-bronze frame and 1/2 nickel-bronze grate, with 1/2" square openings, flange with seepage holes with clamp collar, and white A.R.E. sediment bucket in lieu of dome strainer, or approved equivalent. Set drain flush with floor; confirm setting with local plumbing inspector. (Kitchen Areas)

5. HUB DRAINS – shall be constructed of same piping materials as utilized for system piping. Set each hub drain over a P-trap.

B. All floor drains in floor construction shall be set over P-traps, except exterior drains and shall be furnished and installed with flashing flanges and clamping collars.

C. The Contractor shall check with the Local Plumbing Inspector for setting of tops of all floor sinks and funnel/floor drains relative to finish floors.

D. The Contractor shall coordinate with finished flooring materials to confirm if any additional accessories, including clamping, bracing, etc., for all drains prior to submittal shall be required.

2.05 CLEANOUTS

A. The Contractor shall furnish and install cleanouts at each change in direction greater than 45° in sanitary drainage systems, at the base of all sanitary drainage stacks, and at all other points indicated on the Drawings.

B. Cleanouts installed on under-floor piping, exterior piping, or piping below slab on grade floors shall be extended to floor level or grade level with 45 degree fittings.

C. Cleanouts on concealed piping shall be extended so as to be easily accessible from finish floor, ceiling, or wall.

D. Cleanouts shall be full pipe size up to and including 4", and shall be 4" on larger size piping, if approved by the local authorities having jurisdiction over the installations.

E. All cleanout equipment shall be Zurn, Josam, Smith, Mifab, Wade, or Watts or equivalent as approved by the Professional. Refer to “Tamperproof Screws”, Section 220500.

1. Zurn ZN1443-VP / ZN1447-VP – Cleanout with nickel-bronze access cover with vandal-proof screws, for all piping concealed. For all locations other than where access panels or doors are noted. Plastic, PVC, or fiberglass type cleanout covers not acceptable.
2. Zurn ZN1400-5BZ1-VP – Adjustable floor cleanout with round top, vandal-proof screws. Zurn ZN1400-X-VP – for vinyl tile; ZN1400-Z-VP – for 1-1/4” terrazzo, vandal-proof screws; ZN1400-CM-VP – for carpet installation, vandal-proof screws.
3. Zurn Z1400-HD-VP – Adjustable exterior extra heavy-duty round cleanout, vandalproof screws, cast bronze plug, set in concrete slab, 24” x 24” x 6” thick. Provide nickel-bronze finish cleanouts at any finish entrances or exits of building. Refer to the drawing details.

F. For cleanouts on PVC piping above floor level, cleanouts shall be PVC threaded plugs in wye fittings. For cleanouts on cast iron piping above floor level as described herein, cleanouts shall be cast bronze threaded plugs in wye fittings.

G. Floor cleanouts in interior heavy duty traffic areas, shops, equipment rooms, boiler rooms, janitor’s closets, and storage rooms shall be cast bronze flush floor plugs, Zurn ZARB-1470-PW, or approved equivalent. Provide two (2) plug wrenches only, total.

H. Floor cleanouts shall be furnished and installed with flashing flanges and clamping collars. Floor cleanouts on the bottom-most slab shall not require flashing.

I. Where vertical piping is installed in chases in finished rooms, extension pieces, if required, shall be placed in tees so as to bring cleanout plugs to the back of the cover plate set flush in the finished walls.

J. Except where cover plates are provided with a recess for inserts of the same material as the floor finish, all cover plates in floors of finished areas shall be scoriated nickel bronze. Frames for the cover plates shall be compatible with the finished flooring material.

K. Care shall be exercised in installing cleanouts to avoid locating them in surfaces to be carpeted. Provide additional piping as required to locate cleanouts in other more accessible surfaces.

L. The Contractor shall lubricate all plugs before installation and shall loosen all covers and plugs before final inspection as directed by the Architect.

2.06 TRAPS

A. Service weight or extra heavy weight cast iron, or PVC, shall be used in accordance with applied piping system.

B. A separate trap shall be provided for each plumbing fixture which does not contain an integral trap. In general, all fixture traps shall be provided with accessible cleanout plugs located on the bottom of the bend.

C. Traps shall be set true with respect to their water seals.

2.07 TRAP SEALS

A. Furnish and install for each floor drain a manufactured trap seal, to provide for sewer gas emission protection, the Zurn ZSHIELD Z1072, ProSet, Mifab, Smith or equivalent as approved by the Professional. Prior to ordering, the Contractor must confirm that the installation of trap seals conforms to national, local, and State plumbing and building code requirements. Trap seals shall be of types recommended by the manufacturer for the particular installation.

B. Trap seal material shall be of elastomeric flexible PVC, which shall never lose its curl seal; seal must be of type that maintains its memory. Trap seal shall be of type that maintains memory when subjected to temperatures of 200° or more. Trap seal shall be capable of handling a flow rate of at least 30 GPM. Trap seal shall be of type that will not allow lime scale build-up.

2.08 FRESH AIR INLETS

A. Fresh air inlets shall be the Zurn ZANB-1472-VP, Josam, Smith, Mifab, Wade, or Watts, or

equivalent as approved by the Professional. Fitting shall be round, nickel-bronze, with secured, vandalproof cover and 4” threaded connection. Include stainless steel insect screen beneath cover. Provide any required reducers.

2.09 INTERCEPTORS

A. Solids Interceptors (SI) shall be the Zurn No. ZS1182 or ZS1183, Josam, Smith, Wade, or Watts or equivalent as approved by the Professional, 2" size inlet/outlet, top or side access, stainless steel solids interceptor, in lieu of fixture P-trap, for suspended installation, with a flow rate of 15 GPM. Furnish with removable PVC sediment bucket having a removable 3/32” diameter perforated flow diffusing/intercepting stainless steel screen, designed to intercept all types of solids. Complete with access gasketed secured cover, stainless steel draw latches and hardware. For disabled sink units, mount solids interceptors clear of disabled area at sink cabinetry; install interceptor in accordance with local code distance requirements. It is the responsibility of the Plumbing Contractor to properly select and install the appropriate solids interceptor to allow proper basket strainer removal.

B. Grease Interceptor (GI) shall be the Zurn Z1170 series, Josam, Smith, Wade, or Watts or equivalent as approved by the Professional, acid resistant coated interior and exterior fabricated steel grease interceptor, with internal air relief by-pass, bronze cleanout plug, removable pressure equalizing/flow diffusing inlet baffle, fixed bottom outlet baffle, and visible double wall trap seal, for recessed floor installation. Refer to Drawing Schedule for Grease Interceptor specifics. Gasketed non-skid secured cover, with covered recessed lift handle, complete with center tie-down assembly, with Z1108 flow control fitting, or equivalent. Provide acid resistant coated interior and exterior fabricated steel recessing receiver. Provide acid resistant coated interior and exterior fabricated steel extension section, of proper dimension, to floor level. Vent unit as shown, or in accordance with local code requirements. Set interceptor on a 6” high reinforced concrete pad (underground). Locate unit for access to inlet baffle removal.

1. Include bottom anchor flanges, securely fastened to concrete to prevent movement.
2. Provide 1/8” x 1/8” size screen on 3/4” exterior air intake terminal.

PART 3 – EXECUTION

3.01 PIPE PREPARATION AND INSTALLATION

A. Review the proper procedures and methods for coated cast iron installation with the piping system manufacturer. Provide Pipe End Protection as required by the Cast Iron Piping Supplier for all pipe and fitting connections and applications for a thorough and uniform coating throughout the drainage piping system.

3.02 GRADE

A. Elevations and locations of floor drains, funnel drains, floor sinks, and cleanouts shall be adjusted to avoid interference with other utilities and equipment without additional expense.

3.03 FLASHING

A. Provide 48” square sheet lead, copper, or neoprene flashing for floor drains, funnel drains, floor sinks, and cleanouts, set integral with floor slab. Chloroloy or approved equivalent non-plasticized chlorinated polyethylene waterproofing membrane will be acceptable for flashing of floor drains, funnel drains, floor sinks, and cleanouts.

B. Openings, patching, restoring, and flashing in existing roof by Roofing Contractor at Plumbing Contractor’s expense.

3.04 INSTALLATION AND TESTING PROCEDURES

A. Horizontal cast iron pipe and fitting installations above ground, 6” and larger, shall be suitably braced to prevent horizontal movements, at every branch opening or change of direction, by the use of braces, blocks, rodding, or other suitable method, in accordance with pipe manufacturer’s and Cast Iron Soil Pipe Institute’s installation instructions. Vertical cast iron pipe and fitting installations above ground of all sizes shall be secured at each stack base and

at sufficiently close intervals to keep the system in alignment and to adequately support the weight of the pipe and its contents.

B. Unless noted otherwise on the Drawings or herein specified, or required to suit final floor elevations, all sanitary piping 3” and larger shall be installed with a uniform minimum slope of 1/8" to the foot and all sanitary piping 2” and smaller shall be installed with a uniform minimum slope of 1/4" to the foot, or as otherwise required by local codes.

1. All Kitchen Area grease waste piping shall be installed with a uniform minimum inlet/branch outlet slope of interceptors of 1/4” to the foot.
2. Maintain 30” minimum ground cover over top of exterior sewers.

C. Interior sanitary drainage piping shall be hydrostatically tested after completion of the roughing-in. Piping being tested shall be filled to the top of vent pipes, and left standing for a period of one (1) hour with no loss of water. Smoke tests will be acceptable if required by local authorities. Confirm requirements prior to bidding.

D. After testing and before final acceptance, the Contractor shall completely flush the entire sewer systems and appurtenances included under this Contract in sufficient volume to remove all settlement and debris to obtain free flow through each pipe. Flushing shall be accomplished by the use of automatic flush tanks, fire hoses, or other means approved by the Architect. Depths of water and velocities shall be as required to produce a hydraulic bore. Remove all obstructions and correct all defects discovered.

E. Exercise extreme care to prevent debris from entering floor drains or cleanouts. Carefully check invert elevations of floor drains to which connections are to be made.

F. Inform the Client Agency’s maintenance personnel of the proper methods of cleaning out all interceptor types.

3.05 CLEANING AND FLUSHING OF EXISTING SANITARY SEWERS

A. The Contractor shall clean and flush out existing interior sanitary sewers inside the building effected by this project, by the hydro-sewer cleaning method, using high pressure water.

B. The Contractor shall clean the designated sanitary sewers of all debris, grease, sand, sludge, soap, rocks, and accumulations, flush out, and ensure that all such sewers are completely free-flowing.

C. All sanitary sewer cleaning and flushing work shall be completed by the hydro-cleaning process, by a competent independent firm, with workers specifically skilled in this type of work.

D. A written report of the cleaning and flushing work and remaining condition of these existing sanitary sewers, shall be included. A copy of each shall be furnished to the Client Agency and the Architect.

E. All fees, charges, and costs for cleaning and flushing work shall be included under the Plumbing Contract.

3.06 FINAL INSPECTION

A. At the time of final inspection of the work performed under the Contract, the floor drains and cleanouts shall be complete in every respect and in perfect operating condition. All surplus materials of every description resulting from the work shall have been removed. Floor drains shall be free from debris, sand, silt or other obstructions. Any defects discovered in the floor drains, floor sinks, funnel drains, and cleanouts subsequent to this inspection shall have been corrected.

B. Inform Client Agency’s Operating Personnel to properly maintain trap seals, and periodically flush trap seals with fresh water to clear any foreign objects.

END OF SECTION

SECTION 221429

PLUMBING PUMPS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The pumps shall each be as described in this section, of sizes and capacities as noted on the Drawings.

B. The pumps shall each be installed in accordance with the prevailing local plumbing codes.

C. All pumps must be accessible.

D. Refer to “Electric Motors”, Section 220500.

PART 2 - PRODUCTS

2.01 DOMESTIC HOT WATER RECIRCULATING PUMPS (HWCP)

A. HWCP – Hot Water circulating pumps shall each be of all bronze construction or stainless steel construction, lubricated, the Bell and Gossett Booster Series, Taco, or Grundfos or equivalent as approved by the Professional. Provide an aquastat to control each pump operation. Refer to the schedule shown on drawings for capacities.

B. Power wiring will be furnished and installed under the Electrical Contract. Manual motor starters shall be furnished under the Plumbing Contract and delivered to the Electrical Contractor for installation. All control wiring required to operate aquastats and pumps shall be included under this Contract, of type specified.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install each pump in accordance with manufacturer's written recommendations and installation instructions.

B. For each recirculating pump, furnish and install a ball shutoff valve and strainer on inlet piping to the pump, with a balancing cock on outlet piping. Furnish and install a check valve where shown.

C. For Under-counter sump pump installations, inform the client agency’s maintenance personnel of the frequency necessitated to keep the sump basin cleaned, and the proper methods of cleaning the units.

D. Place each pump in service and check power draw, voltage, and proper system operation. Report the actual current draw and pump flow, and other information for each pump. Provide written results to the Client Agency.

END OF SECTION

SECTION 224000

PLUMBING FIXTURES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections " General Conditions of the Construction Contract ", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The plumbing fixtures, trim, accessories, and miscellaneous equipment shall be as shown on the drawings. Additional manufacturer's names of fixtures, trim, and miscellaneous equipment shall be listed herein.

B. All plumbing fixtures and trim shall be new and of the best quality. All fixtures shall bear the manufacturers' guarantee label or trademark, indicating first quality.

C. **ALL** fixtures and associated trim, including traps, stops, faucets, flush valves, etc., shall be 'Lead Free' or 'No Lead' and shall be documented as such as part of the submittal process.

D. All vitreous china, cast iron, and prefabricated fiberglass, polyethylene, acrylic, or polypropylene fixtures shall be white and all fixtures of all types shall be specially selected, free from cracks, chips, flaws, stains and warping, and other defects. Fixtures shall be replaced by the Contractor, and the guarantee period on such replaced fixtures shall be extended for the full term of the guarantee from the date of replacement.

E. The Contractor shall refer to the Drawings for the quantities of plumbing fixtures of each kind to be furnished.

F. Provide adapters on all final piping connections to equipment furnished under other contracts or by the Client Agency.

G. All fixtures and trim shall be as listed below. Confirm requirements of all fixtures, trim, and manufacturers with Client Agency prior to ordering. Trim shall be commercial grade.

1. Water Closets, Lavatories – Zurn, American-Standard Brands, Kohler, or Sloan
2. Utility Sinks – Zurn, Florestone, or Fiat
3. Electric Water Coolers / Bottle Fillers – Oasis, Elkay, Haws, Murdock, Halsey Taylor
4. Water Closet Flush Valves – Zurn Aquavantage Only, Sloan Royal only
5. Lavatory Faucets – Zurn, Chicago Faucet, Speakman, or T&S Brass
6. Fixture Support Carriers – Zurn, Josam, Smith, or Watts
7. Waste/Trap Assemblies – Zurn, McGuire, or Kohler
8. Water Supplies/Stops – Zurn, McGuire, or Kohler
9. Insulation Kits – Zurn, McGuire, or Truebro

H. All fixtures and equipment shall be properly trapped in accordance with local code requirements.

I. All exposed piping to fixtures shall be chrome plated. Chrome traps and chrome tubing shall be 17 gauge minimum. All traps of all types, exposed and accessible concealed, shall each include cleanout. Chrome finishes shall not be required for fixtures that require insulation kits.

J. All escutcheons shall be chrome, cast brass, set screw type, including on drain assemblies, water supplies at fixtures, and including piping inside fixture cabinets.

K. Plumbing Contractor shall furnish templates to General Contractor for cut-out work for built-in sinks and lavatories. Confirm available cabinet sizes with the General Contractor or Equipment Supplier prior to ordering counter sinks or counter lavatories of any type.

L. Rigidly secure flush valve supply piping so that valves do not move. Include suitable piping

support adapters, as manufactured by Sioux Chief Manufacturing, or approved equivalent. Split ring chrome flush valve supports acceptable.

M. Supply piping to fixtures, faucets, shower heads, wall hydrants, and hose bibbs shall be securely anchored to prevent movement.

N. All ADA water closet flush valve handles shall be mounted on wide side of toilet areas.

O. Contractor shall coordinate all installations with Architectural Drawing elevations and ADA required clearances.

PART 2 - PRODUCTS

2.01 FIXTURES

A. EWC-1 – Dual Height Electric Water Cooler with Bottle Filler – Standard & ADA Height

1. Elkay LZSTL8WSSK ezH2O® Bottle Filling Station & Versatile Bi-Level ADA Cooler Filtered Refrigerated Stainless. Chilling Capacity of 8.0 GPH (gallons per hour) of 50□ F drinking water, based on 80□ F inlet water and 90□ F ambient, per ASHRAE 18 testing. Features shall include Antimicrobial*, Filtered, Green Ticker™, Hands Free, Laminar Flow, Real Drain, Visual Filter Monitor. Furnished with Flexi-Guard ® Safety Bubbler. Electronic Bottle Filler Sensor with Electronic Front and Side Bubbler Pushbar activation. Product shall be Wall Mount (On Wall), for Indoor applications, serving 2 station(s). Unit shall be certified to UL 399 and CAN/CSA C22.2 No. 120
2. Fixture shall have Elkay LKAPREZL ADA apron when unit is installed and exposed on walls.
3. Filter – Elkay 51299C Filter media includes chlorine, taste, odor and lead reducing element.
4. Fixture shall have ADA apron when unit is installed and exposed on walls.

B. L-1 – Wall-Mounted Bowl with Battery-powered Faucet – ADA Height

1. Zurn No. Z5364 vitreous china wall hung lavatory, 20” x 18”, with faucet holes on 4” centers. Fixture shall be provided with hanger plate and holes for concealed arm carrier systems. Mount at ADA Height.
    a. Zurn Series Z1231-79 carrier. Use Z1231-D-79 carrier where back-to-back installation is practical. The Zurn “EZ Set” lavatory support system will be acceptable. Zurn “CB” carrier bank supports acceptable.
2. Drain shall be Zurn No. Z8746-PC flat perforated strainer drain with 1-1/4” offset tailpiece.
3. P-Trap assembly shall be Zurn No. Z8701-9-PC, 1-1/4” x 1-1/2”, with cleanout.
4. Water supplies shall be Zurn Z8800-XL-LRLK-PC. Brass ball valve type “convertible” stops acceptable.
5. Zurn No. Z8946-3-NT ADA compliant insulation kit for waste and hot and cold water assemblies, vandal-resistant; when exposed to users.
6. Faucet shall be Zurn No. Z6950-XL-IM-S-CP4-N-TMV-1, ‘Lead Free’, heavy duty cast brass spout, polished chrome plated finish, 30 second maximum safety shutoff time, 4 AA batteries-included, integral above deck mixing lever, 0.5 GPM vandal-resistant laminar flow spray outlet, and 5 year manufacturer’s warranty covering mechanicals, batteries, electronics and solenoid, and faucet finish

C. MB-1 – Mop Basin

1. Zurn No. Z1996-24-SDL-BS-WG-HH-MH mop basin, 24” x 24” x 10” high, with stainless steel dome strainer and 3” outlet, of color selected by Architect. Complete with four (4) stainless steel rim/bumper guards; back and side 24” stainless steel wall guard panels, of number required by the installation, Type 304, 20 gauge; 30” heavy duty 5/8” rubber hose/bracket combination and mop hanger bracket, stainless steel, 24” x 3” wide. Use silicone sealant caulk on all wall and floor contact edges.

2. Faucet shall be Zurn No. Z843M1-RC faucet with vacuum breaker spout, pail hook, wall brace, lever handles, and rough chrome plate finish. Furnish and install check valves in hot and cold water piping serving the combination faucet.

D. WC-1 – Wall-Mounted Water Closet with Battery-Powered Flush Valve – ADA Height

1. Vitreous china Zurn No. Z5615-BWL, 1.6 gallon per flush, low consumption, siphon jet, elongated bowl, wall mounted closet with 1-1/2" top spud and bolt caps, ADA Compliant.

a. Zurn Z5955SS-EL-AM-STS, heavy duty, anti-microbial, commercial grade, open front, plastic seat less cover, with self-sustaining stainless steel concealed check hinges.

b. Zurn Series Z1201, Z1202, Z1208 and Z1209 carriers. Match carrier selection to specific piping configuration and wall type. Include rear stabilizer support for carrier and wall finishing frame. Waste outlet seal ring must be neoprene or graphite – felt. Do not use a wax ring. Inform Carrier Supplier to include additional auxiliary support and extension assemblies and couplings to accommodate the closet installations.

2. ***Battery-Powered*** Flush Valve shall be Zurn No. ZER6000AV-SM-HET, 1.28 gallon per flush, with true mechanical override.

PART 3 - EXECUTION

3.01 INSTALLATION

A. All fixtures, trim, accessories, and equipment shall be assembled and installed according to manufacturers' recommendations in a neat and workmanlike manner.

B. Thoroughly clean all fixtures, trim, accessories, and equipment installed under this Contract.

C. Refer to the Architectural and Plumbing Drawings for scheduled mounting heights and clearances for fixtures and equipment. Particular attention is directed to mounting and clearances for ADA fixtures.

D. Upon completion of this Contract, the Plumbing Contractor shall furnish the Client Agency's maintenance personnel with a Supplier faucet repair kit furnished by the approved faucet supplier.

E. Caulk with white silicone sealant caulk on all wall and floor contact edges on all fixtures, or of color caulk selected by the Architect. Caulk shall be of suitable type which can be painted.

F. Set lavatory and sink mixing valves as indicated or as directed by the Client Agency.

G. Adjust water cooler flow regulators for proper flow and stream height. Adjust to obtain maximum useable pressure at each water cooler. Adjust water cooler temperature settings.

H. Individual mixing valves shall be utilized at certain fixtures and equipment receiving hot water as designated; refer to Section 220523 regarding mixing valve specifications. The Plumbing Contractor shall verify exact requirements, quantities, and locations of mixing valves with the local Plumbing Inspector prior to ordering or installation.

END OF SECTION

SECTION 230505

HVAC SCOPE

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 EQUIPMENT AND SYSTEMS PACKAGING

A. Equipment and product manufacturers specified in the Section 23 documents are encouraged to form vendor teams where practical to provide equipment in competitively priced packages.

1.04 DESCRIPTION OF WORK

A. The work to be performed under these Specifications and the accompanying Drawings comprises the furnishing of the labor, materials, tools, and other services and facilities necessary for the complete installation of, but not necessarily limited to the following:

1. Demolition of HVAC equipment, ductwork, and piping as indicated on the drawings.
2. Make-up Air Units
3. Rooftop Units
4. Air Handling Units
5. Hot Water Boilers
6. Water Cooled Chiller
7. Terminal Equipment – Constant and Variable Volume Boxes, Fin Tube, Fan Coil Units, Cabinet Unit Heaters, Horizontal Unit Heaters, Convectors
8. Supply and Exhaust Fans, Miscellaneous Ventilating Systems
9. Electric and Data Room AC Units
10. Piping – Hot Water, Chilled Water, Condenser Water, Refrigerant, Condensate Drain
11. Piping Specialties, Valves, Hangers and Supports
12. Ductwork – Low and Medium Velocity
13. Ductwork Accessories – Dampers, Grilles, Registers, Diffusers, Supports, Access Doors, and Turning Vanes
14. Insulation – Piping, Equipment, Ductwork
15. Circulating Water Pumps – Hot Water, Chilled Water, Condenser Water
16. Water Treatment – Closed Loop
17. Cleaning of all existing ductwork, diffusers, grilles, etc. being reused.
18. Refurbishment of existing metal fin tube enclosures being reused.
19. Equipment and Piping Identification
20. Testing, Adjusting, and Balancing
21. A new DDC Automatic Temperature Control system for new equipment. The system shall include new control panels, control wiring, control valves, thermostats, switches, relays, controllers, and other accessories herein specified. ATC system shall be an extension of the existing campus Automated Logic BMS.

22. Furnish combination starter/disconnects, disconnect switches, magnetic motor starters, manual motor starters and fuses to the .4 Contractor for installation on the HVAC Equipment. Coordinate the electrical requirements with the .4 Contractor before ordering any such equipment.
23. Install duct-mounted smoke detectors. Furnish and install the control wiring from the duct-mounted smoke detectors to the air handling unit motor starters for unit shutdown. Duct-mounted smoke detectors shall be furnished and connected to the fire alarm system by the .4 Contractor.

1.05 WORK BY OTHERS

A. The following construction and equipment related to the work under this Contract will be provided by others:
1. Openings in new roof and roof deck. (.1 Contractor)
2. Openings in new exterior walls. (.1 Contractor)
3. Furring around new piping. (.1 Contractor)
4. Final painting of new interior surfaces. (.1 Contractor)
5. Recesses and openings in new construction for piping and equipment. (.1 Contractor)
6. New chases for piping where specifically shown on the drawings. (.1 Contractor)
7. Funnel and floor drains required for the various equipment. (.3 Contractor)
8. The removal of existing electrical wiring, conduit and boxes for existing removed heating and ventilating equipment. (.4 Contractor)
9. The line and load side electric power wiring to the new electrically operated heating, ventilating and air conditioning equipment (.4 Contractor). The control and interlock wiring, both low and line voltage shall be included under the .2 Contract as hereinafter specified for the .2 equipment.
10. The .4 Contractor shall be responsible for the power wiring and associated terminations to line and load side as well as mounting of the combination starter/disconnects, magnetic starters, VFD's, manual starters, disconnect switches, etc. furnished by the .2 Contractor and external to equipment they are designated to serve. The .4 Contractor shall make final connections to the equipment as directed by the .2 Contractor.
11. Furnishing of duct mounted smoke detectors (.4 Contractor). Wiring to fire alarm system by .4 Contractor.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 230506

BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 DEFINITIONS

A. The word "building" used throughout these specifications shall be interpreted to mean the entire Building Complex.

B. The term “The Professional” shall refer to the Architect or Engineer.

C. Where the phrase "or approved equivalent," "or equivalent" or "approved" appears in these specifications, it shall refer to the approval of the Professional on the material or equipment involved.

D. The terms "The Contractor" or "This Contractor" or "the .2 Contractor" mentioned in these specifications refers to the Contractor responsible for the work and equipment included in these specifications.

E. The term ".1 Contractor" mentioned in these specifications refers to the General Contractor.

F. The term ".3 Contractor" mentioned in these specifications refers to the Plumbing Contractor.

G. The term ".4 Contractor" mentioned in these specifications refers to the Electrical Contractor.

1.04 CODES AND STANDARDS

A. The work shall be executed, and the equipment constructed and installed in accordance with the requirements of the State Building Code, the Department of Labor and Industry, ASME, Department of Environmental Resources, Department of Labor, Safety and Health Regulations for Construction, OSHA, National Fire Protection Association, the National Electrical Code as amended to date of bidding, and applicable federal, state, county and local ordinances and regulations.

B. Nothing contained in these specifications or shown on the drawings shall be construed to conflict with the aforesaid codes, ordinances, or regulations.

1.05 PERMITS AND CERTIFICATES

A. The fees and permits required shall be satisfied and obtained by the Contractor and the cost shall be included in the Contract price.

B. Certificates of approval shall be obtained from any department issuing same and shall be turned over to the Department at the completion of the work.

1.06 QUESTIONS AND CLARIFICATIONS OF BID DOCUMENTS

A. Bidders shall not rely on any verbal clarification of the Drawings and Specifications.

B. Any questions or clarifications shall be referred to the Professional at least seven (7) working days prior to bidding to allow for issuance of an addendum.

1.07 GENERAL REQUIREMENTS

A. **No piping, ductwork or equipment shall be installed without first obtaining sign off from the other trades. Should such installation occur, and then subsequent conflicts arise, this Contractor shall, at his own expense, remove that which is in conflict and reinstall appropriately.**

B. The Contractor shall visit the site and thoroughly acquaint himself with conditions existing at the site before submitting his proposal as he will be held responsible for the complete installation of the work in every detail.

C. The Contractor shall carefully examine the general building drawings, and the mechanical and electrical drawings, and carry on his work so as not to delay or interfere with the work of other trades. He shall obtain in writing from the other contractors such data as is necessary to coordinate his work with other trades.

D. Carefully examine the drawings included under this Contract and drawings included under other contracts and report any discrepancies noticed to the Professional as this contractor shall be responsible for the HVAC system installation in its entirety.

E. The drawings are diagrammatic and generally indicative of the work to be installed. Due to the small scale of the drawings, it is not possible to indicate all offsets, fittings, valves, dampers, access panels, and similar parts which may be required. The Contractor shall carefully investigate the structural and finish conditions affecting the work and arrange his work, accordingly, furnishing necessary parts and equipment as may be required to meet the various conditions.

F. The work shown on the drawings and not specifically included in the specifications shall be considered a part of the Contract work. The work included in the specifications and not specifically included on the drawings shall also be considered a part of the Contract work.

G. The Contractor will be responsible for the completion of the work included under this Contract and shall employ skilled and qualified tradesmen as necessary to satisfactorily complete the work and trades.

H. The work shall be installed subject to the approval of the Professional.

1.08 SCHEDULE OF WORK

A. The .2 Contractor shall arrange his work to comply with the project schedule and the published or revised phasing schedule.

B. The .2 Contractor shall submit a complete schedule of work to e-Builder for review and approval by the Professional at the beginning of the Contract in accordance with the phasing schedule.

C. The schedule shall clearly indicate the proposed order in which the various parts of the work will be undertaken, and the estimated time required for the completion of each part of the work.

D. The work shall be coordinated with work being performed by contractors of other trades, with the Department and sequencing schedule.

E. The installation of equipment shall follow the phasing schedule.

F. The .2 Contractor shall especially review the phasing schedule and ensure compliance with this schedule.

G. The schedule of work may be revised periodically during the course of construction, but each revised schedule must be approved by the Professional

1.09 SHOP DRAWINGS AND SUBMITTALS

A. A Refer to Professional’s Division 01 specifications for submittal requirements.

B. A complete list of materials proposed for each installation shall be submitted to e-Builder for the Professional for review and approve before delivery to the site.

C. Prior to the installation of any equipment or materials, submit shop drawings and manufacturer's data for the items listed in the Submittal Register in e-Builder in accordance with the Contract Documents.

D. The Submittal Register in e-Builder shall serve as the .2 Contractor’s checklist to assure the complete submission of the required shop drawings and manufacturer’s data.

E. Equipment and materials furnished as part of this Contract shall be submitted for review whether listed on Submittal Register in e-Builder or not.

F. It is the .2 Contractor's responsibility to check his own submissions for compliance with the Contract Documents and job conditions.

G. Any deviations from the design documents must be clearly identified so that the Professional may properly review such items. It shall not be the Professional's responsibility to search out these deviations. If such deviations are not properly flagged for the Professional's review, The .2 Contractor shall be completely responsible for the consequences that might result from the deviations.

H. The .2 Contractor shall submit samples of materials for approval at the site as requested by the Professional. Such materials may be incorporated into the structures after serving their purpose as samples.

I. At the close of the job, prior to final review, one (1) PDF of operations and maintenance (O&M) manuals shall be submitted to e-Builder for review and approval by the Professional. O&M manuals shall include the following:

J. Equipment warranties.

K. Contractors' warranties.

L. Parts list and manuals for the equipment.

M. Operating instructions (in writing).

N. Written instructions on maintenance and care of the systems.

O. Lubrication and recommended spare parts.

P. Submit Record (As-Built) Drawings. Refer to Paragraph 3.3

1.10 DRAWING DIMENSIONS, GRADES, AND ELEVATIONS

A. Contractor The .2 Contractor shall layout his work from dimensions of Architectural and Structural Drawings and actual dimensions of equipment being installed.

B. Layouts in congested areas should not be scaled from Mechanical and Electrical Drawings. Clearances shall be provided on each side of the equipment as required for proper maintenance purposes and as required by the Department of Labor and Industry, OHSA and the National Electrical Code.

C. Grades, elevations and locations shown on the drawings are approximately correct; however, the .2 Contractor shall field check and otherwise verify grades, elevations, locations, and dimensions at the site before proceeding with the work.

D. The .2 Contractor shall make necessary survey equipment available during construction and shall make use of such equipment wherever necessary to properly install his equipment.

1.11 MECHANICAL PLANS

A. The mechanical plans are intended to be diagrammatic and are based on one (1) manufacturer's equipment.

B. They are not intended to show every item in its exact location, the exact dimensions or the details of the equipment.

C. The .2 Contractor shall verify the actual dimensions of any specified or substituted materials and equipment to ensure that they will fit in the available space.

D. The apparatus shall be located as closely as conditions will permit and deviations there from shall be made only with the consent of the Professional and without additional charge.

E. The right is reserved by the Professional to make any reasonable changes in the location of the equipment prior to rough-in without invoking additional expense.

F. The .2 Contractor shall be responsible to create and distribute for sign-off amongst other trades ductwork and HVAC piping coordination drawings. Refer to Subsection 3.5 for further clarification.

1.12 EQUIPMENT AND MATERIALS

A. Equipment and materials shall be manufactured in accordance with national standards established by manufacturer's associations, engineering and testing societies, such as NBMA, NEMA, ASTM, AMCA, ASME, ANSI, ACI, etc., where such standards have been established.

B. Equipment shall be furnished by authorized manufacturer’s representatives only. There shall be no exceptions to this requirement.

C. In each case where equipment and materials are specified in the singular or plural number, it is intended that such reference shall apply to as many such items as are required to complete the installation.

D. Equipment and materials of similar types shall be of the same manufacturer unless specifically indicated otherwise on the drawings or herein specified.

E. Materials shall be strictly in accordance with the quality, style, and sizes as specified herein.

F. Manufacturers' names and plate numbers are given in the specifications to denote a standard of quality, style, size, and type and shall exclude material of other manufacturers.

G. The .2 Contractor shall make final connections between equipment furnished under this Contract and equipment furnished under other contracts as noted.

H. The materials used throughout shall be those of reputable manufacturers and shall be new and the best of their respective kinds.

I. Equipment, components and materials shall be installed in a neat and professional manner in accordance with best trade practices, manufacturer's recommendations, and applicable codes and standards and by men skilled in each trade of the work assigned to them.

J. The .2 Contractor shall properly lubricate the moving parts of equipment and appurtenances installed under this Contract.

1.13 DELIVERY, STORAGE AND PROTECTION OF EQUIPMENT AND MATERIALS

A. The .2 Contractor shall be responsible for the condition of the equipment associated with the work until the date of substantial completion or warranty begins, whichever comes first. Damage to equipment incurred prior to this, based on the sole discretion of the Department, shall be the .2 Contractor’s responsibility to replace or repair to the satisfaction of said party, at no additional cost to the project. This includes, but is not limited to, damage from transit, site storage, off site storage, mishandling, or misuse during construction.

B. The .2 Contractor shall provide products that comply with the contract documents and are undamaged.

C. Damaged products shall not be installed as part of the Work, except at the sole discretion of the Department.

D. The .2 Contractor shall bear the costs related to replacing, repairing or refurbishing damaged products.

E. The .2 Contractor shall be entirely responsible for the apparatus, equipment and appurtenances furnished by him or his Subcontractors in connection with the work, and special care shall be taken to protect each component thereof in such manner as may be necessary or as may be directed.

F. Protection shall include covers, crating, sheds, or other means to prevent dirt, grit, plaster, or other foreign substances from entering the working parts of machinery or equipment.

G. Special care shall be taken to keep the open ends of pipes, ductwork, VAV/CAV Boxes and other equipment, etc., closed while in storage and during installation.

H. Where equipment must be stored outside the building, it shall be fully covered and secured with heavy waterproof tarps and kept dry.

I. Where equipment has been subjected to moisture, it shall be suitably dried out before placed in service.

J. Piping, ductwork, materials and equipment shall be stored in areas as designated by the Professional.

1.14 LOCATIONS OF EQUIPMENT

A. The actual runs and locations of the piping, ductwork, equipment, etc., shall be determined at the site and shall be installed to meet the various conditions at the building.

B. It is the .2 Contractor's responsibility to predetermine the exact locations of ductwork, piping, and equipment, and to notify the other contractors accordingly to avoid confliction with other lines and equipment.

C. Any changes necessary to conceal pipes, ductwork or clear pipes and equipment of other trades shall be made without additional expense to the Client Agency.

D. The .2 Contractor shall be responsible to create ductwork and HVAC piping coordination drawings and distribute to other contractors for coordination and sign off. Refer to Subsection 3.5 for further clarification.

E. The Professional reserves the right to revise locations of piping, ductwork, locations of equipment, etc., within the building as long as sizes remain the same.

1.15 CONSTRUCTION PENETRATIONS AND OPENINGS

A. The .2 Contractor will provide chases and openings in walls, floors, ceilings, and partitions of new construction to receive pipelines, risers, ducts, and other equipment insofar as it is possible to predetermine the exact location, and the .2 Contractor shall install his work sufficiently in advance of the building construction to permit his work to be built into place.

B. The .2 Contractor shall furnish and place the sleeves required for pipes or ducts passing through new floors, walls and ceilings before such general construction work is built into place.

C. The .2 Contractor shall place the inserts required for hangers and supports, as the construction work progresses, so that unnecessary cutting of construction work will be eliminated.

D. The .2 Contractor shall do the cutting and patching required for the installation of his work.

E. Where piping, ducts, or other equipment pass through existing or new fire or smoke barrier stops, walls, floors, or ceilings, the .2 Contractor shall furnish and install sleeves and shall thoroughly seal openings around sleeves, pipes, etc. with fire and smoke resistant materials.

F. Materials shall be furnished by the .2 Contractor as required to maintain the fire rating of the walls, partitions, ceilings and floors in accordance with the requirements of NFPA, the state building codes and other applicable codes.

1.16 HEATING AND COOLING DURING CONSTRUCTION

A. Advance work as rapidly as possible to permit the heating and cooling systems to be used when it is required for each area of the building.

B. The .2 Contractor shall coordinate the operation of the system with the Department and Client Agency so that heat remains on in each area during construction.

C. Provide the required temporary heat as directed by the Department.

1.17 TEMPORARY USE OF EQUIPMENT

A. The permanent HVAC equipment, when installed, may be used for temporary services, with the consent of the Professional. Should the permanent systems be used for this purpose The .2 Contractor shall make each temporary connection required at his expense. The .2 Contractor shall also repair or replace equipment as necessary due to damage, wear and tear, etc., leaving the same in “as new” condition.

B. Permission to use the permanent equipment does not relieve the .2 Contractor from the responsibility for any damages to the building construction and/or equipment which might result because of its use.

C. A pre-start up conference shall be held with the Department, Professional, Client Agency, and .2 Contractor. Equipment shall not be started until after this meeting.

D. No unit shall be operated during construction phases that create excess dust, debris, or odors in the space on each floor, such as but not limited to drywall installation, sanding, painting, wood cutting, etc. Each unit serving that space shall be shut down during construction phases that are associated with these types of activities and may only be restarted with the approval of the Department and Professional. Any damages, wear, and tear, etc. resulting from use during unapproved times shall be the responsibility of the .2 Contractor to repair or replace as required at no additional cost to the project or Client Agency.

E. During each phase of construction:

1. At a minimum, four complete sets of pre-filter media are required for each air handling unit. In each unit, install two sets of filter media during construction (more shall be required if construction activities dictate more frequent changes). In each unit, install one set of filter media at substantial completion. The other filters shall be used by the .2 Contractor during construction. Dispose of the used construction filter media.

2. At a minimum, two sets of final filter media are required for each air handling unit with a final filter housing. The first set shall be installed at the end of the job when air balance begins, and the second set shall be left in the appropriate mechanical room Do not install final filters during construction.

3. On the outside face of each return air opening install a minimum of two sets of fiberglass filter media, such as cheesecloth, to be utilized as pre-filters for the “construction” filters. Install first set upon start-up and then install second set when first set is dirty. Dispose of the dirty construction filters. Change filters as often as necessary to keep air handling units from becoming dirty at no additional cost.

1.18 MANUFACTURER’S SERVICE PERSONNEL

A. The .2 Contractor shall furnish the services of manufacturers' representatives for the equipment furnished under these Contract Documents.

B. The amount of factory service provided by the .2 Contractor shall be as normally recommended and furnished by the various equipment manufacturers unless specified otherwise.

C. Testing of such systems and equipment shall be made under the direct supervision of competent authorized service representatives and the Commissioning Agent.

D. In the instance of Mechanical and Control systems, such as the major and special equipment, heating equipment, controls, fans, or similar miscellaneous systems and equipment, the installations, final connections and testing of such systems shall be made under the direct supervision of competent authorized service engineers who shall be employed by the respective equipment manufacturer and/or an authorized representative.

E. The expenses incurred by these equipment manufacturers' representatives shall be borne by the .2 Contractor.

1.19 INSPECTIONS AND TESTS

A. Prior to acceptance, the .2 Contractor shall notify the Professional, in writing, when the installation is complete and ready for inspections and tests.

B. Inspections and tests shall be conducted in the presence of the Professional and the Commissioning Agent to determine compliance with the contract documents.

C. If the installation does not comply with the contract documents, the .2 Contractor shall immediately correct each defect and shortcoming.

D. Any additional tests that may be required shall be entirely at the .2 Contractor’s expense. Testing shall be completed as directed by the Professional before the system is accepted.

PART 2 - PRODUCTS

2.01 ELECTRIC MOTORS

A. The electrical motors furnished and installed under this Contract shall be manufactured by Reliance, General Electric, U.S. Motors, or approved equivalent and shall be of the proper type and frame of the services involved in accordance with the NEMA and Equipment Manufacturer's recommendations.

B. Motors shall be "energy efficiency" type with 1.15 service factor. Motor windings shall be entirely copper. Where possible, motors shall be permanently lubricated.

C. Where motors must be lubricated, the manufacturer shall furnish the services of a representative to review the lubrication procedure with the Contractor and the Client Agency and turn over to both a complete set of the necessary maintenance literature.

D. Motors and installation shall conform to the applicable requirements of the National Electrical Code.

E. Motors shall be suitable for across-the-line or reduced voltage starting as applicable in each instance.

F. Motors shall be inverter rated when controlled by Variable Frequency Drives (VFD's).

G. Provide the .4 Contractor with the motor data to properly size overcurrent protection devices for each combination starter and disconnect switch.

H. The .2 Contractor shall be responsible for any additional costs to the Electrical Contractor resulting from any changes in motor sizes initiated by the .2 Contractor, from sizes scheduled on the Drawings.

2.02 ELECTRICAL BEARING DAMAGE PROTECTION FOR MOTORS WITH VFD'S

A. General Requirements – Shaft Grounding:

1. Motors operated on variable frequency drives shall be equipped with a maintenance free, conductive micro fiber, shaft grounding ring with a minimum of two rows of circumferential micro fibers to discharge damaging shaft voltages away from the bearings to ground.

2. Application Note: Motors up to 100 HP shall be provided with one shaft grounding ring installed either on the drive end or non-drive end. Motors over 100 HP shall be provided with an insulated bearing on the non-drive end and a shaft grounding ring on the drive end of the motor. Grounding rings shall be provided and installed by the motor manufacturer or contractor and shall be installed in accordance with the manufacturer's recommendations.

B. General Requirements – High-Frequency Bonding:

1. Motors operated on variable frequency drives shall be bonded from the motor foot to system ground with a high frequency ground strap made of flat braided, tinned copper with terminations to accommodate motor foot and system ground connection.

2. Application Note: Proper grounding of motor frame for inverter-driven induction motors

a. References: ABB Technical Guide No.5

b. Allen Bradley Publication 1770-4.1 Application Data, Industrial Automation Wiring and Grounding Guidelines

C. Recommended parts:

1. Bearing Protection Ring

2. High Frequency Ground Strap

2.03 MANUAL MOTOR STARTERS

A. Manual motor starters shall be furnished by this Contractor, for installation by the .4 Contractor, for single phase fractional horsepower (1/2 horsepower and smaller) motors.

B. Provide the motor electrical characteristics to the .4 Contractor so the .4 Contractor may size wiring.

C. The .2 Contractor shall coordinate the starter control circuit transformer VA requirements with the ATC contractor prior to ordering starters.

2.04 MAGNETIC MOTOR STARTERS - FULL VOLTAGE

A. Furnish to the Electrical Contractor for installation combination full voltage magnetic starters and fused disconnect switches for each 3 phase motor with service factor of 1.15.

B. Starters shall have three (3) current overload relays and low-voltage release.

C. Starters shall be furnished with hand-off-automatic switch, red run light, overload reset, a set of extra auxiliary contacts consisting of one (1) normally open and one (1) normally closed contacts and a control transformer with 120 volt fused secondary control circuit and fused primary circuit.

D. Starter enclosure shall be NEMA 1 enclosures. Furnish Allen-Bradley Bulletin 512 starters or equivalent as manufactured by Square D, General Electric, Siemens, or equal as approved by the Professional.

E. Disconnect switches shall be horsepower rated to match the horsepower of the motors plus 1.15 service factors connected thereto as required.

F. Where starters are separately mounted, they shall be of the magnetic type as herein specified.

G. The magnetic motor starters for motors connected to the normal/emergency electrical distribution system shall be provided with an adjustable time delay unit. Time delay unit shall be capable of delaying motor starting from 0 to 180 seconds.

H. The Heating Contractor shall coordinate the starter control circuit transformer VA requirements with the ATC contractor prior to ordering starters.

2.05 HAND-OFF AUTOMATIC (H.O.A.) SELECTOR SWITCHES

A. The ATC Contractor shall furnish and install remote hand-off-automatic selector switches, where shown or required, and shall be the type that can be changed in the field from two positions and vice versa.

B. Switches shall have padlock attachment that will permit locking in either the manual or automatic positions.

C. Switches shall be furnished with NEMA Type 1 enclosures when installed remote from starter. Provide Cutler-Hammer three (3) position switches, padlocking attachment, or equivalent as manufactured by Square D, General Electric, Siemens, or equal as approved by the Professional.

D. Starter for the Emergency Generator Supply Fans shall be furnished with an “off-auto” selector switch in lieu of a “hand-off-auto” selector switch as the exhaust and supply fans should operate as a pair of fans.

E. Starters for Stair Tower Pressurization Fans shall be furnished with “key” operable “hand-auto” selector switches in lieu of standard H-O-A selector switches.

2.06 DISCONNECT (SAFETY) SWITCHES

A. Disconnect switches shall be furnished to the Electrical Contractor for installation.

B. Disconnect switches shall be of the fusible type as indicated, quick-make, quick-break in NEMA Type 1 sheet steel enclosure unless otherwise noted.

C. Disconnect switches shall be horsepower rated, and of size and number of poles as indicated on the Drawings. Safety switches shall be of type having a direct mechanical linkage between contacts and operating handle.

D. Disconnect switches shall be as manufactured by Cutler-Hammer, General Electric, Square D Company, or equal as approved by the Professional.

E. Fuses for disconnect switches shall be of the UL Class RKI Low Peak.

F. Fuses for motors shall be sized to conform with the motor running current and in strict accordance with the recommendations of the fuse manufacturer.

G. Where disconnect switches are located at the exterior of the building or in wet locations, they shall be provided with NEMA 3R or 4 weather tight and weather resistant enclosures.

H. Enclosures for disconnect switches located in hazardous areas shall be of the appropriate explosion proof type.

I. Disconnect switches used as service entrance switches shall be Underwriters Laboratories listed suitable for Service Entrance Equipment.

J. Disconnect switches serving remotely mounted soft starters or VFD's shall be furnished with a minimum of one (1) set of normally open auxiliary contacts.

2.07 ACCESS PANELS

A. The .2 Contractor shall furnish and install factory-fabricated access panels for access to concealed dampers, damper actuators valves, and other equipment where no other means of access is available. Access panels shall be of appropriate size but not less than 24" flush type, hinged to drop down and out, screwdriver-operated, stainless steel in tile work and prime coated sheet steel in plaster or acoustical tile of every type. The .2 Contractor shall furnish and install access panels for the equipment installed under this Contract. Exact locations and sizes of panels shall be determined by the .2 Contractor, but panels shall be located for a symmetrical appearance. Access panels are not required at lift-out removable tile ceilings.

B. At locations where access panels are installed in existing or new fire-rated construction, access panels shall contain the 1-1/2 hour fire-rated "B" label; and in addition, shall also be provided with layers of gypsum wall board in a thickness which will supply an additional one and two hour fire rating equal to the fire rating of adjacent construction.

C. Coordinate with the .1 Contractor on fire ratings of new and existing construction.

2.08 FIRE STOPPING

A. The following fire stopping requirements constitute minimum requirements of this specification. The Contractor shall be aware of additional requirements by the facility, which may exceed or supersede this specification.

B. Seal openings of fire rated construction with a material or product that has been tested at an independent testing laboratory, such as UL, FM, etc. Fire stopping shall conform to ASTM E-814 and UL 1479, with fire ratings equal to or exceeding the fire rating of the construction involved. Fire stopping shall be UL classified, and shall be like the 3M brand Fire Barrier Penetration Sealing Systems, or approved equivalent. Fire stopping of this type shall also be utilized for openings through smoke rated construction.

C. If desired by the Contractor and approved by local codes, the "Pro Set" piping penetration system also may be utilized. Penetration system shall be UL certified and shall be the "Pro Set" System A. Firestop coupling (sleeve) shall be filled with ceramic fiber material to provide insulation and fire stopping. System shall be capable of maintaining a 3-hour fire rating. Penetration system shall be secure, waterproof, fire rated, and smokeproof and shall allow for pipe expansion and contraction.

2.09 EQUIPMENT GUARDS

A. Equipment guards shall be provided for protection at the belts, chains, gears, motors or other moving parts of equipment and machinery installed under this Contract.

B. Guards shall be made up of suitable structural shapes and heavy gauge steel welded together and attached to equipment by removable clips and bolts.

C. Guards shall be neat and substantial and shall be securely attached to equipment.

D. After fabrication, guards shall be cleaned of rust and scale and painted with one coat of metal primer followed by two coats of enamel to match the equipment.

E. Guards shall be easily removable for maintenance and service of equipment.

F. Equipment guards shall conform to OSHA requirements.

2.10 CONCRETE WORK

A. Furnish and install the concrete work related to work included under this contract.

B. Construct concrete forms and bases for the new equipment installed under this contract.

C. Bases and forms shall be of suitable dimensions for the equipment.

D. The concrete work shall be constructed subject to the approval of the Professional.

E. Provide the concrete for repair work related to work included under this Contract.

F. For each piece of floor mounted equipment shown or specified to have a concrete base or pier built on existing floor slab, the Contractor shall install a floor slab of suitable size for the equipment to rest thereon.

G. Each foundation shall extend 4" above the floor line (unless otherwise indicated on the drawings).

H. Conform to specific equipment manufacturer's recommendations for construction of bases and foundations in each instance.

2.11 MISCELLANEOUS IRON WORK

A. The .2 Contractor shall furnish and install the necessary structural steel members for the proper support of the piping, ductwork, and equipment furnished and installed under this Contract.

B. Miscellaneous iron work shall include, but not be limited to, piping hangers, piping anchors and guides, ductwork supports, and any other equipment supports.

C. Additional structural members shall be furnished and installed to support the heating, ventilating and air conditioning equipment without excessive stress or strain on the building construction.

D. Structural beams and other structural members shall be furnished and installed under this Contract for anchors and guides where the building steel is not available or capable of supporting or anchoring pipe lines and equipment.

E. The equipment and materials furnished and installed under this Contract which are not mounted on bases or floors shall be securely attached and supported from the main supporting structure of the building by metal hangers, clamps and/or brackets.

F. Metal hangers, clamps and/or brackets shall be of suitable design and of sufficient strength to properly and safely support the materials and equipment involved.

G. Lag screws and bolts shall be used where required at wood construction.

H. Materials:

1. Structural steel members for the support of equipment installed under this Contract shall conform to ASTM Specifications A-36 and shall comply with the latest requirements of the American Institute of Steel Construction.

2. Structural steel shall be of standard sections as given in the structural steel manufacturers' handbooks.

I. Anchors:

1. The Contractor shall provide the anchors, bolts, screws, dowels, and connecting members and perform the cutting and fitting necessary to secure the work to adjoining construction.

2. Build in connecting members to masonry, concrete, and structural steel as the new and remodeling work progresses.

J. Supports and Brackets:

1. Supports and brackets shall be neatly constructed of structural shapes to adequately support the equipment intended.

2. The supports must be approved prior to installation. Field conditions will regulate the type of support.

K. Priming and Painting:

1. Before priming, the metal shall be thoroughly cleaned free from scale, rust, and dirt.

2. The steel and iron work shall be primed with Rust-Oleum X-60, or approved equivalent.

3. Paint final coat black on the miscellaneous steel installed under this contract by this Contractor.

2.12 FLASHINGS

A. The Contractor shall furnish and install roof curbs as required for his equipment.

B. The Contractor shall furnish and install pipe portals for pipes as required.

C. An approved roofing sub-contractor, responsible to the .2 Contractor, shall install flashings at roof curbs and final roofing, to maintain the existing roof warranty.

PART 3 - EXECUTION

3.01 CLEANING

A. As the work in the building nears completion, threading, cutting, etc., shall be done where directed by the Professional.

B. Upon completion of the work, the remaining waste materials and rubbish resulting from the Contract work shall be removed from the building and premises.

C. At the completion of the work each part of the installation shall be thoroughly cleaned. Strainers, vents, pumps, etc., shall be cleaned of dirt. Temporary replaceable air filters shall be removed, and new replaceable air filters shall be installed after the areas have been cleaned for occupancy. The system shall be operated for a sufficient period to thoroughly remove grease, metal cuttings, and other foreign matter from the system.

D. Any stoppage or any discoloration or other damage to any part of the building, its finish or furnishings due to the Contractor's failure to properly clean the piping, shall be repaired by the Contractor without cost to the Client Agency.

E. New equipment installed under this Contract, existing remaining equipment, and new and existing furnishings and finishes soiled or damaged due to the work included under this Contract shall be thoroughly cleaned as required to remove plaster, dust, paint splashes, labels and debris.

3.02 INSTRUCTIONS TO OPERATING PERSONNEL

A. The .2 Contractor and his subcontractors shall satisfactorily complete the systems so that they are functional and operating to the satisfaction of the Professional and Commissioning Agent. The systems, their controls and their sequencing must be demonstrated to the satisfaction of the Professional and Commissioning Agent.

B. Instruct the Operating Personnel as to the proper care and maintenance of the systems installed under this contract.

C. The .2 Contractor shall furnish the services of qualified personnel, approved by the Professional and thoroughly familiar with the completed installation to instruct the permanent operating personnel in the proper operation of the systems included under this Contract and the proper care of the equipment and apparatus. These services shall be furnished for a period of five 8 hour days after the operation of the building has been taken over by the Client Agency.

D. When instructions are provided under this Contract, the .2 Contractor shall have in his possession three copies of an identifying letter which shall list the names of the .2 Contractor's qualified instruction personnel including manufacturers' representatives and subcontractors that will be giving instructions. Likewise, on the same letter, spaces shall be provided for the Client Agency's personnel who will receive the instructions. After instructions have been given and received for each system, The .2 Contractor's representatives and subcontractors shall sign and date the letter, and the Client Agency's personnel shall sign and date the letter acknowledging that they have received adequate instructions for operating and maintaining the systems and equipment. A PDF of the signed copy shall be submitted to e-builder as a record of the completed instructions.

E. In addition to the verbal instructions outlined above, the .2 Contractor and his manufacturers' representatives and subcontractors shall furnish written basic instructions indicating the proper operation of each system and associated equipment. The .2 Contractor shall submit to e-Builder, equipment brochures including instructions on operation, lubrication, recommended spare parts, and instructions on preventative, routine, and breakdown maintenance for equipment by each manufacturer. The brochures and formats must be approved by the Professional.

F. The .2 Contractor shall combine the written instructions and the manufacturers' equipment brochures into a PDF of the manuals, indexed by equipment and by manufacturer, which shall be submitted to e-Builder before final acceptance of the Contract work.

G. It is the intent that this entire system with its complement of equipment and auxiliary equipment operate properly in accordance with the design concept and functional intent. It is also the intent that the Client Agency be given complete instructions for the proper operation and maintenance of the entire system.

3.03 RECORD (AS-BUILT) DRAWINGS

A. The Contractor shall maintain a complete set of Contract Drawings at the site and shall record each deviation in his work **(in red ink or pencil**) from that indicated on the Contract Drawings. Deviations shall be clearly and accurately recorded so that the Professional can prepare final record (as-built) drawings using the Contractor's marked-up drawings. Dimensions shall be recorded using permanent reference points such as columns, building walls and like items. These record drawings shall be submitted to the Professional prior to final acceptance.

3.04 COORDINATION DRAWINGS

A. Coordination

1. Each Contractor shall familiarize himself with the drawings and specifications of the other contracts relating to this project and shall coordinate with and be held responsible for his Work which is affected by or dependent on, other contracts.

2. Each Contractor shall provide any dimension, coordination, sleeve, insert, embedded or built-in item, and/or information which is required to be built into, or to complete, the work of another contract in a manner consistent with the Approved Project Schedule. Any additional cost or delay damages arising from a contractor's failure to so furnish or provide shall be borne by that contractor.

B. Coordination Drawings and Procedures

1. Each Contractor shall prepare composite shop drawings and field installation layouts for his work as directed by the Professional to solve tight field conditions except as modified in Paragraph 3 below. Such drawings shall consist of dimensioned plans and elevations and shall give complete information, particularly to size and location of sleeves, attachments, openings, conduits, ducts, boxes, and structural interferences.

2. These composite shop drawings and field installation layouts shall be coordinated in the field among the Contractors to verify the proper relationship to the work of other Contractors based on field conditions and shall be checked for accuracy and approved by the Contractors as directed by the Professional before submission to the Professional for his final approval.

3. HVAC, Plumbing, Fire Protection and Electrical Work shall be coordinated as indicated by the following procedure. Each Contractor shall certify each coordination drawing after the work has been laid out and conflicts resolved. The preparation of coordination drawings and layout Work on the coordination drawings shall be performed at the site by each Contractor.

a. The .2 Contractor shall prepare a detailed BIM model or CAD drawings of each area, at a scale of ¼" inch equal 1'-0", showing his work plan and elevation. The Professional can provide the base BIM model or CAD backgrounds of the entire project to the .2 Contractor for his use. The .2 Contractor shall layout and show light fixtures on the drawings.

b. The BIM model or CAD drawings referred to in 3. a. above shall then be forwarded to the next succeeding Contractor for layout of their work in the field in the following order: (a) PLUMBING AND FIRE PROTECTION; (b) ELECTRICAL; (c) INTERIOR CONSTRUCTION.

c. By use of color coding and layering each succeeding Contractor shall show his work on the referenced BIM model or CAD drawings and shall certify that there is no interference between his work and that of other Contractors. Colors will be assigned by the Professional.

d. When the work has been drawn and certified, the .2 Contractor shall forward the BIM model or CAD drawings to the Professional, for review and approval. Prints of approved BIM model or CAD drawings shall be distributed to the Contractors by the Professional.

e. The Professional shall print one copy for each trade for use in the field.

f. The BIM model or CAD drawings shall be kept at the Professional's field office for future reference in the event of conflict between the trades. At the completion of the project, BIM model or CAD drawings shall be delivered to the Client Agency for his records.

g. No installation work will proceed until EACH contractor has signed off and agreed to the coordination drawings.

C. Meetings

1. Coordination meetings to resolve interferences in the Work will be held at the site in an area to be provided by the Professional. Representatives of each Contractor shall be present at each meeting. Each Contractor shall provide the necessary resources to ensure that the coordination process described herein does not delay the Approved Project Schedule.

D. Each Contractor acknowledges that there may be items of Work which have not been drawn, coordinated, clarified, or specified with complete detail in the Contract Documents but which are required for the completion of the Work, as inferable from the Contractor Documents. Any such item, when identified as part of the development of the Work, shall be drawn, coordinated, clarified, or specified by the Professional in a manner consistent with contemplated kind, quality and customary standards and provided to the .2 Contractor. When such drawing, coordination, clarification or specification is approved by the Department, the drawing, coordination, clarification or specification so approved shall thereupon be part of the Contract Documents and the item of Work shall be performed by the .2 Contractor as part of the Work without further action or order of the Department and without any increase in the Contract amount or time as if such drawing, coordination, clarification or specification were originally included in the Contract Documents.

3.05 MERCURY PROHIBITION

A. The use of mercury as a component of any equipment installed as part of this work is strictly prohibited. Where required, mercury substitutes shall be used in thermometers, thermostats, switches, and other equipment, which might commonly contain mercury.

END OF SECTION

SECTION 230511

RESTORATION AND RETROFIT - HVAC

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 DEFINITIONS

A. The term “The Professional” shall refer to the Architect or Engineer.

1.04 WORK IN EXISTING FACILITY

A. This work shall be coordinated with the work of other trades and shall be performed in accordance with the Schedule of Work as required by the Department. The Contractor shall review the phasing schedule and comply with sections of this schedule.

B. The .1 Contractor will renovate the existing facility in areas shown on the Drawings in accordance with a specific schedule.

C. The .2 Contractor shall refer to the Construction drawings to determine the extent of the renovations in each area.

D. The .2 Contractor shall disconnect and remove existing equipment no longer required and furnish and install new equipment as shown, herein specified, and as required to form complete, new systems.

E. Equipment shall include some existing heating equipment, ductwork, and piping as shown and noted.

F. The Contractor shall visit the site to determine exact locations, sizes and quantities of existing equipment and ductwork which must be removed.

G. The .2 Contractor will be held responsible for the disconnection and removal of existing heating and ventilating systems as noted and the installation of all new piping, ductwork and equipment complete in every detail and in accordance with the phasing schedule.

H. The Contractor shall provide Demolition/Renovation Notification" as required by the State Department of Environmental Resources, Bureau of Air Quality Control.

I. Existing ductwork, piping and conduit for the heating system no longer required and concealed in walls, pipe tunnels, crawl spaces or above fixed ceilings and not interfering with new construction or renovations may remain and shall be capped, abandoned, and rendered "dead."

J. The Contractor shall arrange the new hangers and supports so that new pipelines and other equipment are not suspended from the same joists and structural members as existing lines and equipment.

K. Hangers and supports shall be arranged to distribute the weight of the new lines and equipment uniformly on the existing structure.

L. Additional new structural members shall be furnished and installed as necessary to safely support the new lines and equipment.

M. Generally, the existing ceilings will be replaced throughout the existing facility in the renovated areas. New ductwork, piping, etc., shall be concealed above the new and existing ceilings. As noted, and shown, only piping and ductwork noted as below ceiling can remain exposed.

N. Work above Existing Ceilings:

1. At locations indicated on the drawings, existing ductwork and equipment shall be disconnected and removed, and new piping, ductwork, and equipment shall be furnished and installed under this contract above existing ceilings.
2. The .2 Contractor will be responsible for restoring the existing ceilings to their existing condition where they are removed or damaged by the work included under this Contract, and when the ceilings are not being replaced with new ceilings by the .1 Contractor.
3. The .2 Contractor shall also be responsible for repair work to the existing ceilings, as required to maintain the fire rating of the existing ceiling.

O. The Contractor shall clean the work areas as the work progresses and thoroughly remove waste and debris daily or when directed. Waste and debris in the work areas shall be removed by the Contractor regardless of origin.

P. The Contractor shall perform the cutting and patching required for the installation of new piping, ductwork, and equipment, and for the removal of existing equipment as herein specified.

Q. The .2 Contractor shall be responsible for maintaining the structural integrity of the existing facility where areas such as load bearing walls, and floor construction are patched and repaired under this Contract.

R. The patching shall be done subject to the approval of the Professional.

S. The .2 Contractor will be responsible for entrance of the new equipment into the facility, for the removal of existing equipment from the facility, and for the associated cutting, patching, and repairing of existing construction.

T. Useful Existing Equipment to Be Removed:

1. Existing removed unit heaters, fans and other similar useful equipment and materials, tagged by the Client Agency, shall remain the property of the Client Agency and shall be stored at the site as directed by the Client Agency, Department and Professional.
2. Equipment shall be stored as complete units with the associated accessories and auxiliary equipment.
3. Equipment shall be disconnected and carefully removed under this Contract and shall be transported to the storage areas as directed.
4. Equipment shall be stored in a neat and workmanlike manner, tagged, and identified for future use.

U. Removed piping, fittings, hangers, ducts, grilles and other miscellaneous materials and equipment no longer required, shall not be reused as a part of the new installation, but shall become the property of the Contractor and shall be immediately removed from the site. The .2 Contractor shall give due consideration and credit in his proposal for existing materials and equipment which will become his property. Existing removed equipment remaining the property of the Contractor shall be dismantled and cut in sections as required for removal from facility.

V. The Contractor shall provide and later remove temporary HVAC services and equipment as required to keep systems operating during construction. The Contractor shall maintain acceptable temperatures in construction-impacted spaces where Client Agency operations, functions and services continue to be provided.

1.05 REMOVAL AND DISPOSAL OF HEALTH HAZARDOUS MATERIALS

A. Asbestos removal work shall be performed by a contractor prior to the start of this construction.

B. This Contractor shall immediately report the presence of any asbestos to the Professional. No asbestos removal is to be included under this Contract.

1.06 CUTTING AND PATCHING

A. The Contractor shall perform the cutting and patching for the removal of existing piping, ductwork and equipment and the installation of new piping, ductwork, and equipment in the existing facility.

B. New openings in walls, floors, and partitions for pipelines, ducts, hangers, supports, and other equipment in the existing facility shall be provided by this Contractor for the new and renovated installation.

C. New openings in existing construction and the repair of such openings for the entrance of new heating, ventilating and air conditioning equipment into the facility or for the removal of existing heating and ventilating equipment from the facility shall be included in the HVAC Contract.

D. Openings in existing exterior walls shall be cut by the .2 Contractor.

E. Openings in existing roofs shall be the responsibility of the .2 Contractor. All roofing work on the project shall be performed by an approved Roofing Subcontractor hired by the .2 Contractor. This includes all roofing work for all trades and shall be coordinated by the .2 Contractor. All roof work shall be completed by an approved Roofing Subcontractor to maintain existing roof warranty.

F. When necessary, to cut out any portions of walls, floors, ceilings, or other portions of the facility, as required to perform the work under this Contract, the Contractor shall perform the necessary cutting and fitting, shall remove the excess material, and shall replace damaged work to leave the premises in a finished condition.

G. No cutting shall be done which may in any way affect the facility structurally or architecturally without first securing the consent and approval of the Professional.

H. Any damage incident to cutting or other causes in the performance of this Contract shall be made good by replacement or repairs in a manner satisfactory to the Professional.

I. The Contractor shall not disturb or weaken the bearing quality of existing walls or other construction.

J. .2 Contractor shall furnish openings in existing walls and roof for intake and outlets. This Contractor shall coordinate location and site. Openings in existing roofs shall be the responsibility of this Contractor. Final roofing shall be by this Contractor. All roof work shall be completed by an approved Roofing Subcontractor hired by the .2 Contractor to maintain existing roof warranty.

K. Where existing equipment is removed and unused openings remain in walls, floors, partitions, etc., the .2 Contractor shall properly patch such openings to match their immediate surroundings unless specifically shown to be included under the .1 Contractor's scope of work.

L. Cutting performed under this Contract shall be done in a neat and workmanlike manner. The size of each new opening shall be kept to minimum size. The location of each new opening must be approved by the Professional before the opening is drilled or cut.

M. Where existing ceilings and walls and similar construction are penetrated for the installation of new hangers, supports, and other equipment, the Contractor shall repair the openings with fireproof materials to maintain the fire rating of the ceiling or wall construction, or similar construction.

N. The Contractor's attention is directed to the Architectural Drawings to determine areas in which the other contractors will perform work. Cutting and patching shall be directly coordinated with work performed by other contractors. This Contractor shall cooperate with the other contractors in every manner in making the installations.

O. Patching and Repairing:

1. Patching and repairing shall be by workers skilled in this type of work and shall match existing or new finishes.
2. Patching and repairing shall match existing construction and finishes in materials, color, and texture.
3. Cutting, patching, repairing, and painting shall be performed by workers skilled in that type of work.
4. Patching shall be completed to a neat, finished condition.

5. Where the .1 Contractor applies new finishes, except painting, on existing walls, floors, ceilings, and similar locations, it will not be necessary for the .2 Contractor to apply finished patching or painting to the renovated surfaces; however, the Contractor shall rough patch the areas for the final finish.
6. Where the existing area is to be repainted by the Painting Contractor, the .2 Contractor must repair his openings and provide a prime coat and one finish coat of paint to be ready for the Painting Contractor's final coat of paint.
7. The Contractor's attention is directed to the Professional's Construction Drawings to determine exact locations where new finishes on walls, floors, ceilings, and similar locations will be provided under separate Contract.
8. The .2 Contractor shall repair and finish all openings where the other Contractors are not providing new finishes.
9. When providing final painting of patched areas, the entire wall or ceiling shall be painted corner to corner and top to bottom so that the entire wall or ceiling is painted.
10. Painting of existing walls or ceilings will not be necessary unless the walls or ceilings are patched and repaired under this Contract.

1.07 DUST, DIRT, AND NOISE

A. The Contractor shall perform cutting and patching and shall make modifications, relocations, and installations with a minimum of noise.

B. Existing and new equipment, floors, walls, etc., shall be adequately protected from dust and dirt caused by the work.

C. Protection shall include suitable temporary barriers or coverings.

D. The exterior and interior premises of the facility shall be kept as clean as possible during construction.

E. At no time shall the Contractor interfere with the normal operation of the facility by allowing debris, etc., to remain on the premises.

F. Contractor shall use industrial type vacuum cleaners for removal of plaster, dust, etc. in each area of the facility included in his scope of work.

1.08 SCHEDULE OF WORK AND CONTINUITY OF SERVICE

A. It is the Department and Client Agency's desire to maintain the operation of the existing facility with a minimum of disruption; therefore, the Contractor shall closely coordinate the scheduling of his work as well as equipment deliveries with the Schedule of Work prepared by the Professional.

B. The schedule of work may be revised periodically during construction, but each revised schedule must be approved by the Professional.

C. When it becomes necessary to interrupt any part of the operation of the HVAC system, the Contractor shall notify the Department 48 hours in advance of the proposed interruption.

D. The HVAC system shall only be interrupted when necessary and at a time to conform to the Department's and Client Agency's schedule.

E. Long interruptions of the HVAC system, due to faulty workmanship or improper scheduling of work will not be tolerated. The facility must remain in use.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 230519

PIPING SPECIALTIES – HVAC

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The piping specialties for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 GAUGES AND THERMOMETERS

A. Furnish and install all pressure gauges and thermometers as herein specified. All pressure gauges shall be calibrated at the site by the Contractor at the same point of connection. Separable wells shall be installed by the .2 Heating Contractor at each location.

B. Pressure gauges shall be 4½" diameter and adjustable to zero to compensate for static water pressure. Gauge dial ranges on the water systems shall be graduated 0 to 100 psi with 10 psi figure intervals and 1 psi graduation, for the water system. Accuracy of each gauge shall be ½ of 1% over entire scale range. Cases shall be cast aluminum with black finish and chrome ring. Pressure gauges shall be of the bronze bourdon tube type with 4½" diameter dials similar to the 500X Series, each with No. 872-2 pressure snubber, and No. 735-2 needle valve as manufactured by Trerice, Ashcroft, Weksler, Miljoco or approved equal.

C. Thermometers shall have 9" scales, adjustable angle non- mercury thermometer with "A" Series brass stem. Range for hot water lines and equipment shall be 30 degrees F. to 300 degrees F. Thermometers shall each have a stainless steel front with glass cover and shall be provided with a suitable stainless steel separable socket. Thermometers shall be the BX Series, adjustable angle type, as manufactured by Trerice, Ashcroft, Miljoco or approved equal.

D. Stem lengths shall range between 30% and 50% of inside diameter of piping, and wells shall be arranged to accommodate stems.

G. Thermometers and gauges shall be installed in a manner that will allow them to be easily read from the operating floor.

H. In lieu of installing a multiple number of pressure gauges at circulating pumps, the Contractor shall have the option of installing one pressure gauge of type herein specified mounted on a multiple port manifold valve constructed of brass and suitable for 175 psig working pressure. Manifold valve shall be furnished with spring return pushbutton ports with 1/4" O.D. compression unions, mounting bracket and capped test port connection for gauge calibration. Furnish and install Type L 1/4" O.D. copper tubing with flared connections from manifold valve ports to locations on pump casing and piping where pressure gauges would normally be installed, generally where indicated on the Drawings. Furnish and install screwed connectors, compression union and shut-off valve at each connection to piping or pump casing. Copper tubing shall be installed in a neat workmanlike manner and shall be properly supported. Manifold valves shall be mounted on system piping at convenient location to permit easy access for pushbutton operation and pressure gauge observation. The manifold valve shall be as manufactured by Flow Conditioning Corp., or approved equal.

2.02 FLOW METERING SYSTEM

A. Furnish and install complete Venturi flow metering system as manufactured by Gerand, Aeroquip Corporation/Barco Division, or approved equal.

B. The system shall be a coordinated system and shall include Venturi flow stations in mains and branches at locations noted and a portable meter supplied by one manufacturer. Each Venturi station shall be complete with quick disconnect valves and safety shutoff valve, metal identification tag on chain, giving pipe size, Venturi series, station identification and meter reading at specified flow rate. Venturi stations shall be one-piece brass screwed 1/2" through 2". Sizes 2-1/2" through 10" shall consist of zinc or cadmium plated steel with welding end or Victaulic grooved ends. Size 12" and larger shall be fabricated steel with welding ends. Venturi size and series shall be selected so that design flow rate shall be between 10" and 90" of water pressure differential with permanent pressure loss of not more than 1.0 foot head. Flow stations shall be of the "Self-Cleaning Type". Flow metering system other than the Venturi self-cleaning type, will not be acceptable.

C. Pressure-sensing lines on flow stations in the Mechanical Equipment Room shall be extended along wall with disconnect valves located 5'-0" above floor for convenience of instrumentation.

D. Where indicated on the drawings, the flow metering systems shall be provided with a Rosemount Pressure Differential Measuring System to provide 4-20 milliamp signal to the DDC Energy Management Control System for GPM readings on the control system. Coordinate all requirements with the Automatic Temperature Control Sub-Contractor.

2.03 PRESSURE TAPS

A. At locations shown on the Drawings, the Contractor shall furnish and install combination pressure and temperature taps on supply and return lines at all terminal equipment and at other locations indicated on the Drawings. Pressure and temperature taps at each location shall consist of a 1/4" NPT fitting to receive either a temperature or a pressure probe 1/8" O.D. The fitting shall be solid brass with two (2) self-closing valve core of Nordel suitable for a temperature of 275 degrees F. and pressure rating of 1,000 psig, fitted with a yellow color-coded and marked cap with gasket. Fitting shall be the "Pete's Plug" Model 110XL, as manufactured by the Peterson Equipment Co., Inc. or approved equal. Fitting shall be capable of passing a no-leakage test by a recognized testing laboratory for a minimum of 80 insertions during a five day period at a pressure of 100 psig and temperature of 240 degrees F.

B. Furnish and deliver to the Client Agency a separate Test Kit consisting of a 0-200 psi, 0-230 foot of water pressure gauge with a 1/8 inch O.D. gauge adapter attached, a 0 degree F. to 220 degrees F. pocket testing thermometer, and a protective carrying case. The Contractor shall also supply the Client Agency with two additional pressure gauge adapters (Model 500XL) with 1/8" O.D. probe and four five inch stem pocket testing thermometers graduated 0 degrees to 220 degrees F. All of the above components shall be as manufactured by Peterson Equipment Co., Inc., or approved equal.

2.04 ELECTROLYSIS CONTROL

A. All copper tubing installed or connected under this Contract shall be installed in such a manner that the tubing will not touch or come in contact in any way with ferrous metals. Where copper tubing, piping or fittings are anchored, guided, supported or may come in contact with ferrous metal construction, an insulating nonconductor spacer, similar to rubber or fiber, shall be installed to assure prevention of electrolysis.

B. Copper tubing lines shall not be (even temporarily) supported or secured to ferrous metals. When copper tubing or piping is connected to ferrous piping or equipment, connections shall be made with dielectric unions, couplings or fittings, as manufactured by Epco Sales, Inc., Walter Vallett Company, Watts Regulator Co., Clear-Flow, or approved equal.

2.05 MECHANICAL SEALS

A. Mechanical seals at the annular space between pipes and the holes in the exterior walls will be sealed with the Link-Seal System as manufactured by Thunderline Incorporated.

B. The Link-Seal System shall be for high or low temperature service as required for the pipe.

C. Pressure plate shall be low carbon steel, zinc galvanized plated. Bolt and nut to be low carbon steel, zinc galvanized plated to resist normal corrosion.

D. Sealing element shall be silicone rubber for temperature from –67 degrees F to +450 degrees F.

2.06 EXPANSION TANKS

A. Furnish and install ASME constructed and equipped expansion tanks as indicated for the hot and chilled water system. Tanks shall be supported with rod and angle supports and concrete base.

B. Tanks shall be furnished with necessary tappings and shall be equipped with gauge glass, air charging type hose and drain valve, and air control fitting and, where required, air vent tube. The tank supply line from the system shall be fitted with a gate type shut-off valve to facilitate draining the tank individually. Expansion tanks shall be Extrol diaphragm type or approved equivalent.

C. Tanks shall be precharged to pressure indicated on Drawings. The installation must conform with the requirements of the State Department of Labor and Industry, including the installation of a relief valve.

2.07 AIR ELIMINATOR AND DIRT SEPARATOR

A. Acceptable Manufacturer:

1. Bell & Gossett CRS (Basis of Design)
2. Spirovent by Spirotherm
3. Peerless
4. Armstrong
5. Taco
6. Wessels Company
7. American Wheatley

B. Furnish and install as shown on the drawings a coalescing type air eliminator and dirt separator on the hot and chilled water systems.

C. Pipe size is not a factor and all units should be selected at the point of peak efficiency per the manufacturer’s recommendations.

D. All combination units shall be fabricated steel, rated for 150 psig working pressure with entering velocities not to exceed 4 feet per second at specified GPM.

E. Units specifically designed for high velocity systems may have an entering velocity of up to 10 feet per second.

F. Units shall include an internal bundle filling the entire vessel to suppress turbulence and provide high efficiency. The bundle must consist of a copper core tube with continuous wound copper medium permanently affixed to the core. A separate copper medium is to be wound completely around and permanently affixed to the internal element.

G. Each eliminator shall have a separate venting chamber to prevent system contaminants from harming the float and venting valve operation. At the top of the venting chamber shall be an integral full port float actuated brass venting mechanism.

H. Units shall include a valved side tap to flush floating dirt or liquids and for quick bleeding of large amounts of air during system fill or refill.

I. Separator shall have the vessel extended below the pipe connections an equal distance for dirt separation.

J. Separator shall include a removable lower head to facilitate removal of internal assembly for inspection or cleaning. Separators shall be capable of removing 100% of the free air, 100% of the entrained air, and up to 99.6% of the dissolved air in the system fluid. Dirt separation shall be at least 80% of all particles 30 micron and larger within 100 passes.

2.08 CHEMICAL FEEDER (ONE SHOT TYPE)

A. Furnish and install on the hot and chilled water piping system, where shown, a "One-Shot" chemical feeder. Feeder shall be complete with tank, wide mouth opening, shutoff valves, drain valve, flow indicator, and nipples.

B. Feeder shall have a capacity of 2-1/2 gallons, and shall be the Model M-20 as manufactured by the North American Mogul Products Company, Culligan, Clow, or approved equal, and shall be installed in strict accordance with the manufacturer's recommendations.

C. The Contractor shall have a chemical analysis made of the heating system water, cooling system water and raw building water. Water analysis shall be made after complete system has been cleaned. Two copies of each water analysis along with two copies of the treatment recommended, shall be furnished, one copy delivered to the Client Agency and one copy delivered to the Professional. The analysis shall be made by the approved feeder supplier.

D. Chemicals for the initial filling of the system shall be purchased by the Contractor. All chemical containers shall be marked with the chemical name and appropriate hazard warnings as required by OSHA 29, CFR 1910.1200.

2.09 RESERVOIR TANK

A. The reservoir tank shall be a manufactured in strict accordance with ASME Unfired Pressure Vessel Code Section VIII, for a maximum working pressure of 125 psi. tank capacity shall be as indicated on the drawings. The tank shall be manufactured from carbon steel, and shall be unlined. The tank shall be mounted in a vertical position. The tank shall be insulated in the field. The tank shall be supplied with a top air vent and with one 3” flanged inlet tapping at a high location, and one 3” flanged outlet tapping at a low location. Any threaded connections shall be stainless steel. A 12” x 16” manhole shall be included in the tank for field maintenance if required. This application will include a propylene glycol solution.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install all equipment per manufacturers recommendation and Best Industry Standards.

END OF SECTION

SECTION 230523

HVAC VALVES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The valves for the various HVAC systems shall be as hereinafter described in this section.

1.04 SUBMITTALS

A. Provide data sheets for each valve type and accessory to be included on this project.

B. Submitted valves and accessories shall conform to the specifications, including materials, sizes and styles.

PART 2 - PRODUCTS

2.01 VALVES AND ACCESSORIES – CIRCULATING WATER SERVICE

A. Circulating Water Service shall include the following:

1. Hot Water Supply and Return (HWS & R)
2. Chilled Water Supply and Return (CWS & R)
3. Domestic Cold Water Make-Up
4. Associated drain, relief and vent piping

B. General Requirements:

1. Furnish and install all valves and piping system accessories indicated on the Drawings or as required for proper operation of the systems.
2. Unless otherwise specified, valve numbers in the Specifications are taken from the catalog of NIBCO Inc., and are intended to denote a standard of quality and type required. Comparable valves of other manufacturers, such as Milwaukee, Hammond, Apollo, Crane, Jamesbury, Neles, Victaulic or approved equivalent will be acceptable.
3. All valves shall be of one manufacturer, except where specified otherwise.
4. **Apollo International is not acceptable.**
5. In general, ball valves and butterfly valves shall be used on water lines where the service requires valves to be wide open or tightly closed.
6. Plug valves shall be used where services require valves to be throttled.
7. Valves in Mechanical Equipment Rooms shall be provided with chain operators to make valves accessible from the floor where valves are located out-of-reach of operating personnel, 7’-0” feet in height or higher.
8. All valves, except where specified otherwise, shall be suitable for at least 200 PSI minimum water working pressure, Class 125. All valves, except on small threaded or soldered lines, shall be flanged.
9. Bronze valves, including bronze check valves, shall be made to be “dezincification resistant”, with metal components in the waterway not containing more than 15% zinc in their chemical makeup.

C. Gate Valves:

1. Gate valves 2" and smaller shall be bronze body, bronze-mounted, threaded pattern, solid wedge, inside screw, rising stem; solder pattern for copper lines.
2. Valves 2½" and larger shall be iron body, bronze-mounted, flanged, OS&Y pattern.
3. Iron body valves shall be suitable for 125 PSI SWP, Figure No. F-617-0.
4. Bronze body valves shall be suitable for a minimum of 125 PSI SWP, Figure No. T-111.
5. Valves on copper tubing water lines shall be suitable for a minimum of 125 PSI SWP and shall be solder end type, Figure No. S-111.

D. Ball Valves:

1. Ball valves shall be installed on all water service lines 2" and smaller and shall be two-piece bronze body, stainless steel stem and ball, with a conventional port, reinforced TFE packing (no "O" ring), with insulated operator, 600 PSIG CWP.
2. Ball valves shall be suitable for -40°F. to 350°F.
3. Ball valves shall be NIBCO No. T-585-70-66-NS (NIB-SEAL Handle) for threaded ends and NIBCO No. S-585-70-66-NS for soldered ends, or approved equivalent.

E. Butterfly Valves:

1. Butterfly valves shall be BOS-US, uninterrupted seat, offset disc, resilient seated, as manufactured by DeZurik, 815 Series as manufactured by Jamesbury, or Vic®-300 MasterSeal™ series as manufactured by Victaulic.
2. Butterfly valves shall be furnished and installed on all water lines 2-1/2" and larger. Valves shall be guaranteed for zero-leakage bi-directional shut-off, complete with manual infinite throttling handle and position indicator, and suitable for dead-end service.
3. Valves shall be suitable for 200 PSI CWP, shall be complete with EPDM seat and shaft seals suitable for high temperature (250°F.) service, aluminum bronze bearings, 316 SS discs, lug type ductile iron body, and 316 SS stem.
4. Bodies shall be furnished with tapped lugs and flange bolts or grooved fittings to allow downstream piping to be disconnected, leaving the valve in line to control the flow.
5. Bolts shall be installed at each side of the lugs to allow downstream piping to be disconnected.
6. Butterfly valves 4" and smaller shall be furnished with a hand lever operator.
7. Butterfly valves 6" and larger shall be furnished with a quarter turn gear operator with hand wheel.
8. All valves shall be furnished with a disc position/over-travel indicator to provide visual indication of disc position and to simplify actuator adjustment.

F. Globe Valves:

1. Globe valves 2" and smaller shall be bronze body, bronze-mounted, threaded pattern, solid wedge, inside screw, rising stem; solder pattern for copper lines.
2. Valves 2½" and larger shall be iron body, bronze-mounted, flanged, OS&Y pattern.
3. Iron body valves shall be suitable for 125 PSI SWP, Figure No. Figure No. F-718-B.
4. Bronze body valves shall be suitable for a minimum of 125 PSI SWP, Figure No. Figure No. T-211 or angle valve T-311-Y.
5. Valves on copper tubing water lines shall be suitable for a minimum of 125 PSI SWP and shall be solder end type, Figure No. Figure No. S-211 or angle valve S-311-Y.

G. Plug Valves:

1. Plug valves at locations on water mains, isolation valve stations, pumps, and on water piping 2½" and larger at terminal equipment, shall be the gland-packed type, complete with resilient facing, suitable to 250°F., similar to DeZurik Series 100, Keystone "Ballcentric", or approved equivalent.

2. Plug valves 2" and smaller shall be DeZurik Figure 120, Keystone "Ballcentric", or approved equivalent, suitable for 175 PSI WWP and shall be provided with bronze bodies, screwed ends, stainless steel bearings, and resilient plugs.
3. Plug valves 2½" and larger shall be DeZurik Figure 118, Keystone "Ballcentric", suitable for 175 PSI WWP and shall be provided with cast iron bodies, nickel seats, flanged ends, and resilient plugs.

H. Manual Balancing Valves:
1. Furnish and install one manual balancing valve at all water terminal equipment coils on 2" and smaller return piping.
2. Valves shall be suitable for combined indicating, balancing, and tight shut-off. Valves shall be the Circuit Setter Plus by Bell and Gossett, Quick Set by Griswold Controls, the UltraXB Orturi Model XB by Nexus, Model TBV by IMI, ACCU FLO by Taco, TA Series 786/787/788/789 and 78K by Victaulic / Tour Anderson, or NIBCO styles 1810, F737A, and G737.
3. Valves shall be suitable for 300 PSI water pressure, 250°F. total temperature, and shall have full turn balancing device, lockable in any position.
4. Valves shall be equipped with a visible indicating dial with screwdriver adjustment.
5. Valves shall be re-packable under pressure.
6. Balancing valves 4" and smaller shall be furnished with a hand lever operator.
7. Balancing valves 6" and larger shall be furnished with a quarter turn gear operator with hand wheel.
8. All balancing valves shall be furnished with a disc position/ over-travel indicator to provide visual indication of disc position and to simplify actuator adjustment.

I. Check Valves (Pump Discharge, Surge, & Water Hammer):
1. Check valves at all pumps and on water piping 2½" and larger shall be of type that controls surge pressures and resulting water hammer.
2. Valves shall be iron body, flanged, with bronze trim.
3. Check valves shall be "Silent Check Valves", the Nibco No. F-910-B-LF, Metraflex Company, Techno Corp., or approved equivalent.

J. Check Valves:
1. Check Valves 2" and smaller shall be bronze body, horizontal swing, regrinding type, Y-pattern, renewable seat and disc, threaded ends, or solder ends for copper lines.
2. Bronze body valves shall be suitable for a minimum of 125 PSI SWP, Figure No. T-413-B.
3. Valves on copper tubing water lines shall be suitable for a minimum of 125 PSI SWP, Figure No. S-413.

K. Strainers:
1. Furnish and install Y-type strainers. Baskets in strainers shall be stainless steel, 2" and smaller shall be No. 20 mesh, and 2½" and larger shall have 1/8" diameter perforations.
2. Each strainer shall have a full size gate valve on the blowdown drain connection with drain line extended to funnel
3. Valves, nipples and strainer baskets shall be readily removable.
4. Strainers 2" and smaller shall be bronze body, screwed or sweat ends as required, Spirax Sarco Type BT or TBT, Armstrong, Watts, or approved equivalent.
5. Strainers 2½" and larger shall be cast iron body, flanged, Spirax Sarco Type CI-125 or F-125, Armstrong Type A1FL-125, Watts, or approved equivalent.

L. Safety Relief Valves:

1. Safety relief valves shall be installed on water piping as required by local regulatory agencies having jurisdiction.
2. Safety relief valves shall serve the dual purpose of relieving over-pressure created by thermal expansion and over-pressure in the form of water.
3. Safety relief valves shall be ASME rated and shall be similar to Watts Series 174A and 740, Kunkle, Conbraco, or approved equivalent.
4. Discharge of safety relief valves shall be piped to funnel drains or floor drains.
5. All safety relief valves shall be ASME approved and certified by the National Board of Boiler and Pressure Vessel Inspectors and shall bear approval stamps, along with pressure and capacity data.

M. Manual Air Vents:

1. On all high point of water mains and on coils and other heating terminals furnish and install a ¼" manual air vent with full sized gate valve. Air vent outlets shall be extended to accessible locations. Air vent outlets shall terminate over funnel or floor drains where possible. Where necessary, hose end adapters shall be provided on vent piping.
2. Furnish and install on high point of each coil in each cabinet unit heater, and radiant panel, one manual air vent similar to Dole No. 14, or approved equivalent. Vents shall be connected to coil vent taps and extended to an accessible location in each cabinet. Vent tubing shall be coiled and outlet extended to a point near access door. All tubing within the cabinets shall be securely anchored.

N. Automatic Air Vents:

1. Furnish and install on each horizontal delivery propeller type hot water unit heater, one automatic float type air vent, similar to Hoffman No. 79, or approved equivalent. Provide cock at each vent. Vents shall be suitable for 75 PSIG operating pressure.
2. Automatic air vents on lines at locations shown shall be the Armstrong No. 1-AV with petcock, Spirax Sarco No. 13WS, Apco No. 50, or approved equivalent. Air vents shall have 150 PSI cast bodies and stainless steel trim.

O. Drain Valves:

1. All low points of the piping system shall be provided with drain valves so that the complete system can be drained.
2. Each down fed unit or other equipment shall be provided with drain valves.
3. Drain valves shall be ½" with hose end and cap similar to NIBCO No. T-585-70-66-HC or S-585-70-66-HC, or approved equivalent.

P. Unions:

1. Unions shall be 300 lb. WOG, malleable iron ground joint type, with bronze-to-iron seat, Class 150, Grinnell Fig. No. 463, or approved equivalent.

Q. Coil Connection Valve Assemblies (Coil Kits):

1. Victaulic Koil-Kits Series 799 or 79V may be used at coil connections. The kit shall include a Series 786/787/78K circuit balancing valve, Series 78Y Strainer-Ball, Series 78U Union-Port fitting, with Series 78T ball valve and required coil hoses. A meter shall be provided by the valve manufacturer that shall remain with the building Professional after commissioning.
2. ½" through 2": Y-pattern, globe style design, with all metal parts of nonferrous Ametal® brass copper alloy and EPDM seat. 4-turn digital readout hand wheel. Valves shall be suitable for 300 PSI water pressure, 250°F total temperature. Series 786 (soldered end), Series 787 (female threaded ends), or Series 78K (male x female threaded ends).

3. 2½" through 16": Y-pattern, globe style design, with ductile iron body, all other wetted parts of Ametal® brass copper alloy and EPDM seat. 8, 12, 16, or 20-turn digital readout hand wheel. Valves shall be suitable for up to 350 PSI water pressure, 250°F total temperature. Series 788 (flanged end), rated to 250 PSI, or Series 789 (grooved end).
4. Acceptable manufacturers: Victaulic, IMI Flow Design, Nexus Valve, Bell & Gossett, Griswold, or approved equal.

R. Grooved End Valves:

1. Butterfly Valves:
   a. Grooved end butterfly valves shall be furnished and installed on all water lines 2" and larger utilizing a grooved piping system.
   b. Valves shall be suitable for bi-directional, dead-end, and bubble-tight shut off at full rated pressure.
   c. Grooved end butterfly valves shall be as manufactured by Victaulic as follows:
   d. 2" through 12": Ductile iron body, electroless nickel or polyamide coated, ductile iron disc, blowout-proof 416 stainless steel stem. Disc shall be offset from the stem centerline to provide full 360 °° seating. EPDM pressure responsive seat and seal material, TFE lined fiberglass bearings, lever handle or gear operator with handwheel and memory stop feature, 300 PSI, grooved ends designed for installation with Victaulic standard couplings. Victaulic Vic®-300 MasterSeal™ or NIBCO GD-4765 Series.
   e. 14" through 24": Polyphenylene Sulfide (PPS) coated ductile iron body and disc, 17-4 PH stainless steel stem design, EPDM seal, reinforced PTFE bearings, gear operator with handwheel and memory stop feature, 300 PSI, AGS grooved ends designed for installation with Victaulic "W" series couplings. Disc shall be offset from the stem centerline to provide full 360 degree seating. Victaulic Vic®-300 AGS.
   f. Butterfly Valves on copper tubing water lines 2½" Inch through 6 Inch shall be grooved end type, Victaulic Butterfly Series 608N.
2. Check Valves:
   a. Check valves at all pumps and on water piping 2" and larger utilizing a grooved piping system shall be spring-assisted, "Silent Check Valves" as manufactured by Victaulic, as follows:
   b. 2" through 3": Ductile iron body, stainless steel disc and spring, brass shaft, nickel-plated seat and grooved ends, 365 PSIG CWP. Victaulic Series 716H.
   c. 4" through 12": Ductile iron body, elastomer encapsulated ductile iron disc, stainless steel spring and shaft, welded-in nickel seat, grooved ends, 300 PSIG CWP. Victaulic Series 716.
   d. 14" through 24": Ductile iron body, 304 stainless steel dual disc design, stainless steel spring and shaft, EPDM seat bonded to the valve body, AGS grooved ends, 230 PSIG CWP. Victaulic Series W715.
3. Strainers:
   a. Furnish and install grooved end strainers on water systems 2-1/2" and larger utilizing a grooved piping system.
   b. Y-Type, 2" through 18": Ductile iron body, Type 304 stainless steel perforated metal removable baskets with [0.062"] [0.125"] [0.156"] diameter perforations, blow down port with off-centered pipe plug, 300 PSIG CWP. Victaulic Series 732 and W732.
   c. T-Type, 2" through 12": Ductile iron body, Type 304 stainless steel mesh removable basket, no. 12 or no. 6 mesh, 57% free open area, removable access coupling and cap for strainer maintenance. Victaulic Series 730.

d. T-Type, 14” through 24”: Carbon steel body, Type 304 stainless steel mesh removable basket, no. 6 or no. 4 mesh, 57% free open area, carbon steel t-bolt hinged closure/cap for strainer maintenance, AGS grooved ends. Victaulic Series **W730.**

2.2 OTHER VALVES AND ACCESSORIES

A. Gas Service Valves:

1. Valves on gas lines 2" and smaller shall be the NIBCO No. T-580-70-UL or T-585-70-UL, or approved equivalent.
2. Valve shall be suitable for natural gas use, UL listed, bronze body, bronze ball, threaded ends, and with blowout-proof stem.
3. Valve shall be rated at 600 PSIG WOG.
4. Valves on gas lines 2-1/2" and larger shall be the lubricated plug type, gray iron construction, flanged pattern, and shall be the Rockwell-Nordstrom No. 115, or approved equivalent.
5. Furnish suitable valve wrenches

B. Pressure Reducing Valves (for Domestic Cold Water Make-Up):

1. Furnish and install on domestic cold water makeup piping to the circulating water system, and/or steam system, water pressure reducing valves similar to the Watts Model U5B or approved equivalent, as required to provide automatic filling of the systems.
2. Pressure reducing valves shall each be suitable for 200 PSI WWP, with cast bronze body and bronze trim, sizes shown on the Drawings, but not less than 3/4" size.
3. Pressure reducing valves shall be set at pressure indicated on the Drawings.
4. The .2 Heating Contractor shall connect to cold water outlet provided by the .3 Plumbing Contractor.

C. Double Check Valve Assemblies (for Domestic Cold Water Make-Up):

1. Double check valve assemblies on domestic cold water make-up piping shall be Watts Series LF007, or approved equivalent.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install valves as described above and per manufacturer recommendations.

B. Grooved Joints:

1. Grooved joints shall be installed in accordance with the manufacturer’s latest published installation instructions.
2. Grooved ends shall be clean and free from indentations, projections, and roll marks.
3. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service.
4. A factory-trained field representative (direct employee) of the mechanical joint manufacture shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products.
5. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed.
6. A distributor’s representative is not considered qualified to conduct the training.
7. Contractor shall remove and replace any improperly installed products.

END OF SECTION

SECTION 230529

PIPE HANGERS AND SUPPORTS - HVAC

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The hangers and supports for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 GENERAL

A. All piping shall be supported from the building construction by the use of fixed or adjustable beam clamps, concrete inserts, welded structural attachments, lag bolts and lag screws from wood construction, brackets, extension rods, adjustable band ring pipe hangers, or other equipment as dictated by the type of building construction.

B. Furnish and install all structural steel members for the support of the piping, and equipment to suit the structural and vibration isolation conditions.

C. Hangers and supports shall be arranged to distribute the weight of the piping and equipment uniformly on the Building structure.

D. All necessary structural supports and inserts to hang all piping and equipment shall be provided by this Contractor. Hanger rods shall be securely attached to plates. Where cutting is required for the installation of hangers, piping and supports, all openings must be neatly drilled by the .2 Heating Contractor. Punching or chipping of concrete will not be permitted. All necessary openings shall be drilled in a location and manner satisfactory to the Professional. All concrete damaged by the .2 Heating Contractor shall be patched, reinforced or replaced as directed by the Professional Location of all holes, openings and sleeves shall clear reinforcing steel in floor and roof decks. The .2 Heating Contractor shall coordinate all work with the Professional and shall determine exact locations of all supports, especially for those for vibration isolation, and openings,

E. Insulation shall be installed over band hangers and all openings shall be sealed as hereinafter specified.

F. Piping shall only be supported by code approved and manufacturer recommended hanger systems connected directly to the building’s structure.

G. The Contractor shall support piping mains as required in accordance with these specifications.

2.02 HANGERS FOR STEEL PIPE

A. Hangers for all steel piping shall be complete with band hangers, turnbuckles, and rods. Hanger bands shall be flat and suitable for application of insulation over the hanger and pipe.

B. Acceptable Manufacturers:

1. Basic-PSA, Model BE 124, BE124-1, BE 124-2, BE 124A-1, & BE 124A-2
2. Modern Pipe Supports Corp., Figure 87
3. Anvil International, Figure 295
4. Approved Equal.

2.03 HANGERS FOR COPPER PIPE

A. Hangers for all copper piping shall be complete with all-copper band hangers, turnbuckles, and rods. Hanger bands shall be flat and suitable for application of insulation over the hanger and pipe.

B. Acceptable Manufacturers:

1. Modern Pipe Supports, Corp, Figures 48, 49, 59, and 403
2. Approved Equal.

C. Copper piping shall be supported with flat band copper hangers as hereinafter specified.

D. All supports directly in contact with copper lines shall be all copper where possible or copper-plated where approved by the Professional. Ferrous metals shall not be used in contact with copper lines. Hangers shall be all-copper as hereinbefore specified.

E. PVC coated steel hangers are acceptable on the condition that the coating is undamaged and without penetrations to the underlying steel.

F. In lieu of copper band hangers, the Contractor will be permitted to use a steel clevis type hanger with the pipe insulation acting as an isolator to prevent electrolysis between the pipe and hanger. Clevis hanger shall be complete with hanger, adjuster, rod and insulation protection saddle

1. Acceptable Manufacturers:
   a. Modern Pipe Supports Corp., Figure 590
   b. Basic-PSA, Model BE 120
   c. Anvil International, Figure 260
   d. Approved Equal

G. Clevis hangers are acceptable only as hereinbefore specified for copper tubing.

2.04 HANGER RODS

A. Hanger rods installed in conjunction with hangers shall be not less than the following:

Pipe Size	Hanger Rod Diameter
1/2" to 2"	3/8"
2-1/2" and 3"	1/2"
4" and 5"	5/8"
6"	3/4"

B. Hanger rods shall be larger where recommended by the hanger manufacturer.

2.05 PIPE SUPPORT SPACING

A. Pipe supports shall be spaced as indicated below. Smaller pipe shall be provided with additional supports to prevent lines from sagging.

MAXIMUM PVC AND COPPER PIPE SUPPORT SPACING

Pipe Size	PVC, FT	Copper, FT
Up to 1-1/2”	3	6
2” and Larger	4	8

MAXIMUM STEEL PIPE SUPPORT SPACING

Pipe Size	Water Service, FT	Steam, Air & Gas Service, FT
1”	7	9
1-1/2”	9	12
2” & 2-1/2”	10	13
3”	12	15
4” & 5”	14	17
6”	17	21

B. Where concentrated loads occur, closer spacing may be necessary.

C. The Contractor shall minimize the sagging of pipe. Where piping is intended to slope (i.e. drains and condensate return lines), the Contractor shall maintain the slope of the piping to minimize pockets of standing water.

D. Hangers must be installed not more than 2.5 pipe diameters from each change in horizontal direction of pipes.

2.06 SUPPORT OF VERTICAL PIPES

A. All vertical runs of piping shall be supported at each floor and/or at specified intervals, by means of riser clamps or pipe lugs.

B. Riser clamps with bolts and hex nuts shall be used for support of vertical lines in pipe spaces and other locations required.

C. For vertical pipe runs, risers shall be suspended from or supported by steel spring isolators (Mason Industries type PC3ON hangers, type SLR mounts, or equal) and the piping restrained or guided by all-directional supports (Mason Industries type ADA, or equal). Steel spring deflections shall be 3/4", except in those expansion locations where additional deflection is required to limit deflection or load changes to +/- 25% of the initial stress.

D. All vertical runs of piping shall be supported at each floor and/or at specified intervals, by means of riser clamps. Copper tubing shall be protected against electrolysis, such as PVC coating or plating, or by the use of an all-copper clamp. Riser clamps placed on floor construction in finished areas, including stairwells, will not be permitted.

E. Copper tubing shall be protected against electrolysis, using PVC coating or plating, or by the use of an all-copper clamp.

2.07 SLEEVES

A. Where vertical pipes pass through floors in mechanical equipment areas, chases or pipe spaces, the Contractor shall construct watertight sleeves made up of a section of Schedule 40 steel pipe extending 4" above the floor.

B. Where vertical pipes pass through floors in finished spaces, the Contractor shall construct watertight sleeves made up of a section of steel pipe of proper length to extend through masonry and terminate flush on finish side.

C. Where horizontal pipes pass through walls, sleeves shall be as specified above terminating flush with finish on each side.

D. Where vertical pipes pass through plaster or dry wall ceilings, sleeves shall be No. 18 gauge galvanized steel flush with ceiling.

E. Where piping is insulated, insulation shall be extended through sleeves. Sleeves shall be at least two sizes larger than the pipe or of suitable dimensions to allow the installation of pipe, insulation and sealant.

F. At all locations space between sleeve and pipe shall be filled with sealant to level of sleeve. Sealant shall be Dow Corning 3-6548RTV, or approved equal. Conform to manufacturer's recommended installation procedures.

G. Sleeves and inserts shall be installed in concrete. Sleeves shall be large enough to receive the insulation and jackets.

2.08 INSERTS

A. The Contractor shall place all hanger and support inserts in concrete. Special studs "shot" into concrete will not be permitted.

B. All expansion shells shall be of the self-drilling types as manufactured by the Phillips Drill Company, Ramset, Rawlplug, or approved equal. Shells shall be the hammer installed, special flush or hanger rod types. Shells shall be installed with a drill-hammer.

C. Lead expansion shields or lead wedge type shields are not permitted.

D. Epoxy adhesive anchors, Hilti or equal, shall be used where specified on the design drawings.

2.09 ATTACHMENTS

A. Beam clamps are permitted on 2-inch pipes with a service temperature of 180°F or less and shall be fixed or adjustable as manufactured by Modern Hangers, Penn Pipe Hanger Co., Arrow Pipe Hanger Co., or approved equal.

2.10 PENETRATIONS

A. Seal all openings through walls of air plenum spaces and relief air shafts, where ducts, pipelines, etc. are installed under this Contract to assure airtight plenum spaces. Coordinate all work with contractors of other trades.

B. Where pipes of any type pass through new fire and smoke barrier stops, ceilings, floors or walls, this Contractor shall thoroughly seal such openings with fire-rated sealant as required to maintain fire-rating of adjacent construction.

C. Where exposed pipes pass through walls, floors or ceilings of finished rooms, furnish and install steel chromium-plated setscrew type floor, wall or ceiling plates.

2.11 PIPES SUPPORTED FROM STEEL JOISTS

A. The weight of pipe supported from steel joists shall be distributed as follows:

Pipe Size	Minimum Requirement
2” and Smaller	Pipe shall be hung from one joist with beam clamps
2” to 3”	Pipe shall be suspended from 1-1/4" steel pipe or steel angle, laid-in and hook-bolted to the web members of the joists.
4" and 5"	Pipe shall be supported from three joists.
6" and over	Pipe shall be supported from not less than four joists

2.12 SUPPORT OF PIPES ALONG WALLS

A. Lines along walls shall be supported on neat, substantial wall hangers securely attached to construction by means of inserts or expansion sleeves, or adhesive anchors, and bolts.

B. Acceptable Manufacturers:

1. Basic-PSA, Model BE 203, BE 204, and BE 205
2. Modern Pipe Supports Corp, Figures 605, 606, 607, or 608
3. Anvil International, Figure 194,195, and 199

4. Approved Equal.

2.13 SUPPORT OF PIPES AT MECHANICAL EQUIPMENT CONNECTIONS

A. All piping 3" or larger connected to mechanical equipment shall be mounted with steel spring isolators.

B. The first three hangers or mounts near the mechanical equipment shall have the same static deflection as specified for the mountings under the connected equipment and shall be Mason Industries type PC30N (or approved equal).

C. The first three hangers or mounts near the mechanical equipment, with no mountings under the equipment, shall be isolated by Mason Industries type 30N (or equal) hangers.

D. Floor supported piping shall rest on restrained mounts, Mason Industries type SLR-MT (or approved equal).

E. All other spring hangers and mounts, where specified, shall have a minimum static deflection of 3/4".

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install hangers and supports in accordance with the IBC and ASME B31.1.

B. All piping shall be supported from the building construction by the use of beam clamps, concrete inserts, brackets, or other equipment as dictated by the type of building construction.

C. Trapeze type hangers may be used for multiple parallel line installations. The Contractor shall submit sketches for the proposed hangers indicating the type of construction, number and size of lines, and maximum spacing to the Construction Manager and the Professional for approval.

D. ALL hanger and support locations shall be coordinated and reviewed with the Professional, Structural, .2 HVAC, .4 Electrical and .5 Fire Protection Professional Construction Representatives during construction. If any hanger locations or connection methods are unacceptable to any of the professional team (for example – penetrations of pre-cast concrete tees, from piping, uneven spacing or height, etc.), the Contractor shall relocate the support, at his own expense, to an approved location.

3.02 UNACCEPTABLE HANGER AND SUPPORT INSTALLATIONS

A. It is unacceptable to support any pipe(s) or duct(s) from other pipe(s) or duct(s).

B. If unistrut is used to support piping, strap hangers are unacceptable since they do not allow for continuous insulation.

C. It is unacceptable for this Contractor to support his work from the hangers of other trades. All trades must install their own hangers.

D. It is unacceptable to attach supports to the building structure or concrete slabs using nails or a nail gun.

E. It is unacceptable to support pipes using cable hangers.

F. Unacceptable hanger and support installations shall be corrected as directed by the Professional at no cost to the Client Agency.

G. Unisrut is not acceptable to support pipes equal to or greater than 3 inches in diameter.

H. Riser clamps placed on floor construction in finished areas, including stairwells, are not permitted.

I. Strap hangers, wire hangers, or split-ring hangers are not acceptable.

E. Perforated band iron, strap, split ring, wire, chain, or pipe hooks are not permitted for hangers or supports of pipe.

F. Piping shall not be supported from any other piping systems, ductwork, conduit, etc.

G. Attachments to, and penetrations of new or existing concrete structural tees for hanger connections **shall be not be permitted** until reviewed and approved by the Professional and

Structural Professional. The Contractor shall be responsible for the expense of all repairs required as a result of the installation of unauthorized attachments to, or penetrations of new or existing concrete structural tees.

H. It is unacceptable to torch burn holes in structural steel to attach support components. All holes in structural steel must be approved by the Professional and drilled.

I. Pipe roller supports shall not be used.

END OF SECTION

SECTION 230533

HVAC PIPE HEAT TRACE

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SECTION INCLUDES

A. Heating cable.

B. Ambient sensing or bulb and capillary thermostat for heating cable.

1.03 PERFORMANCE REQUIREMENTS

A. Pipe Trace - Freeze Protection

B. The following table is calculated for 50°F change in temperature using fiberglass insulation with K factor of 0.25, 20 MPH wind, and 10% safety margin.

Pipe Size	Insulation Size	W/Ln. Ft.
up to 1 1/2”	1”	3
2” - 5”	1 1/2”	5
6” - 12”	2”	8
14” - 20”	2 1/2”	10
21” - 24”	3”	10

C. Pipe Heat Trace must be rated for 200°F service when used for hot water supply and return (HWS&R) piping.

1.04 PROJECT RECORD DOCUMENTS

A. Accurately record actual locations of heating cable, thermostats, and branch circuit connections.

1.05 QUALIFICATIONS

A. Manufacturer: company specializing in manufacturing the products specified in this Section with minimum 25 years’ experience.

B. All self-regulating cable equipment furnished under this section shall be supplied by a single manufacturer.

C. UL, CSA, or FM Listed self-regulating cable and thermostats.

1.06 COORDINATION

A. Coordinate installation of heating cable with .1, .2, and .4 Contractors.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Delta-Therm Corporation (Basis of Design)

B. Raychem

C. Easyheat

D. Equal as approved by the Professional

2.02 HEATING CABLE

A. Heating Cable: UL, CSA, or FM Listed self-regulating cable.

1. Self-regulating cable construction shall consist of two 16 AWG, stranded, nickel plated copper bus wires between which a positive temperature coefficient conductive polymer heating element is placed.

2. For low temperature (non-steam) line applications, provide the Delta-Therm SR-NA Series.
    a. Maximum operating temperature: 140 ºF
    b. Maximum continuous exposure temperature (power off): 176 ºF
3. Power off for 1000 hours cumulative: 374 ºF

B. Rating: 120 V.

2.03 ACCESSORIES

A. Thermostat:
1. Thermostat shall be either ambient or line sensing.
2. Enclosure shall be one of the following either NEMA 3, 4X, 7, 9, 11, or 12.
3. Thermostat shall be set to activate at 35 degrees F.

B. Fiberglass Tape

C. Caution Labels

D. Aluminum Tape (Necessary for plastic pipe installation)

PART 3 - EXECUTION

3.01 EXAMINATION

A. Installer to verify field measurements are as shown on Drawings.

B. Installer to verify that required utilities are available, in proper location, and ready for use.

C. Beginning of installation means installer accepts conditions.

3.02 INSTALLATION

A. Complete installation shall conform to appropriate local codes and shall be in accordance with manufacturer's instructions.

B. Allow additional cable for values, flanges, pumps and support per manufacturer's installation instructions.

C. Band heating cable to pipe with tape wraps approximately every 12". Locate heating cable on pipe per manufacturer's instructions.

D. If heating cable is being used to heat plastic pipe, attach aluminum tape length of pipe and band heating cable on aluminum tape to evenly distribute heat.

E. For pipes with flanges and multiple runs install according to detailed layout drawings.

3.03 FIELD QUALITY CONTROL

A. Test continuity of heating cable.

B. Perform insulation resistance (megger) test on each cable heater before, during, and after installation. Minimum acceptable megger reading shall be 10 megohms.

C. Measure voltage and current at each unit.

D. Submit written test report showing values measured on each test for each cable.

END OF SECTION

SECTION 230548

SOUND AND VIBRATION CONTROL - HVAC

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The sound and vibration control for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 VIBRATION AND NOISE CONTROL

A. All equipment shall operate without objectionable noise or vibrations within Noise Criteria Curves listed in Sound and Vibration Control of the latest edition of the ASHRAE Handbook of HVAC Applications. Sound and vibration measurements shall conform with the ASHRAE Handbook of Fundamentals. If such objectionable noise or vibration shall be produced and transmitted to occupied portions of the building by apparatus, piping, ducts or other parts of this work, any necessary changes, as approved, shall be made without cost to the Client Agency. Noise levels shall conform with the requirements of OSHA.

B. All mechanical equipment shall be isolated in accordance with the Latest Edition of the ASHRAE Handbook of HVAC Applications. Piping for the first three (3) support points away from remotely located mechanical equipment shall be isolated with Type 2 Isolators with a minimum deflection of 1.0 inches. All vibration isolators shall be of the same manufacturer where possible and shall be furnished by Consolidated Kinetics, Korfund, Vibration Eliminator Co. or approved equivalent.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install vibration isolators, flexible connectors, etc per manufacturers recommendations.

END OF SECTION

SECTION 230549

INERTIA BASES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The sound and vibration control for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATION FOR HOT WATER, CHILLED WATER, CONDENSER WATER, AND SNOWMELT CIRCULATING PUMPS

A. General

1. Description - Furnish and install vibration control devices, materials and related items. Perform all work as shown on the drawings and as specified herein to provide complete vibration isolation systems in proper working order.
2. Material and Equipment -
   a. All vibration isolation mounts shall be supplied by one of the following approved manufacturers:
      1) Amber/Booth Co. - A.B.
         Houston, Texas
      2) Korfund Dynamics Corp. - K.D.
         Westburn, New York
      3) Mason Industries, Inc. - M.I.
         Hollis, New York
      4) Peabody Noise Control Inc. - P.N.C.
         Dublin, Ohio
      5) Vibration Mountings & Controls, Inc. - V.M. & C.
         Butler, New Jersey
      6) Equal as approved by the Professional
   b. Unless otherwise specified, supply only new equipment, parts and materials.
   c. Substitutions of equal equipment beyond the alternatives listed will be permitted only with the written permission of the Professional. Accompany each request for acceptance of substitute equipment with manufacturer's certified data proving the equivalence of the proposed substitute in quality and performance. The Professional shall be the final judge of the validity of the data submitted.
3. Quality Assurance
   a. Coordinate the size, location and special requirements of vibration isolation equipment and systems with other trades. Coordinate plan dimensions with size of housekeeping pads.

b. Provide vibration isolators of the appropriate sizes and proper loading to meet the specified deflection requirements.

c. Supply and install any incidental materials needed to meet the requirements stated herein, even if not expressly specified or shown on the drawings, without claim for additional payment.

d. Verify correctness of equipment model numbers and conformance of each component with manufacturer's specifications.

e. Should any rotating equipment cause excessive noise or vibration, the .2 Contractor shall be responsible for rebalancing, realignment or other remedial work required to reduce noise and vibration levels. Excessive is defined as exceeding the manufacturer's specifications for the unit in question.

f. Upon completion of the work, the Department shall inspect the installation and shall inform the .2 Contractor of any further work that must be completed. Make all adjustments as directed by the Professional that result from the final inspection. This work shall be done before vibration isolation systems are accepted.

4. Speed and Balance Requirements for Rotating Equipment

a. Rotating mechanical equipment shall not operate at speeds in excess of 80% of their true critical speed.

b. Vertical vibration of rotating equipment shall not be greater than the levels indicated. The vibration shall be measured on the equipment or steel frame equipment base when the equipment is mounted on its vibration isolation mounts. If the equipment has an inertia base, the allowable vibration level is reduced by the ratio of the equipment weight alone to the equipment weight plus the inertia base weight.

Equipment Speed	Vibration Displacement (Mils Peak-To-Peak)
Under 600 RPM	4
600 to 1000 RPM	3
1000 to 2000 RPM	2
Over 2000 RPM	1

5. Submittals

a. Refer to related sections elsewhere for procedural instructions for submittals.

b. Prior to ordering any products, submit shop drawings of the items listed below. The shop drawings must be complete when submitted and must be presented in a clear, easily understood form. Incomplete or unclear presentation of shop drawings may be reason for rejection of the submittal.

1) A complete description of products to be supplied, including product data, dimension, specifications and installation instructions.

2) Detailed selection data for each vibration isolator supporting equipment, including:

a) the equipment identification mark

b) the isolator type

c) the actual load

d) the static deflection expected under the actual loads

e) specified minimum static deflection

f) the additional deflection to solid under actual load; and

g) the ratio of spring height under actual load to spring diameter.

3) Steel rails, steel base frames and concrete inertia bases showing all steel work, reinforcing, vibration isolator mounting attachment method, and location of equipment attachment bolts.

4) Special details necessary to convey complete understanding of the work to be performed.

c. Submission of samples may be requested for each type of vibration isolation device. After approval, samples will be returned for installation at the job. All costs associated with submission of samples shall be borne by the .2 Contractor.

B. Products

1. Vibration Isolation Mount Types

a. General

1) All metal parts of vibration isolation units installed out-of-doors shall be cold-dip galvanized, cadmium plated, or neoprene coated after fabrication. Galvanizing shall meet ASTM Salt Spray Test Standards and Federal Test Standard No. 4.

2) Isolator types are scheduled to establish minimum standards. At the .2 Contractor's option, labor-saving accessories can be an integral part of isolators supplied to provide initial lift of equipment to operating height, hold piping at fixed elevations during installation and initial system filling operations and similar installation advantages. Accessories must not degrade the vibration isolation system.

2. Equipment Bases

a. Unit BIB (Base - Inertia Base) for Pumps and Pump Skids

1) Concrete inertia bases shall be formed of stone-aggregate concrete (150 lbs./cu.ft.) and appropriate steel reinforcing cast between perimeter structural steel channels. Inertia bases shall be built to form a rigid base which will not twist, rack, deform, deflect or crack in any manner which would negatively affect the operation of the supported equipment or the vibration isolation mounts. Inertia bases shall be adequately sized to support basic equipment units and motors plus any associated pipe elbow supports, duct elbow supports, electrical control elements, or other components closely related and requiring resilient support in order to prevent vibration transfer to the building structure. Inertia base thickness shall be at least 1/12 the longest dimension of the inertia base but not less than 6". Inertia bases shall include side mounting brackets for attachment to vibration isolators. Clean all debris from between floor and bottom of inertia pad.

2) The steel frame and reinforcement shall be supplied by the vibration isolator manufacturer. Concrete may be provided by the .1 Contractor.

3) Frame and reinforcement for Unit BIB bases shall be one of the following products or approved equal:

Type CustomA.B.

Type RCPFK.D.

Type KSLM.I.

Type CIB-L or CIB-HP.N.C.

Series WPFV.M.&C.

PART 3 – EXECUTION

3.01 APPLICATION

A. General

1. The Static deflection of all isolators specified herein are the minimum acceptable deflections for the mounts under actual load. Isolators selected on the basis of rated deflection are not acceptable and will be disapproved.

B. Equipment

1. Unless otherwise shown or specified, all floor mounted major equipment shall be set on 4" high concrete housekeeping pads.
2. Types and minimum static deflections of vibration isolation devices for major equipment items shall be as scheduled on the drawings or specified herein.
3. The .2 Contractor shall obtain weight loading distribution from manufacturers of equipment to enable vibration isolation manufacturer to properly size vibration isolation equipment.

3.02 INSTALLATION OF VIBRATION ISOLATION EQUIPMENT

A. General

1. Locations of all vibration isolation equipment shall be selected for ease of inspection and adjustment as well as for proper operation.
2. Installation of vibration isolation equipment shall be in accordance with the manufacturer's instructions.

B. Isolation Mounts

1. All vibration isolators shall be aligned squarely above or below mounting points of the supported equipment.
2. Isolators for equipment with bases shall be located on the sides of the bases which are parallel to the shaft unless this is not possible because of physical constraints.
3. If a housekeeping pad is provided, the isolators shall bear on the housekeeping pad and the isolator base plate shall rest entirely on the pad.

C. Bases

1. No equipment unit shall bear directly on vibration isolators unless its own frame is suitably rigid to span between isolators and such direct support is approved by the equipment manufacturer. This provision shall apply whether or not a base frame is called for on the schedule. In the case that a base frame is required for the unit because of the equipment manufacturer's requirements and is not specifically called for on the equipment schedule, a base frame recommended by the equipment manufacturer shall be provided at no additional expense.
2. Unless otherwise indicated, there is to be a minimum operating clearance of 1-1/2" between inertia bases or steel frame bases and the floor beneath the equipment. Position isolator mounting brackets and adjust isolators so that the required clearance is maintained. The clearance space shall be checked by the .2 Contractor to ensure that no construction debris has been left to short circuit or restrict the proper operation of the vibration isolation system.

D. All electrical wiring to equipment shall contain a loop prior to connection for vibration elimination.

END OF SECTION

SECTION 230553

EQUIPMENT AND PIPING IDENTIFICATION - HVAC

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The equipment and piping identification for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 VALVE TAGS

A. The Contractor shall tag each new valve, controller, and other devices requiring adjustment and affecting the performance of equipment furnished under this Contract. He shall prepare a list giving the number of each valve, its location, and the equipment or portion of the system tagged. The list shall be enclosed in a metal frame with glass and shall be hung where directed. Tags shall be of aluminum or brass, 2" in diameter with numbers as large as possible and attached by short, small link aluminum or brass chains or "S" hooks. Numbers and tags shall be coordinated with those being installed under the Plumbing Contract.

B. Prepare a typewritten list giving the number of each valve, its location, and the equipment or portions of the system controlled. The list shall be enclosed in a metal frame with glass. The list shall be hung at location directed by the Professional.

2.02 EQUIPMENT IDENTIFICATION

A. Where valves, cleanouts, dampers, VVB’s, CVB’s, humidifiers, etc., are located above removable tile ceilings or above access panels the Contractor shall furnish and install identification labels on the corners of the access panels or the support grid of removable ceiling tiles. Labels shall be provided with the word "VALVES," "RELAY," "DAMPER," etc., so that the equipment may be readily located in the future. Additionally, label designations shall correlate with the equipment designations on the drawings.

B. Identification labels shall not exceed 3" in length and 1" in height. Black letters shall be 1/4" high on white background. Labels shall be manufactured of engraved Micarta or Bakelite with pressure-sensitive backing and shall be nonabsorbent, nonporous and colorfast. Adhesive backing shall be chemically compounded to hold tight and fast at wide temperature extremes. Labels shall be as manufactured by Seton Name Plate Company, Brady Co., Kimball Systems, or approved equivalent. Labels shall be additionally secured with screws or rivets. Flexible plastic punched tapes will not be acceptable. Labels shall be coordinated with those being installed under other contracts.

C. All major pieces of HVAC equipment shall include, at a suitable and accessible observation point on the equipment, a manufacturer's stamped brass or aluminum identification plate, with all pertinent capacity data stamped on the plate. Identification plate shall include all specific data, such as model number, serial number, motor data, horsepower, capacities, sizes, amperes, power consumption, speed, flows in GPM, temperatures, working pressures, operating pressures, and similar factors as applicable. In addition, pumps shall include total head in feet and impeller sizes.

D. The Contractor shall be responsible for furnishing and attaching an identification plate for the above mentioned major equipment if not provided by the equipment manufacturer.

E. Equipment marking tags shall be engraved phenolic, 1/16" thick, four edges binded, black with white lettering. The tag shall be securely mounted to the equipment with minimum of two (2) - 3/8" long No. 3 screws. Tags shall provide such information as: "Exhaust Fan - EF1", "Air Handling Unit - AHU 1" and include "date of installation and project number".

F. All piping shall be labeled with appropriate service designation as indicated in the table below, as well as with flow arrows at every 20 ft intervals and at every change of direction:

1. Pipe Designations Table.

SERVICE	DESIGNATIONS
Domestic Cold Water	CW
Domestic Hot Water	HW
Gas	GAS
Sanitary Drain	SAN
Storm Drain	STORM
Hot Water Supply	HWS
Hot Water Return	HWR
Chilled Water Supply	CWS
Chilled Water Return	CWR
Sprinkler	SPRK
Standpipe	STANDPIPE

G. The installations will not be considered acceptable unless identification plates and nameplates are attached.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install per manufacturers recommendations.

END OF SECTION

SECTION 230593

TESTING ADJUSTING AND BALANCING OF SYSTEMS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The Scope of the Work includes the performance of testing, adjusting, and balancing of the HVAC systems, following the procedures defined herein and the preparation and submission of balancing reports.

B. Circulating water piping systems, air distribution systems, and other heating, ventilating, and air conditioning equipment and systems installed under this Contract shall be balanced under this Contract.

1.04 DEFINITIONS

A. TAB – Testing, Adjusting and Balancing

B. ATC – Automatic Temperature Controls

1.05 SUBMITTALS

A. Experience and qualifications of the proposed TAB Contractor shall be submitted for review by the Professional.

1. The TAB Contractor shall be independent of the .2 HVAC Contractor and shall have at least 5 years' experience providing TAB services.

2. The TAB Contractor shall provide qualifications for balancing variable air volume systems, including a list of previous projects.

B. Prior to the start of the Work, the TAB Contractor shall submit to the Professional a list of the balancing equipment and instruments he intends to use. The equipment must be first approved before being used on the project.

C. The .2 HVAC Contractor shall submit three (3) hard copies, or a PDF file, for each of the following:

1. Circulating water systems balancing report.

2. Air systems and related equipment balancing report.

3. ATC system.

D. A written report shall be prepared and submitted to the Professional after each site visit when adjustments to the HVAC system are required during the first heating and cooling seasons that it is in operation.

1.06 GENERAL REQUIREMENTS

A. The TAB Contractor shall be a sub-contractor to the .2 HVAC Contractor and shall perform this work under the direction of the .2 HVAC Contractor.

B. The TAB Contractor shall be responsible for the testing, adjusting, and balancing work.

C. The TAB Contractor shall be a member of the Associated Air Balance Council, or the National Environmental Balance Bureau. Balance reports shall be submitted on AABC or NEBB forms.

D. Testing shall be as specified herein and in accordance with the aforementioned codes and best trade practices.

E. The TAB Contractor shall furnish the labor, and supervision and shall furnish the instruments and provide the instrumentation required to perform the balancing work.

F. Balancing of heating systems shall be performed when outside temperature is averaging less than 30 degrees F. and on cooling systems when outside temperature is above 80 degrees F.

G. The .2 HVAC Contractor shall enlist the cooperation of equipment manufacturers where needed to obtain proper equipment performance.

H. The TAB Contractor shall furnish services for two (2) complete adjustments of the HVAC systems and controls, for the first cooling season and the first heating season. (A written report must be made to the Professional after each visit.)

1.07 COORDINATION WITH ATC CONTRACTOR

A. The .2 ATC Contractor will provide software to be loaded on the TAB Contractor's computer for use in balancing the VAV system.

B. The TAB Contractor shall be responsible for delivering his computer to the .2 ATC Contractor's office to have the software loaded and at the same time receive training on proper use of the software package.

C. During the project, the .2 ATC Contractor will provide additional telephone support to the TAB Contractor on proper use of the software package.

D. At the end of the project, the TAB Contractor shall be responsible for delivering his computer back to the .2 ATC Contractor's office to have the balancing software deleted.

E. In addition to any balancing and/or start-up assistance specified elsewhere in this section of the specifications, the .2 ATC Contractor will include in his bid thirty (30) days of on-site technician time to aid the TAB Contractor in using the DDC system to configure required modes of operation for testing purposes. This time shall be consumed in full day increments, not necessarily concurrent, and must be scheduled with the .2 ATC Contractor a minimum of one (1) week in advance of the actual need date.

F. Should the TAB Contractor require additional assistance, he shall be responsible for compensating the .2 ATC Contractor on a time-and-material basis.

1.08 DEMONSTRATION

A. At the completion of the work and before final acceptance, the TAB Contractor shall place the piping, ductwork and equipment in proper operation, adjust the equipment, valves and control systems and make the necessary corrections.

B. The TAB Contractor shall make final adjustments to the equipment and controls as may be required for proper operation, maintaining correct temperature in every part of the facility which may be impacted by the .2 HVAC Contract.

C. With approved supervisory employees, the .2 HVAC Contractor, with the assistance of the TAB Contractor, shall demonstrate to representatives of the Professional and the Professional that the systems and equipment perform in accordance with their specific use as a part of the overall system and in accordance with the Contract requirements as evaluated and interpreted by the Professional or his representatives.

D. During the tests, it shall be demonstrated that the systems will operate correctly.

E. Controls will be adjusted by the control system manufacturer's mechanics and authorized representatives on the advice of the TAB Contractor.

F. Leaks, faulty equipment, and poor workmanship shall be repaired or replaced by the .2 HVAC Contractor. The related additional costs of rebalancing shall be borne by the .2 HVAC Contractor.

G. The TAB Contractor shall study and report on noise and vibration problems, which may develop in the course of system balancing.

H. The .2 HVAC Contractor, with the assistance of the TAB Contractor, shall perform the necessary corrective work required to demonstrate and prove the systems and equipment function in an approved manner.

I. The demonstrations shall continue until the systems operate satisfactorily as determined by the Professional and his representative.

PART 2 – PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 BALANCING OF AIR SYSTEMS

A. Supervise and perform the balancing of the air conditioning and ventilating systems to achieve the air quantities specified at each air inlet, outlet and damper shown on the Contract Drawings at the proper conditions of static pressure and temperature differential.

B. The supply air, return air, and exhaust systems, under the .2 HVAC Contract, shall be accurately balanced by means of a velometer to the CFM noted on the Drawings and the dampers and registers securely locked into position.

C. The duct system accessories shall be adjusted and set for the proper airflow quantities and conditions, and the TAB Contractor shall adjust and set fans, VFD's, sheaves, dampers and adjustment mechanisms, including mechanical air valves.

D. Diffusers, registers, and grilles shall be set for proper air distribution and for comfortable conditions.

E. The TAB Contractor shall follow the variable volume box or diffuser manufacturer's recommendations for balancing the variable volume air systems.

F. Manual dampers, on the main supply air, return air, and exhaust duct risers at the shafts, shall each be tagged with the quantity of airflow and the static pressure set point of the damper. Tags shall be brass or aluminum and shall securely attached to the damper handle. The set point position on the damper shall be permanently marked.

G. The entire air balance shall be completed before the water balance is started.

3.02 BALANCING OF CIRCULATING WATER SYSTEMS

A. Supervise and perform the balancing of the circulating water systems and parts thereof installed under the Heating Contract to obtain the water flow rates and temperature drops in accordance with the system design concept and functional intent as determined by the Professional.

B. After adjustment and balancing of each water heating coil and chilled water coil, the TAB Contractor shall securely attach a brass or aluminum tag to the element return piping, within the enclosure, designating the GPM and pressure drop through the coil.

3.03 TAB INSTRUMENTS

A. The TAB Contractor shall furnish the instruments and provide the instrumentation required to perform the above work.

B. The following is a list of the minimum instruments required:

1. Combination inclined-vertical manometer.
2. Differential pressure gauges.
3. Pitot tubes.
4. Hook gauges.
5. Magnehelic gauges.
6. Multi-point pyrometers.
7. Thermal anemometers.
8. Inclined manometers.
9. Insertion thermometers.

10. U-tube manometers.
11. Contact pyrometers.
12. Stethoscopes.
13. Velometer with probes.
14. Water pressure gauges.
15. Rotating vane anemometers.
16. Smoke bombs.
17. Clamp-on volt-ammeters.
18. Tachometers and tips.
19. Sling psychrometers.
20. Air pressure gauges.
21. Taps, tubing, valves, cocks, rubber tubing and like miscellaneous items.

3.04 GENERAL REQUIREMENTS FOR BALANCING REPORTS

A. These reports shall certify test methods and instruments used, the readings obtained, temperature and pressure drops, RPM of equipment, amperage of the motors, and balancing problems encountered and suggestions.

B. Reports shall be submitted to the Professional and shall include data on the tests in the form normally used by AABC or NEBB; but varied as required to suit these specifications.

3.05 AIR SYSTEM BALANCE REPORT

A. The air system balance report, prepared by the TAB Contractor, shall include the CFM at outlet or inlet of each grille, diffuser, and register.

B. Report shall include fan curves for the final speeds developed from the fan manufacturer's performance test data for the major fans.

C. With the air systems set to handle the normal outdoor air quantity, the TAB Contractor shall perform the following tests, compile information, and submit written reports to the Professional on the following:

1. Air Handling Equipment
    a. Design Conditions
        1) CFM Supply Air, and Exhaust Air (Each System)
        2) Static Pressure
        3) Motor HP
        4) Fan RPM
        5) Outlet Velocity
    b. Installed Equipment
        1) Fan Manufacturer, Size, Model Number (Supply and Exhaust)
        2) Motor, Frame and Manufacturer
        3) Motor Size/Model Number
        4) Motor HP, Voltage, Phase, Full Load Amperage, RPM
        5) Belt size/Model Number, and number of belts
        6) Sheave size and make
        7) Sheave bore size
        8) Sheave keyway size
    c. Field Test

1) Fan Speed
2) No load operation amperes
3) Fan motor operating amperes
4) Calculated BHP

d. Test for Total Air
1) Size of supply air, and exhaust air ducts
2) Number and locations of velocity readings taken and static pressure readings taken
3) Duct average velocity
4) Supply Air CFM
5) Outside Air CFM
6) Exhaust Air CFM

2. Individual inlets and outlets (Diffusers, Registers and/or Grilles)
a. Identify each outlet or inlet as to location area and fan system.
b. Manufacturer and type
c. Size
d. Free area, core area or neck area
e. Required FPM and test velocity found for each
f. Required CFM and test results for each

D. Testing and adjusting of individual outlets shall be performed under procedures recommended by the manufacturers of the outlets.

E. Outlets shall be set for air pattern required and air dampers shall be adjusted and set for design CFM indicated.

F. Any required changes in air patterns, settings, or any other miscellaneous changes necessary for achieving correct air balance, shall be provided under this Contract.

G. Total CFM of outlets shall agree with total CFM of branches and the grand total shall agree with the air volume for the fans.

3.06 WATER SYSTEM BALANCE REPORT

A. The water system balance report, prepared by the TAB Contractor, shall indicate the GPM and the pressure drop through each coil of each unit after balancing is completed.

B. The TAB Contractor shall perform the following tests, compile information and submit written reports to the Professional on the following:
1. Pumps
a. Design Data
1) GPM, Head
2) RPM, BHP

b. Installed Equipment
1) Manufacturer, Size
2) Type Drive
3) Motor HP, Volts, Cycles and Phase
4) Full Load Amperes

c. Field Test
1) Discharge Pressures: Full flow and no flow

2) Suction Pressures: Full flow and no flow
3) Operating Head and GPM
4) No load amperes (where possible)
5) Full flow amperes, no flow amperes
6) Calculated BHP

2. Heat transfer equipment.
   a. Design Data
      1) MBH specified, GPM specified.
      2) Entering Water Temperature (E.W.T.)
      3) Entering Air Temperature (E.A.T.)
      4) Water Temperature Drop (W.T.D.)
      5) Element Type Specified.
   b. Field Test
      1) Identify each element as to location.
      2) Required water temperature drop.
      3) Actual entering air temperature and water (GPM) through the coil.
      4) Adjust element until required temperature drop is obtained.

END OF SECTION

SECTION 230700
HVAC INSULATION

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The insulation for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 GENERAL

A. Fiberglass insulation shall be as manufactured by Owens Corning, CertainTeed, Johns-Manville, Knauf, or approved equal.

B. Manufacturer’s names are indicated herein to denote a standard of quality and type only. Products of other manufacturers not mentioned herein will be acceptable providing they meet the requirements of these Specifications in quality and type and are submitted according to Section 230506, Paragraph 1.4.

C. The materials, finish and adhesive herein specified, shall be listed and inspected by Underwriters Laboratories Incorporated. Covering, vapor barriers, and adhesives used in this application shall have a flame spread classification of not more than 25 and a smoke developed rating of not more than 50, based on tests in accordance with ASTM Standard E84, "Methods of Tests for Surface Burning Characteristics of Building Materials," except as hereinafter specified. Each product shall bear the label Underwriters Laboratories. Products used on this project shall be classified as "non-combustible" by NFPA.

2.02 HOT PIPING SYSTEM INSULATION

A. Hot piping systems shall include the following:

1. Hot Water Supply and Return (HWS & R)
2. Glycol Hot Water Supply and Return (GHWS & R)
3. Drain piping
4. Relief valve piping
5. Vent piping

B. Hot piping system insulation, except where specified otherwise, shall be glass fiber pipe insulation with white Type ASJ jacket, Owens Corning FIBERGLAS™ pipe insulation or approved equal. End and transverse joints shall be wrapped with factory-furnished sealing strips of same material as jackets. Horizontal laps and end joints shall be sealed down with Foster® 85-20™ Spark-Fas® Adhesive, non-flammable, vapor barrier adhesive.

C. Exterior hot piping Insulation shall be the same as specified for hot piping systems. Thickness shall comply with the table in Paragraph 2.4, but shall be no less than 2 inches. Insulation shall be covered with a Type ASJ jacket and a Childers 0.016” smooth aluminum exterior weatherproof jacket neatly banded and sealed in place.

2.03 COLD PIPING SYSTEM INSULATION

A. Cold piping systems shall include the following:

1. Chilled Water Supply and Return (CWS & R)

2. Glycol Chilled Water Supply and Return (GCWS & R)
3. Condenser Water Supply and Return (CDWS & R)
4. Cooling tower overflow and drain piping.
5. Cold Water Make-Up
6. Condensate Drain Lines

B. Cold piping system insulation shall be glass fiber pipe insulation with white Type ASJ vapor barrier jacket, Owens Corning FIBERGLAS™ pipe insulation or approved equal. End and transverse joints shall be wrapped with factory-furnished sealing strips of same material as jackets. All horizontal laps and end joints shall be sealed down with Foster® 85-20™ Spark-Fas® Adhesive, non-flammable, vapor barrier adhesive.

C. Vapor barrier jacket shall have a vapor transmission of approximately 0.02 perms.

D. Exterior cold piping insulation shall be the same as specified for cold piping systems. Thickness shall comply with the table in Paragraph 2.4, but shall be no less than 2 inches. Insulation shall be covered with a Type ASJ vapor barrier jacket and a Childers 0.016" smooth aluminum exterior weatherproof jacket neatly banded and sealed in place.

2.04 INSULATION THICKNESS AND THERMAL CONDUCTIVITY

A. Insulation thickness shall comply with the following table for the pipe service and fluid temperatures indicated:

Minimum Pipe Insulation Thickness, Inches								
Pipe Designation	**Fluid Temperature Range, °F**	**Insulation Conductivity**		**Nominal Pipe or Tube Size, Inches**				
		Conductivity, k, BTU • IN / HR FT² • °F	**Mean Rating Temperature, °F**	**< 1**	**1 to < 1½**	**1½ to < 4**	**4 to < 8**	**≥ 8**
HWS & R GHWS & R Drain, Relief Valve, and Vent Piping	141 – 200	0.25 – 0.29	125	1.5	1.5	2.0	2.0	2.0
	105 – 140	0.21 – 0.28	100	1.0	1.0	1.5	1.5	1.5
CWS & R GCWS & R	40 – 60	0.21 – 0.27	75	1.0	1.0	1.0	1.0	1.0
CDWS & R	40 – 60	0.21 – 0.27	75	1.0	1.0	1.0	1.0	1.0
Condensate Drain Lines	40 – 60	0.21 – 0.27	75	1.0	1.0	1.0	1.0	1.0

For piping smaller than 1½ inch and located in partitions within conditioned spaces, reduction of these thicknesses by 1 inch shall be permitted, but not to a thickness less than 1 inch.

Thermal conductivity (k) of fiberglass insulation shall not exceed the following:

1. At 75°F mean temperature: k = 0.27 BTU • IN / HR FT^2 • °F.
2. At 250°F mean temperature: k = 0.32 BTU • IN / HR FT^2 • °F.

2.05 HOT PIPING SYSTEM EQUIPMENT INSULATION

A. The following shall be insulated with 2” thick tank insulation and jacketing as specified for hot piping systems.
   1. Air Separators
   2. Expansion Tanks
   3. Brazed Plate Heat Exchangers
   4. Plate and Frame Heat Exchangers

B. Tank insulation shall be FIBERGLAS™ Pipe and Tank Insulation as manufactured by Owens Corning or approved equal.

C. Tank insulation shall be cut and mitered as necessary to fit the shape of the tank and shall be banded in place in strict accordance with the manufacturer's requirements. Joints shall be pointed with insulating cement.

D. Joints shall be pointed with insulating cement. Insulation for the equipment shall be covered with an all service jacket (ASJ) with seams overlapped and sealed with Foster® 85-20™ Spark-Fas® Adhesive, non-flammable, vapor barrier adhesive and vapor barrier tape.

2.06 HOT PIPING SYSTEM FITTINGS

A. Fittings on Interior Hot Piping Systems shall be insulated with fiberglass, factory-fabricated pipe fitting insulators the full thickness of pipe insulation. Insulation fittings shall be held in place with glass gauze wired on or stapled. Gauze shall be covered with a fire-resistant white coating applied in two equal coats in the amount of four gallons per each 100 sq. ft. by brush or spray to entire fitting surface similar to Foster® 30-35™ Tite-Fit™. Coating shall be covered with a flameproof canvas sealed in place. Canvas shall be wrapped on and sealed with Benjamin Foster flame resistant sealer. Cloth shall be applied after coating has dried.

B. Flanged and Union Connections and Valves on Hot Piping Systems shall not be insulated; however, insulation shall be neatly tapered at flanges, unions and valves with insulating cement, and held in place by flameproof canvas wrapped on and pasted, as specified for fittings. Flanges and union connections and valves on cold water piping shall be insulated similar to that herein specified for chilled water lines except thickness shall be equal to the adjacent pipe insulation.

2.07 COLD PIPING SYSTEM EQUIPMENT INSULATION

A. The following shall be insulated with 1.5” thick tank insulation and vapor barrier jacketing as specified for chilled water piping:
   1. Air Separators
   2. Expansion Tanks
   3. Reservoir Tank
   4. Plate and Frame Heat Exchangers
   5. Brazed Plate Heat Exchangers

B. Tank insulation shall be FIBERGLAS™ Pipe and Tank Insulation as manufactured by Owens Corning or approved equal.

C. Tank insulation shall be cut and mitered as necessary to fit the shape of the tank and shall be banded in place in strict accordance with the manufacturer's requirements. Joints shall be pointed with insulating cement.

D. Joints shall be pointed with insulating cement. Insulation for the equipment shall be covered with an all service jacket (ASJ) with all seams overlapped and sealed with Foster® 85-20™ Spark-Fas® Adhesive, non-flammable, vapor barrier adhesive and vapor barrier tape.

E. Vapor barrier jacket shall have a vapor transmission of approximately 0.02 perms.

F. Air conditioning unit drip pans, chilled water pump heads, unit casings, cooling coil frames, and other surfaces subject to sweating, if not factory insulated, shall be thoroughly insulated with 1" thick fiberglass insulation with vapor barrier and cover to prevent condensate from forming. Temperature control valves installed in conjunction with the chilled water system shall be insulated to prevent condensation.

G. Valves and accessories above ceilings and other locations shall be insulated as required to prevent condensation.

2.08 COLD PIPING SYSTEM FITTINGS

A. Fittings, Flanges and Valves on Cold Piping Systems shall be insulated with Insul-Coustic Insul-Sure or approved equal pre-molded fiberglass fittings. Pre-molded fittings shall be held in place with glass reinforcing cloth and insulating cement. Cloth shall be covered with a fire-resistant white vapor barrier coating applied in two equal coats in the amount of four gallons per each 100 square feet by brush or spray to the entire surface. Vapor barrier coating shall be Foster® 30-35™ Tite-Fit™ Coating, or approved equal. Coating shall be covered with 8 oz. flameproof canvas jacket sealed in place. It is the intent of these specifications that piping and equipment in contact with the chilled water be insulated for such use. This includes pump casings, valves and any other item where condensation is expected.

2.09 COMMON INSULATION REQUIREMENTS FOR PIPING SYSTEMS

A. Seams, overlaps and end joints shall be thoroughly sealed down with Foster® 85-20™ Spark-Fas® Adhesive or Foster® 85-75 Drion® Contact Cement vapor barrier adhesive as required. Ends of pipe insulation shall be sealed off at valves, fittings, flanges and every 20'-0" on straight runs with Foster® 30-35™ Tite-Fit™ Coating. The entire installation shall be sealed and free of condensation.

B. Insulation shall be applied with Bostitch outward clinched staples, one every 3" and four at each butt strap.

C. In lieu of pre-molded insulation fittings, the Contractor will be permitted to insulate pipe fittings with mitered and segmented fiberglass pipe insulation with elbows and changes of direction mitered, segmented and rounded to a thickness equal to the adjacent insulation, and thoroughly sealed and wrapped. Square cornered mitered joints will not be permitted. Field applied mitered and rounded insulation shall be held in place with reinforced glass cloth and vapor barrier insulating cement applied as specified above for pre-molded fittings. Coating shall be covered with 8 oz. flameproof canvas jacket sealed in place.

D. Insulation shall be applied over clean dry surfaces with the pipe at approximately room temperature. The installations shall be sealed and shall be free of condensation.

E. Fittings including tees, 90 degree fittings, 45 degree fittings, etc., shall be covered in strict accordance with the recommendations of the manufacturer of the pre-molded insulators. Joints and overlaps at fittings shall be buttered with fire resistant vapor barrier sealer.

F. In lieu of the pre-molded fittings previously specified herein, pre-molded one-piece PVC insulated fitting covers, with factory-precut and marked fiberglass All-Temp insulation, Zeston® 2000 PVC, as manufactured by Johns Manville, will be acceptable. Insulation shall fully cover the fitting and the covers shall be stapled and taped in place. Tapes shall be off-white and shall be of the pressure sensitive type furnished by the fitting manufacturer. Bands are not permitted. Ends shall be overlapped. Fittings on cold piping systems shall have all edges sealed with Zeston® Fire-resistant vapor barrier adhesive.The circumferential edges shall be wrapped with Zeston® fire-resistant vapor barrier sensitive Z-tape. The tape shall extend over the adjacent pipe insulation and have an overlap on itself at least 2" on the downward side. Cold pipe system fittings shall have at least two layers of factory-precut All-Temp insulation inserts. Installations shall be sealed and free of condensation. Fittings shall be installed in strict accordance with the fitting manufacturer's recommendations and details. Twine shall be used for securing insulation at chilled water and cold water installations.

G. Where certain thicknesses of pre-molded fitting insulators are not available from the manufacturer, the fitting insulation shall be one size smaller than the pipe insulation and shall be built up to the correct thickness with vapor barrier cement. Where necessary, fitting shall be mitered and segmented to a thickness equal to the adjacent insulation and shall be sealed and wrapped. Pre-molded fittings shall be installed to the satisfaction of the Professional, and shall be removed and replaced at the direction of the Professional where the installation is not completed in a neat and workmanlike manner. Pre-molded fittings shall have surfaces level, smooth and uniform without bulges, changes in thickness or uniformity.

H. Pipe covering shall not be installed on flanged or screwed fittings until connections have been tested and are free of leaks.

I. Insulation on piping shall extend full size through oversized floor, ceiling or wall sleeves. Piping shall be fully insulated except where specifically mentioned otherwise.

J. Glass cloth, fireproof canvas, vapor barrier sealer and adhesive shall be of types which can suitably be painted.

K. In lieu of sealing all-service jackets with a field applied vapor barrier adhesive, the Contractor may use factory applied pressure sensitive laps provided the pressure sensitive laps are guaranteed to remain sealed for the life of the insulation. Guarantee letters must be submitted in triplicate from the insulation manufacturer and the .2 Heating Contractor. In lieu of the lifetime guarantee, the Contractor may use factory applied sensitive laps and additionally staple overlaps as hereinbefore specified.

L. Branch piping in confined equipment spaces where approved by the Professional, may be insulated with 3/4" thickness Armaflex FR fire resistant flexible tubing insulation if desired. Ends and joints shall be thoroughly sealed. Armaflex FR flexible tubing insulation shall not be installed in any other locations.

2.10 PIPE HANGERS AND STRUCTURAL MEMBERS

A. Pipe Hangers supporting cold piping systems shall be insulated separately in the same manner as fittings. The insulation shall be applied upward along the vertical hanger rod to a point not less than 6" above the pipe and sealed off in a neat and symmetrical manner. ½" thickness Armaflex FR flexible tubing insulation may be used in lieu of fiberglass at pipe hangers. Riser clamps and other supports directly in contact with chilled water piping shall be thoroughly insulated similar to that specified above.

B. Structural members and metal supports or equipment in direct contact with cold piping systems shall be insulated separately with 1-1/2" thick fiberglass blankets with vapor barrier jacket, securely fastened and covered with 8 oz. flameproof canvas. The insulation shall be applied along the members to a point not less than 6" above the pipe and sealed off in a neat and symmetrical manner. Venturi flow stations shall be insulated similar to the above, except at meter connections. Exposed disconnect valves and shutoff valves shall be wrapped with anti-sweat tape and covered with 8 oz. flameproof canvas.

C. Insulation shall be continuous at hangers and supports on piping. Extend insulation over pipe and hangers and thoroughly seal joint with a permanent pliable vapor barrier sealer such as Foster Elastolar® Sealant 95-44, or approved equal.

2.11 REFRIGERANT PIPING INSULATION

A. Suction and liquid piping less than or equal to 1-1/2", valves and accessories shall be insulated with 1" thickness Type FR Armaflex, or approved equivalent, flexible tubing insulation. Suction and liquid piping greater than 1-1/2" shall have 1.5" thick insulation. Insulation exposed to weather shall be painted with two coats of Armaflex Finish, or approved equivalent, protective coating.

2.12 INTERIOR RECTANGULAR DUCT INSULATION (DUCT LINER)

A. Interior supply low and medium velocity heating and air conditioning supply air ducts shall be lined 1.5" thick insulation with a minimum R-6 value.

B. Ductwork, including return air, located in unheated spaces, like vented attics, shall be lined with 2” thick insulation with a minimum R-8.

C. Duct lining shall be not less than 1-1/2 lb. density glass fiber with neoprene fire-resistant coating or mat facing. Coatings shall meet the requirements of NFPA No. 90A. Insulation shall have a noise reduction coefficient of not less than 0.70. Duct lining shall be moisture-proof, fire-resistant, vermin-proof and shall have a low coefficient of friction.

D. Insulation shall be installed in duct runs complete to air outlets.

E. Transfer air ducts shall be lined similar to the above, except insulation thickness shall be 1/2". Exhaust ducts and relief air shall not be lined.

F. Duct liner may be "formed" for all ducts with largest dimensions not exceeding 12". Ducts shall be lined by carefully adhering the insulation liner in a continuous piece to clean flat metal sheets with a quick-tacking, rubber based adhesive, spread over the entire duct surface and forming the liner with the metal through the brake.

G. Liner shall be additionally attached to the interior of the ducts by means of weld pins installed through the insulation into the ductwork and spaced not over 18" on centers, but not less than two rows per side. Weld pins shall not be used on aluminum ductwork.

H. Gripnails are acceptable for attaching duct liner to ductwork.

I. The coated side of the duct liner shall face the air stream. Exposed edges of insulation shall be covered with adhesive and tape. Liner installation shall also conform to SMACNA Standards.

J. Duct liner shall be individually "cut" for ducts with largest dimensions exceeding 12". Ducts shall be lined by cutting pieces to fit snugly to the interior of the duct surfaces. The liner shall be fastened to the duct with a heavy coat of quick-tacking, rubber-based adhesive spread over the entire duct surface. The top and bottom pieces shall lap the side pieces, and exposed edges of the insulation at the duct ends shall be covered with adhesive and tape. Individually "cut" insulation shall be additionally attached to the duct with weld pins or Gripnails, as herein specified.

K. Where ductwork is to be lined with insulation, duct dimensions indicated on the Drawings are inside the insulation. Shape and location of ducts may be changed to suit building conditions, but equivalent area must be maintained.

L. Return air and exhaust ductwork shall not be insulated except where specified herein.

M. Duct liner shall be as manufactured by Owens-Corning, Knauf, Certainteed Corp., Manville Products, or approved equal.

N. In lieu of installing duct liner in round spiral duct that is concealed above ceilings, the Contractor may externally wrap with 2” thick and 1-1/2 lb. density glass fiber insulation with a vapor barrier as manufactured by Knauf, Owens, Corning, John Manville or approved equal (R-6 minimum installed value). Vapor barrier shall be taped and sealed as required to prevent condensation

O. All ductwork in exposed areas scheduled to be painted (Dining 205) to be internally lined with a duct exterior suitable for painting. Duct wrap is NOT acceptable in these areas that are to be painted unless wrap is approved to accept paint per manufacturer data. Any painted duct/insulation that does not remain painted shall be re-prepped and re-painted at no additional cost to the project.

2.13 INTERIOR DUCT INSULATION (DUCT WRAP)

A. Supply air and outdoor air ductwork (low and medium velocity) shall be externally wrapped with 2” thick and 1-1/2 lb. density glass fiber insulation with a minimum R-6 value with vapor barrier.

B. Ductwork, including return air, located in unheated spaces, like vented attics, shall be wrapped with 3” thick insulation with a minimum R-8 value with vapor barrier.

C. Vapor barrier shall be taped and sealed as required to prevent condensation.

D. Duct wrap shall be cut to manufacturer's "stretch out" dimensions and a 2" piece of duct wrap removed from the facing at the end of the piece of duct wrap to form an overlapping staple and tape flap.

E. Seams shall be stapled 6" on center with outward clinching staples.

F. Where rectangular ducts are 24" in width or greater, duct wrap shall be additionally secured to the bottom of the duct with mechanical fasteners such as pins and speed clip washers, spaced on 18" centers to prevent sagging of insulation.

G. Return air and exhaust ductwork shall not be insulated, except where specified herein.

H. Duct wrap shall be as manufactured by Knauf or approved equal.

2.14 KITCHEN HOOD EXHAUST DUCTWORK INSULATION

A. Acceptable Manufacturers:

1. 3M Fire Barrier Duct Wrap 615+
2. Unifrax FyreWrap Elite 1.5
3. Morgan Thermal Ceramics FireMaster FastWrap XL
4. Or equal as approved by the Professional

B. Where indicated on the drawings, insulate concealed kitchen hood exhaust ductwork with 1-1/2" thick, 6 PCF, grease duct wrap. Wrap shall be two-layer, totally foil-encapsulated, non-combustible 2000 degree F rated, low bio-persistence, flexible fireproofing wrap specifically tested to provide a 2 hour fire rated enclosure for horizontal and vertical commercial kitchen grease and air ventilation ducts. The core blanket chemistry shall be alkaline-earth silicate wool free of binders and lubricants. Wrap shall require zero clearance to combustibles protection.

C. When the duct penetrates fire rated wall or floors, silicone firestop sealant used in combination with the wrap to provide protection.

D. Wrap shall be resistant to mold growth is test conditions of 75-95% relative humidity.

E. Wrap shall have flame spread rating of 0 and smoke development rating of 0. Thermal resistance shall be 4.15 per inch at 70 degrees F.

F. Store in a dry area on pallets. Surfaces of openings and penetrating items need to be clean, airy, frost free and dust free.

G. Cut edges of the wrap shall be taped with aluminum foil tape to prevent exposed edges of the insulation from wicking moisture from condensation or grease from a compromised leaking duct joint into the material. Wrap may be installed with either a mechanical banding system or installation pins and clips

H. Entire wrap installation shall be in accordance with manufacturer's instructions.

PART 3 – EXECUTION

3.01 GENERAL INSTALLATION

A. Insulation shall be installed by an Insulation Subcontractor responsible to the .2 Heating Contractor. Insulation shall be installed in a neat and workmanlike manner by workmen skilled in the installation and handling of commercial and industrial insulation for piping, ductwork, and equipment.

B. Insulation shall be installed as recommended by the insulation manufacturer.

3.02 PIPING SYSTEMS

A. Insulation shall be applied on clean, dry surfaces after pressure testing and approval. Insulation shall be continuous, including through wall and ceiling openings and sleeves. Insulation on piping systems operating at 60 degrees or less shall be maintained with a continuous unbroken vapor seal. Hangers, supports, anchors, guides and equipment shall be insulated and vapor sealed to prevent condensation.

B. Covered pipe shall be located a sufficient distance from walls, other pipes, ductwork, and other obstacles to permit the application of the full thickness of insulation specified; and if necessary, extra fittings and pipes shall be used.

C. Fiberglass insulation shall be installed with Bostitch outward clinched staples, one (1) every 3" and four (4) at each butt strap.

D. Insulation shall not be applied to any piping or equipment until pressure tests have been performed and approved by the Professional. Surfaces shall be clean and dry when insulation is installed.

E. Piping located in walls, in pipe chases, in crawl spaces, or above ceilings shall be considered as concealed. Other locations shall be considered as exposed unless otherwise specified herein.

F. Insulated piping (including piping with vapor barrier jacket) shall be wrapped with factory applied ASJ all-service jackets securely sealed in place with Benjamin Foster fire-resistant sealer. All-service jackets shall be heavy density, white, suitable for operating temperatures from –60 degrees F. to +450 degrees F., with vinyl coated and embossed vapor barrier laminate. All-service jackets shall be the Owens-Corning Fiberglass ASJ-25, or approved equal. All-service jackets shall have a vapor transmission rating of approximately .02 perms.

G. Piping furnished and installed under this Contract shall be insulated unless specifically indicated otherwise.

H. Exposed hot and chilled water piping in the boiler and chiller rooms shall be provided with PVC covers for a neat and professional appearance.

I. Pipe insulation inside the custom-built roof top units (RTU's) shall be field installed by this contractor.

END OF SECTION

SECTION 23 08 00 – HVAC SYSTEM COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

B. General: This Section specifies HVAC System commissioning requirements, administration, and procedures. See Specification Section 019100 General Commissioning Requirements for general commissioning requirements, administration, and procedures.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this section.

B. Specification 01 91 00 GENERAL COMMISSIONING REQUIREMENTS

C. All applicable Technical Specification sections.

1.3 REFERENCES

A. See Specification Section 019100 General Commissioning Requirements for a summary of the references.

1.4 HVAC SYSTEM COMMISSIONING DESCRIPTION

A. Commissioning: HVAC System Commissioning is a systematic process of ensuring that the HVAC system has been installed in the prescribed manner to perform with the design intent and that verification of proper installation is documented. The Commissioning Agent shall provide the Department with an unbiased, objective view of the HVAC system's installation and performance. This process does not eliminate nor reduce the responsibility of the Design Professional to provide a complete design or Prime Contractors to provide a finished product. Commissioning is intended to enhance the quality of HVAC system installation.

B. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
   1. Verify HVAC system is installed according to the manufacturer's recommendations and to industry accepted minimum codes and standards.
   2. Verify the installation and operation of all system components, including but not limited to equipment, controls, supports, piping and ductwork, and other transmission components.

C. The Commissioning process shall be a team effort and shall encompass and coordinate the traditionally separate functions of HVAC system installation, testing, verification, and performance checkouts.

D. The Commissioning Agent will work closely with the construction team, cooperating and coordinating all commissioning activities with the Prime Contractor, Department's representative, sub-contractors, manufacturers, and equipment suppliers.

E. The commissioning process shall not reduce the responsibility of the Prime Contractor to comply with the Contract Documents.

1.5 HVAC SYSTEMS TO BE COMMISSIONED

A. The following HVAC systems shall be commissioned. All parties associated with the design, installation and/or testing of these systems shall comply with commissioning requirements specified in this section, the individual Division commissioning sections and in the Commissioning Plan.

B. The systems that shall be commissioned in this project include but are not limited to the following:
   1. Air Handling Units
   2. Heat Pump Units.
   3. Water Chilled Water Systems (including chillers, pumps, and cooling towers)
   4. Water Heating Systems (including boilers and pumps)
   5. Air Terminal Units.
   6. Heat Recovery Systems
   7. Exhaust Fans
   8. Duct Heaters
   9. Finned Tube Radiation Units
   10. Building Automation Systems

1.6 HVAC SYSTEM COMMISSIONING AND CLOSEOUT SUBMITTALS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the general submittals and processes for reviews.

B. Contractor shall make additional submittals requested by Commissioning Agent for each piece of equipment or system indicated to be commissioned. Incorporate requested submittal information into related operation and maintenance manuals.

1.7 HVAC SYSTEM COMMISSIONING DOCUMENTATION AND REPORTS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the submittals, reports, and processes.

B. HVAC System Commissioning Plan: A component of the overall Commissioning Plan document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the HVAC system commissioning process, and shall include, but is not limited to the following:
   1. All general requirements and documentation as noted in Specification Section 019100 General Commissioning Requirements.
   2. Description of expected performance for HVAC systems and subsystems.
   3. Identification of installed HVAC systems and subsystems including design changes that occurred during the construction phase.

4. Step-by-step procedures for testing HVAC systems with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.
5. Witness and verification of all HVAC quality assurance tests completed by the Contractor as specified in the contract documents.

1.8 SEQUENCING

A. See Specification Section 019100 General Commissioning Requirements for a summary of the sequencing requirements.

1.9 SCHEDULING

A. See Specification Section 019100 General Commissioning Requirements for a summary of the scheduling requirements.

B. Commissioning of systems shall proceed per the criteria established with activities to be performed on a timely basis. The Commissioning Agent shall be available to respond promptly to avoid construction delays.

C. Prepare schedule indicating anticipated start dates for all major work activities and all verification activities identified in the Commissioning Plan.

D. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.

E. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy use.

1.10 OTHER REQUIREMENTS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the commissioning team responsibilities.

B. Commissioning requires support from the Prime Contractor and subcontractors. The commissioning process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner.

1.11 QUALITY ASSURANCE

A. BAS Testing Technician Qualifications: Technicians to perform BAS construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
1. Journey-level or equivalent skill level with knowledge of BAS, HVAC, electrical concepts, and building operations.
2. Minimum five years' experience installing, commissioning and operating BAS

B. HVAC Testing Technician Qualifications: Technicians to perform HVAC construction checklist verification tests, construction checklist verification test demonstrations, commissioning tests, and commissioning test demonstrations shall have the following minimum qualifications:
   1. Journey-level or equivalent skill level. Vocational School four-year program graduate or an Associate's degree in mechanical systems, air conditioning, or similar field. Degree may be offset by three years' experience in servicing mechanical systems in the HVAC industry. Generally, required knowledge includes HVAC systems, electrical concepts, building operations, and application and use of tools and instrumentation to measure performance of HVAC equipment, assemblies, and systems.
   2. Minimum five years' experience installing, commissioning and operating HVAC systems.

1.12 COMMISSIONING RESPONSIBILITIES

A. See Specification Section 019100 General Commissioning Requirements for a summary of the commissioning requirements of all parties involved.

B. Equipment or System Installer Commissioning Responsibilities:
   1. Ensure temperature controls installer performs assigned commissioning responsibilities as specified below.
   2. Ensure testing, adjusting, and balancing agency performs assigned commissioning responsibilities as specified.
   3. Ensure subcontractors perform assigned commissioning responsibilities.
   4. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.
   5. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
   6. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
   7. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
   8. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
   9. Provide factory supervised startup services for equipment and systems. Coordinate work with manufacturer and Commissioning Agent.
   10. Perform verification checks and startup on equipment and systems as specified.
   11. Assist Commissioning Agent in performing functional performance tests on equipment and systems as specified.
   12. Perform operation and maintenance training sessions scheduled by Commissioning Agent.
   13. Conduct HVAC system orientation and inspection.

C. BAS / Temperature Controls Installer Commissioning Responsibilities:
   1. Attend commissioning meetings.
   2. Review design for ability of systems to be controlled including the following:
      a. Confirm proper hardware requirements exists to perform functional performance testing.
      b. Confirm proper safeties and interlocks are included in design.

c. Confirm proper sizing of system control valves and actuators and control valve operation will result with the capacity control identified in Contract Documents.
d. Confirm proper sizing of system control dampers and actuators and damper operation will result in proper damper positioning.
e. Confirm sensors selected are within device ranges.
f. Review sequences of operation and obtain clarification from Architect/Engineer.
g. Indicate delineation of control between packaged controls and building automation system, listing BAS monitor points and BAS adjustable control points.
h. Provide written sequences of operation for packaged controlled equipment. Equipment manufacturers' stock sequences may be included, when accompanied by additional narrative to reflect Project conditions.

3. Inspect, check, and confirm proper operation and performance of control hardware and software provided in other HVAC sections.
4. Submit proposed procedures for performing automatic temperature control system point-to-point checks to Commissioning Agent and Architect/Engineer.
5. Inspect, check, and confirm correct installation and operation of automatic temperature control system input and output device operation through point-to-point checks.
6. Perform training sessions to instruct DGS's personnel in hardware operation, software operation, programming, and application in accordance with commissioning plan.
7. Demonstrate system performance and operation to Commissioning Agent during functional performance tests including each mode of operation.
8. Provide control system technician to assist during Commissioning Agent verification check and functional performance testing.
9. Provide control system technician to assist testing, adjusting, and balancing agency during performance of testing, adjusting, and balancing work.
10. Assist in performing operation and maintenance training sessions scheduled by Commissioning Agent.

D. Testing, Adjusting, and Balancing Agency Commissioning Responsibilities:
1. Attend commissioning meetings.
2. Participate in verification of testing, adjusting, and balancing report for verification or diagnostic purposes. Repeat sample of 20 percent of measurements contained in testing, adjusting, and balancing report as selected by Commissioning Agent.
3. Assist in performing operation and maintenance training sessions scheduled by Commissioning Agent.

1.13 COMMISSIONING MEETINGS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the commissioning meeting requirements.

1.14 COORDINATION

A. Notify Commissioning Agent minimum of three weeks in advance of the following:
1. Scheduled equipment and system startups.
2. Scheduled automatic temperature control system checkout.
3. Scheduled start of testing, adjusting, and balancing work.

B. Coordinate programming of automatic temperature control system with construction and commissioning schedules.

PART 2 PRODUCTS (Not Used)

A. See Specification Section 019100 General Commissioning Requirements for a summary of the Product requirements.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. This Section establishes general requirements pertaining to HVAC system commissioning of building systems, equipment, and appurtenances. These requirements apply to the Prime Contractors, Subcontractors, Material Supply Vendors, Commissioning Agents, and Design Professionals

B. Commissioning is intended to achieve the following specific objectives of the Contract Documents.
   1. Verify and document proper installation and design parameters of equipment, systems, and integrated systems.
   2. Ensure that operating and maintenance and Commissioning documentation requirements are complete.
   3. Provide DGS with functional buildings and systems that meet the Contract Document and DGS's operational requirements at Substantial Completion.

C. The Prime Contractor shall deliver a successful Commissioning process. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents and the specified operational requirements. During Commissioning, the Prime Contractor shall systematically demonstrate to the Commissioning Agent, Design Professional, and DGS that the operable systems are properly performing in strict accordance with the Contract Documents and DGS requirements.
   1. Commissioning requires cooperation and involvement of all parties throughout the construction process.
   2. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion, with the exception of deferred tests approved in advance.
   3. Commissioning will encompass and coordinate traditionally separate functions of system documentation, Inspection, Pre-functional Checklists and start-up, control system calibration and point-to-point checkout, Testing, Adjusting, and Balancing, Functional Performance Tests, Integrated System Tests, Prime and Sub Contractor demonstration to DGS, and Training of DGS's personnel. This requires assembling all related documentation into one Commissioning Manual.

D. Certify that HVAC systems, BAS, sub-systems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents, manufacturer's specifications, DGS standards and specifications, and approved Shop Drawings and submittals.

E. Certify that HVAC instrumentation and control systems have been installed and calibrated, that they are operating according to the Contract Documents, DGS standards and specifications, and approved Shop Drawings and submittals, and that pretest set points have been recorded.

F. Certify that TAB procedures have been completed and that TAB reports have been submitted, discrepancies corrected, and corrective work approved.

G. Set systems, sub-systems, and equipment into operating modes to be tested according to approved test procedures. Modes required to be tested include normal start-up, (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions.).

H. Measure capacities and effectiveness of systems, assemblies, subsystems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

I. Test systems, assemblies, sub-systems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

J. Perform tests using design conditions, whenever possible.
   1. Simulated conditions may, with approval of DGS, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Agent and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
   2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.
   3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

K. If tests cannot be completed because of a deficiency outside the scope of the HVAC system, document the deficiency and report it to DGS. After deficiencies are resolved, reschedule tests.

L. Include seasonal testing. Complete appropriate initial performance tests and documentation and schedule seasonal tests.

M. Coordinate schedule with and perform the commissioning activities at the direction off Commissioning Agent and DGS.

N. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying HVAC systems and equipment and the Commissioning Plan.

O. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
   1. Performance tests.
   2. Demonstration of a sample of performance tests.
   3. Commissioning tests.
   4. Commissioning test demonstrations.

3.2 INSTALLATION

A. Place HVAC systems and equipment into full operation and continue operation during each working day of commissioning.

B. Prior to start of functional performance test, install replacement filters in equipment as specified in individual section.

3.3 COMMISSIONING AGENT MECHANICAL SYSTEM VERIFICATION

A. Witness all or part of the HVAC piping test and flushing procedures, sufficient to be confident that proper procedures were followed. A minimum of 25% of the tests must be witnessed. Document this testing and include the documentation in O&M manuals. Notify DGS's representative of any deficiencies in results or procedures.

B. Witness all or part of any ductwork testing, balancing, leakage testing, and cleaning procedures, sufficient to be confident that proper procedures were followed. Document this testing and include the documentation in O&M manuals. Notify DGS's representative of any deficiencies in results or procedures.

C. Approve systems startup by reviewing start-up reports and by selected site observation.
   1. Witness the first of each system start-up for each unique piece of equipment.
   2. Witness the first of each system start-up for each unique startup crew.
   3. Witness the first of each system start-up for revised startup procedures.

D. Review TAB execution plan.

E. Oversee complete functional testing of the control system and approve it to be used for TAB, before TAB is executed.

F. Approve air and water systems balancing by spot testing, by reviewing completed reports, and by selected site observation. Observe operation of all critical HVAC applications.

G. Review DDC/BMS Trends to confirm proper operation of the HVAC systems across a wide range of set points and sequences.

3.4 FIELD TESTS AND INSPECTIONS

A. Systems Readiness Checklists
   1. The Contractor shall complete Systems Readiness Checklists to verify systems, sub-systems, and equipment installation is complete and systems are ready for Systems Functional Testing.

2. The Commissioning Agent will prepare Systems Readiness Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be uploaded to eBuilder for review.
3. The Commissioning Agent may spot-check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and re-submission. If the Commissioning Agent determines that 10% of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of 50% of checklists for review. If the Commissioning Agent determines that another 10% of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and re-submission.
4. Refer to SECTION 019100 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for System Readiness Checklists, Equipment Startup Reports, and other commissioning documents.

B. Contractors Tests
1. Contractor tests as required by other sections of Division 23 shall be scheduled and documented. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

C. Systems Functional Performance Testing:
1. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions.
2. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by Design Professional. The Contractor shall review and comment on the tests prior to approval.
3. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will direct and document the testing.
4. See Section 019100 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

D. Occupancy Sensitive Functional Performance Tests:
1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.
2. Participate in testing delayed beyond Final Completion to test performance with actual occupancy conditions.

E. Training of Department Personnel
1. Training of DGS operation and maintenance personnel is required in cooperation with the Design Professional and Commissioning Agent.
2. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with DGS after submission and approval of formal training plans.

3. Refer to Section 019100 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.
4. Participate in testing delayed beyond Final Acceptance to test performance at peak seasonal conditions.
5. Participate in initial and alternate peak season test of systems required to demonstrate performance.

END OF SECTION

SECTION 230900

INSTRUMENTATION AND CONTROL FOR HVAC

The BMS system shall be by Automated Logic Controls, Harrisburg, PA. It is the intent of this project to extend the existing DDC controls integrated with the ALC BMS system. All new equipment shall be controlled by DDC on the existing ALC network. The 0.2 Mechanical Contractor shall still be required to coordinate their equipment with Automated Logic Controls. Contact Automated Logic – Harrisburg at 717-909-7000.

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 01 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS, REQUIRED COORDINATION/CLARIFICATIONS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. All work of this Section shall be coordinated and provided by the single 0.2 BMS Sub-Contractor.

C. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other sections/trades. Reference the Division 23 and Division 26 Sections.

D. The work of this Section shall be as required by the Specifications, Drawings, Point Schedules, Sequences of Operation and Mechanical Systems Commissioning activities.

E. The contract documents and the sequences of operation are for conveying general concept only and are not meant to be inclusive of all hardware requirements or all functional sequence requirements. Refer to the complete package of contract drawings. Items mentioned in Sections 230900 and 230993, shown on the contract documents, mentioned in the sequences of operation, or shown on other HVAC drawings shall become part of the work of this project without the necessity of being separately detailed in each of those applicable sections of the contract documents. Reference in one section of the contract documents shall be interpreted to include reference in all other applicable sections. Any additional hardware and/or software required to accomplish functional intent shall be provided (without additional cost to the Client Agency) just as though it were fully detailed throughout the contract documents.

F. If the 0.2 BMS Sub-Contractor believes there are conflicts or missing information in the project documents, the contractor shall promptly request clarification and instruction from the design team prior to the submission of bids.

G. Where conflict exists among sections 230900 and 230993 and the contract drawings, and questions were not raised during the bidding period to obtain clarification, the most stringent interpretation shall apply thereafter.

H. The listing of specific manufacturers hereinafter does not imply acceptance of their products that do not meet the specified construction, performance, feature and function requirements. Listed manufacturers are not relieved from meeting these specifications in their entirety.

1.03 PRODUCTS NOT FURNISHED OR INSTALLED BY, BUT INTEGRATED WITH THE WORK OF, THIS SECTION

A. General:

1. Coordination Meeting: The 0.2 BMS Sub-Contractor shall meet with the supplier(s) furnishing each of the following products to coordinate details of the interface between these products and the BMS network. The Client Agency or his designated representative shall be present at this meeting. Each supplier shall provide the Client Agency and the 0.2 BMS Sub-Contractor with details of the proposed interface including PICS for BACnet equipment, hardware and software identifiers for the interface points, network identifiers, wiring requirements, communication speeds, and required network accessories. The purpose of

this meeting shall be to insure there are no unresolved issues regarding the integration of these products into the BMS network. Submittals for these products shall not be approved prior to the completion of this meeting.

a. 0.2 HVAC Contractor to mount all control dampers.

b. 0.2 HVAC Contractor to mount and/or pipe all immersion wells and differential pressure devices.

1.04 BMS DESCRIPTION

A. The 0.2 BMS Sub-Contractor shall be responsible for coordination with the Client Agency's IT staff to ensure that the BMS will perform in the Client Agency's environment without disruption to any of the other activities taking place on that LAN. In addition to other capabilities described hereinafter, the BMS shall include full programmability of all connected nodes (controllers provided by the 0.2 BMS Sub-Contractor) for an authorized user.

B. In addition to other capabilities described hereinafter, the BMS shall include full programmability of all connected nodes (controllers provided by the 0.2 BMS Sub-Contractor) for an authorized user. The BMS shall also include implemented override capability of all controller outputs (for controllers provided by the 0.2 BMS Sub-Contractor) for an authorized user. An authorized user shall also be able to create/edit graphic screens, trends and alarms without the need for any additional hardware and/or software. The BMS shall consist of control systems for, but not limited to:

1. Hot Water System
2. Chilled Water System
3. Pumps
4. Air Handling Units
5. Rooftop Units
6. Makeup Air / Kitchen Exhaust Systems
7. VAV Boxes
8. Hot Water Duct Coils
9. Exhaust Fans
10. Finned Tube Radiators

C. The work of the 0.2 BMS Sub-Contractor shall be as defined individually and collectively in all Sections of this Division specification together with the associated Point Lists and Drawings, Sequences of Operation and the associated interfacing work as referenced in the related documents.

D. The work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned system.

E. Provide a complete, neat and workmanlike installation. Use only manufacturer employees who are skilled, experienced, trained, and familiar with the specific equipment, software, standards and configurations to be provided for this Project.

F. New graphics screens required for the work of this project shall become an integral part of the existing graphic package systems. NO EXCEPTIONS.

G. The 0.2 BMS Sub-Contractor shall have on-site personnel capable of making programming changes and colorgraphics changes to the BMS throughout the commissioning process.

H. Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

I. All hardware and software shall be provided with required licensing registered under the Client Agency's name, valid for the life of the project. The licensing shall provide the Client Agency the ability to allow unrestricted access and reprogram ability to whomever the Client Agency provides system access to.

J. The 0.2 BMS Sub-Contractor shall provide a full complement of software tools and associated training (and hardware where software keys or other proprietary devices are involved) for use by the Commissioning Agent. The Commissioning Agent shall return all software and hardware tools to the 0.2 BMS Sub-Contractor at the end of the Commissioning Agent's involvement with the project.

K. Where a unit is provided with manufacturer furnished (factory) controls, the unit manufacturer shall be responsible for evaluating the requirements of the contract documents sequences of operation and defining the read/write operations between the BMS and the factory controls that will be required in order to implement those sequences. Where the BMS vendor will be required to provide/install field hardware to supplement the factory controls, the unit manufacturer will be responsible for providing that information to all BMS vendors listed in the project specifications no later than five (5) days before the bid due date. The manufacturer's control Professional shall meet (telephone conference calls will be acceptable) with the BMS vendor's application programmer, in the presence of the Professional, to define and coordinate those read/write communication requirements and provide a hardcopy record for the project O&M Manuals. The Professional shall continue those discussions as necessary in order to establish that both parties understand their responsibilities in relation to the final working product. Should this coordination not take place, the unit manufacturer shall be responsible for reimbursing the Professional, at standard billing rates, for all time spent researching any field start-up, check-out and commissioning problems that are traced to a lack of the prerequisite coordination defined above.

L. The unit manufacturer shall be responsible for determining that the factory controls, with proper communication to/from the BMS, are capable of implementing the sequences of operation as defined by the contract documents. Results that merely "approximate the intent" of the required sequences of operation are not acceptable. NO EXCEPTIONS. In addition, the unit manufacturer shall be responsible for maintaining the read/write coordination requirements, as defined for the initial construction process, throughout a ten (10) year period that begins with the start of the warranty period. Any updates to the factory controls during this ten year period shall not require any reprogramming on the part of the BMS vendor. Should any reprogramming be required by the BMS vendor, the unit manufacturer shall be responsible for reimbursing the BMS vendor, at standard billing rates, for all time spent to accomplish the required reprogramming.

1.05 APPROVED CONTROL SYSTEMS

A. The BMS system shall be by Automated Logic Controls, Harrisburg, PA. It is the intent of this project to provide a new ALC BMS system. All new equipment shall be controlled by DDC on the ALC network. The 0.2 HVAC Contractor shall still be required to coordinate their equipment with Automated Logic Controls. Contact Automated Logic – Harrisburg at 717-909-7000.

B. Cheyney University has standardized on ALC controls products and services for HVAC system controls when projects call for replacing, upgrading, or installing new control systems throughout all of buildings. ALC provides a web-enabled BACnet compliant controls product that has allowed the facility to design a web-based controls network that connects buildings for real-time remote monitoring and control of all HVAC systems and equipment. It is critical that this project connect with and be fully compatible with the ALC network. Standardizing on one set of controls products and services has enabled the facility to develop a standard format of controls graphics and computer interface and reduce the cost of training of staff that would otherwise have to learn how to use, operate and maintain different controls products. As a result, no server hardware or software is required to be included in this project and this represents a cost savings that reduces or eliminates any cost disadvantage in use of a proprietary manufacturer.

C. The above item has been approved by the Department as a Proprietary Item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

1.06 QUALITY ASSURANCE

A. General

1. The 0.2 Building Management System (BMS) Sub-Contractor shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems. Throughout this specification, any reference to "0.2 Control Contractor", "Controls Contractor" or “local field office” shall be interpreted as referring to the 0.2 Building Management System (BMS) Sub-Contractor.
2. The term “manufacturer” when used to identify an automatic temperature control sub-contractor/supplier, shall mean the complete system of building energy management. Components of the completed system shall include but not being limited to, hardware equipment, engineering, wiring, installation, sequence of operations, network architecture, commissioning, training, software programming and warranty.
3. The new system shall be base bid design using Automated Logic Controls. NO EXCEPTIONS.
4. The 0.2 BMS Sub-Contractor shall have a branch facility within a 100-mile radius of the job site supplying complete maintenance and support services on a 24 hour, 7-day-a-week basis.
5. As evidence and assurance of the contractor’s ability to support the Client Agency's system with service and parts, the contractor must have been in the BMS business for at least the last ten (10) years.
6. The Building Management System architecture shall consist of the products of a manufacturer regularly engaged in the production of Building Management Systems and shall be the manufacturer’s latest standard of design at the time of bid.

B. Workplace Safety and Hazardous Materials

1. Provide a safety program in compliance with the Contract Documents.
2. The 0.2 BMS Sub-Contractor shall have a corporately certified comprehensive Safety Certification Manual and a designated Safety Supervisor for the Project.
3. The 0.2 BMS Sub-Contractor and its employees and subtrades comply with federal, state and local safety regulations.
4. The 0.2 BMS Sub-Contractor shall ensure that all subcontractors and employees have written safety programs in place that cover their scope of work, and that their employees receive the training required by the OSHA having jurisdiction for at least each topic listed in the Safety Certification Manual.
5. Hazards created by the 0.2 BMS Sub-Contractor or its subcontractors shall be eliminated before any further work proceeds.
6. Hazards observed but not created by the 0.2 BMS Sub-Contractor or its subcontractors shall be reported to either the General Contractor or the Client Agency within the same day. The 0.2 BMS Sub-Contractor shall be required to avoid the hazard area until the hazard has been eliminated.
7. The 0.2 BMS Sub-Contractor shall sign and date a safety certification form prior to any work being performed, stating that the 0.2 BMS Sub-Contractor’s company is in full compliance with the Project safety requirements.
8. The 0.2 BMS Sub-Contractor’s safety program shall include written policy and arrangements for the handling, storage and management of all hazardous materials to be used in the work in compliance with the requirements of the Authority Having Jurisdiction (AHJ) at the Project

site.

9. The 0.2 BMS Sub-Contractor's employees and subcontractor's staff shall have received training as applicable in the use of hazardous materials and shall govern their actions accordingly.

C. Quality Management Program

1. Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manager shall be empowered to make technical, scheduling and related decisions on behalf of the 0.2 BMS Sub-Contractor. At minimum, the Project Manager shall:

   a. Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.

   b. Manage the financial aspects of the BMS Contract.

   c. Coordinate as necessary with other trades.

   d. Be responsible for the work and actions of the BMS workforce on site.

1.07 REFERENCES

A. All work shall conform to the following Codes and Standards, as applicable:

1. National Fire Protection Association (NFPA) Standards.
2. National Electric Code (NEC) and applicable local Electric Code.
3. Underwriters Laboratories (UL) listing and labels.
4. UL 864 UUKL Smoke Control
5. UL 268 Smoke Detectors.
6. UL 916 Energy Management
7. NFPA 70 - National Electrical Code.
8. NFPA 90A - Standard for The Installation of Air Conditioning and Ventilating Systems.
9. American National Standards Institute (ANSI).
10. National Electric Manufacturer's Association (NEMA).
11. American Society of Mechanical Professionals (ASME).
12. American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) and ASHRAE 62 IAQ as applicable.
13. Air Movement and Control Association (AMCA).
14. Institute of Electrical and Electronic Engineers (IEEE).
15. American Standard Code for Information Interchange (ASCII).
16. Electronics Industries Association (EIA)
17. Occupational Safety and Health Administration (OSHA).
18. American Society for Testing and Materials (ASTM).
19. Federal Communications Commission (FCC) including Part 15, Radio Frequency Devices.
20. Americans Disability Act (ADA)
21. ANSI/ASHRAE Standard 195-2004 (BACnet)

B. In the case of conflicts or discrepancies, the more stringent regulation shall apply.

C. All work shall meet the approval of the Authorities Having Jurisdiction (AHJ) at the project site. The BMS vendor shall be responsible for gaining BMS system approval from the AHJ.

1.08 SUBMITTALS

A. Shop Drawings, Product Data, and Samples

1. The 0.2 BMS Sub-Contractor shall submit shop drawings within 90 days of contract award. Shop drawing submittal shall be complete for the full scope of the project work and shall be provided as ONE COMPLETE PACKAGE. Package shall include the work of Sections 230900 and 230993 in order to verify integrated performance requirements. Partial or incomplete submittals shall be returned unchecked.
2. Equipment and systems requiring approval of local authorities must comply with such regulations and be approved. Filing shall be at the expense of the 0.2 BMS Sub-Contractor where filing is necessary. Provide a copy of all related correspondence and permits to the Client Agency.
3. Prepare an index of all submittals and shop drawings for the installation. Index shall include a shop drawing identification number, Contract Documents reference and item description.
4. The 0.2 BMS Sub-Contractor shall correct any errors or omissions noted in any review submission.
5. Shop drawing submittals shall be complete and fully detailed so as to establish all required information to provide a fully engineered, coordinated and integrated distributed processing HVAC/LAFCS control system. All terminal-to-terminal and one line wiring diagrams and flow diagrams shall be submitted in AUTOCAD or VISIO format (latest version). At a minimum, submit the following:
    a. Complete BMS network architecture diagrams including all nodes, interconnections and interface to nodes not provided by the 0.2 BMS Sub-Contractor but a BMS communication interface required. BMS network architecture shall detail each controller, controller ID, controller location, system served, communication buses and type associated, sub-busses with connected sub-systems, etc. BMS network architecture diagrams shall include communication speeds for each bus segment.
    b. Sequentially numbered systems schematics, sequences and flow diagrams with an index identifying pages for each drawing for the project.
    c. Provide a schematic wiring diagram for each controlled system. Each schematic shall have all elements labeled. Where a control element is the same as that shown on the control system schematic, it shall be labeled with the same name. All terminals shall be labeled.
    d. Provide an instrumentation list for each controlled system. Each element of the controlled system shall be listed in table format. The table shall show element name, type of device, manufacturer, model number.
    e. Include a complete description of the operation of the control system, including sequences of operation. The description shall include a schematic diagram of the controlled system.
    f. Provide a point list for each system controller including both input and output (I/O) points, point number, the controlled device associated with the I/O point, and the location of the I/O device.
    g. Samples of Graphic Display screen types and associated menus.
    h. Control Damper Schedule including a separate line for each damper provided and a column for each of the damper attributes, including: Code Number, Fail Position, Damper Type, Damper Operator, Duct Size, Damper Size, Mounting, and Actuator Type.
    i. Control Valve Schedules including a separate line for each valve provided under this section and a column for each of the valve attributes including, but not limited to: Code Number, Configuration, Fail Position, Pipe Size, Valve Size, Body Configuration, Close off Pressure, Capacity, Valve CV, Design Pressure, and Actuator Type.
    j. Room Schedule including a separate line for each VAV box and/or terminal unit indicating location and address and room thermostat specifics.

k. Details of all BMS interfaces and connections to the work of other trades.

l. Listing of all read and or write points derived via interfaces to mechanical system components as required per project specifications, sequences of operation, points list(s), and/or required for correct systems operation and functionality. Points shall be identified as to point type (AI, DI, AO, DO, AV, BV), point source (read, write, commandable), interface type (Lon, BACnet, N2, etc.) point ID in BMS and point ID in mechanical system, mechanical system source (RTU, Chiller, etc.), point (object) name (% speed, fan status, cws temp, etc.) and point description (speed of motor, fan on, chilled water supply temperature, etc.)

m. Sequentially numbered product data sheet section with an index identifying page(s) for each product utilized in the installed BMS system and product data sheet(s) for each product. The index shall individually list each product with the associated numerically sequenced page number(s) of the product data sheets. For all products including software, provide product data sheet(s) or marked catalog pages that include part number, photo, complete specifications and numerically sequenced page number(s) referenced in the index.

6. Existing “as-built” drawings shall be completely updated to reflect integration of the work of this project and submitted as part of the shop drawings.

1.09 RECORD DOCUMENTATION

A. Operation and Maintenance Manuals

1. Three (3) copies of the Operation and Maintenance Manuals shall be provided to the Client Agency's Representative upon completion of the project. The entire Operation and Maintenance Manual shall be furnished on Flashdrive media, and include the following for the BMS provided:

a. Table of contents.

b. As-built system record drawings. Computer Aided Drawings (CAD) record drawings shall represent the as-built condition of the system and incorporate all information supplied with the approved submittal.

c. Manufacturers product data sheets or catalog pages for all products including software.

d. System Operator’s manuals.

e. Archive copy of all site-specific databases and sequences.

f. BMS network diagrams.

g. Interfaces to all third-party products and work by other trades.

2. The Operation and Maintenance Manual CD shall be self-contained, and include all necessary software required to access the product data sheets. A logically organized table of contents shall provide dynamic links to view and print all product data sheets. Viewer software shall provide the ability to display, zoom, and search all documents.

3. The 0.2 BMS Sub-Contractor shall provide O&M manuals that are organized in a logical, concise easy to use format. Where changes have occurred from the original submittal package, those changes shall be reflected on the appropriate unit/system/sub-system drawings and not just grouped as a series of partial drawings (i.e. changes only) at the end of the drawing package. In like fashion, new terminal devices shall be logically inserted into the specification data sheet sections according to the type of device(s) involved and not just grouped as a series of new pages at the end of the previous data sheet submittal section. In addition, the BMS overview drawings shall accurately reflect “as-built” conditions, including the integration of communication nodes provided by other manufacturers/trades. To the extent that the original submittal package must be totally redone in order to satisfy these requirements, the 0.2 BMS Sub-Contractor shall make the necessary changes at no additional cost to the Client Agency.

4. Existing “O&M Manuals” shall be completely updated to reflect integration of the work of this

project and submitted as part of the shop drawings

1.10 WARRANTY

A. Standard Material and Labor Warranty:

1. Provide a two (2) year labor and material warranty on the BMS from date of final payment.
2. The local field office shall warranty all BMS computers, controllers, software and related I/O equipment and all new pneumatic and electric hardware for a period of two (2) years from the date of final payment.
3. All equipment found to have defects in material or workmanship during this warranty period shall be replaced at no charge to the Client Agency with equipment of equal type and quality by the local field office. All labor required during the warranty period shall also be included, with the following clarification. Materials furnished but not installed by the 0.2 BMS Sub-Contractor shall be covered to the extent of the product only. Installation labor shall be the responsibility of the trade contractor performing the installation.
4. Operator workstation software updates, project-specific software updates, graphic software updates, database software updates, and firmware updates which resolve known deficiencies as identified by the local field office and/or Client Agency shall be provided to the Client Agency at no charge during the warranty period. The local field office shall also keep current with manufacturer's software and firmware updates for the Client Agency's BMS during the warranty period at no charge to the Client Agency.
5. The 0.2 BMS Sub-Contractor shall respond to the job site within a 24 hour period for any warranty work relating to the control system.
6. Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming, occurs in a timely manner. Warranty work shall be done during 0.2 BMS Sub-Contractor's normal business hours.
7. Provide updates to web server software including new version releases, project-specific software, database software, and firmware that resolve the contractor-identified software deficiencies at no charge during warranty agreement to receive upgrades for functional enhancements associated with above-mentioned items. Do not install updates or upgrades without Client Agency's written authorization.
8. Exception: Contractor shall not be required to warrant reused devices except those that have been rebuild or repaired and factory recertified. Installation labor and materials shall be warranted. Demonstrate operable condition of reused devices at time of Professional's acceptance.
9. Client Agencyship of Proprietary Material: Project-specific software and documentation shall become Client Agency's property. This includes, but is not limited to:
    a. Graphics
    b. Record drawings
    c. Database
    d. Application programming code
    e. Documentation

PART 2 – PRODUCTS

2.01 SYSTEM OVERVIEW

A. BMS shall consist of control systems for, but not limited to:

1. Hot Water System
2. Chilled Water System
3. Pumps

4. Air Handling Units
5. Rooftop Units
6. Makeup Air / Kitchen Exhaust Systems
7. VAV Boxes
8. Hot Water Duct Coils
9. Exhaust Fans
10. Finned Tube Radiators

2.02 GENERAL DESCRIPTION

A. General: The building management system (BMS) system shall consist of a high-speed, peer-to-peer network of DDC controllers, a control system server, and a web-based operator interface.

B. System software shall be based on a server/thin-client architecture, designed around the open standards of web technology. The control system server shall be accessed using a Web browser over the control system network, the Client Agency's local area network and (at the Client Agency's discretion) over the Internet. The server shall also act as a "workstation" when running as a server/client platform. Additional clients shall have concurrent access to the "workstation" in this mode.

C. The intent of the thin-client architecture is to provide operators complete access to the control system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends, configure trends, configure points and controllers, or to download programming into the controllers.

D. System shall use BACnet protocol for communication between the control modules and web server. Communication between the web server and the user's browser shall be HTTP or HTTPS protocol utilizing HTML5. Use of Adobe Flash technology is not acceptable.

E. The Building Management System shall consist of the following:
1. Network Controller(s)
2. Field Controllers
3. Primary Network – Panel to Panel Communication
4. Operator Interface, network processing and data storage equipment
5. Graphical Programmer
6. Graphical User Interface (GUI)
7. Workstation/Centralized Server Hardware Station and Software
8. Other components required for a complete and working BMS

F. The system shall be modular in nature and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

G. System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution. The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

H. Acceptable Manufacturers
1. Automated Logic Controls – Base Bid the above item has been approved by the Department as a proprietary item. No other item will be accepted. Section 9.6 and 9.7 of the General Conditions to the Construction contract does not apply to the above item.

I. The substitution provisions of other Sections of these specifications shall not be applicable to the work of these Sections – Instrumentation and Control for HVAC and Sequences of Operation for HVAC Controls. NO SUBSTITUTIONS. NO EXCEPTIONS.

J. The system shall be a standard product with the manufacturer who will guarantee ongoing parts

availability and factory trained field support for ten (10) years after system acceptance.

K. The 0.2 BMS Sub-Contractor shall provide project specific BMS architecture overview diagram as part of the bid. The architectural overview shall begin with the Client Agency provided network and include all servers/workstations, a riser-type diagram of all Ethernet switches and hardware panels utilized on the project, including 3rd party equipment being interfaced to the BMS, at each communication bus level. Quantities and model numbers of the controllers involved shall be clearly indicated in order to facilitate evaluation of the proposed hardware solution in light of specification requirements. Specification data sheets for all controllers shall also be included. Overview diagram shall clearly indicate ALL network communication protocols used in the system for this specific project and the baud rate for each communication bus segment.

2.03 BMS ARCHITECTURE

A. The design of the BMS shall support networking of operator workstations and Network Controllers. The network architecture shall consist of two levels, an Ethernet based primary network for all operator workstations, servers, and primary DDC controllers.

B. Access to system data shall not be restricted by the hardware configuration of the building management system. The hardware configuration of the BMS network shall be totally transparent to the user when accessing data or developing control programs.

C. Network Communication

1. All PCs shall simultaneously direct connect to the Network without the use of an interposing device.
2. Operator Workstation shall be capable of simultaneous direct connection and communication with BACnet/IP, OPC and TCP/IP corporate level networks without the use of interposing devices.
3. The Network shall not impose a maximum constraint on the number of operator workstations.
4. Any controller residing on the primary network shall connect to Ethernet network without the use of a PC or a gateway with a hard drive.
5. Any PC on the Network shall have transparent communication with controllers on the primary networks connected via Ethernet.
6. Any break in Ethernet communication from the PC to the controllers on the Network shall result in a notification at the PC.
7. The standard client and server workstations on the Network shall reside on industry standard Ethernet utilizing standard TCP/IP, IEEE 802.3.
8. System software applications will run as a service to allow communication with Network Controllers without the need for user log in. Closing the application or logging off shall not prevent the processing of alarms, network status, panel failures, and trend information.
9. Any break in Ethernet communication between the standard client and server workstations on the Network shall result in a notification at each workstation.
10. Access to the system database shall be available from any standard client workstation on the Network.

D. Primary Network - Panel to Panel Communication:

1. All Primary Controllers shall directly reside on the primary Ethernet network such that communications may be executed directly between Primary Controllers, directly between server and Primary Controllers on a peer-to-peer basis.
2. Systems that operate via polled response or other types of protocols that rely on a central processor, file server, or similar device to manage panel-to-panel or device-to-device communications shall not be acceptable.
3. All operator interfaces shall have the ability to access all point status and application report data or execute control functions for any and all other devices. Access to data shall be based

upon logical identification of building equipment. No hardware or software limits shall be imposed on the number of devices with global access to the network data.

4. The primary network shall use TCP/IP over Ethernet. All devices must:
   a. Auto-sense 10/100 Mbps networks.
   b. Receive an IP Address from a Dynamic Host Configuration Protocol (DHCP) Server or be configured with a Fixed IP Address.
   c. Resolve Name to IP Addresses for devices using a Domain Name Service (DNS) Server on the Ethernet network.
5. The primary network shall provide the following minimum performance:
   a. Provide high-speed data transfer rates for alarm reporting, report generation from multiple controllers and upload/download efficiency between network devices. System performance shall insure that an alarm occurring at any Controller is displayed at any PC workstations, all controllers, and other alarm printers within 15 seconds.
   b. Message and alarm buffering to prevent information from being lost.
   c. Error detection, correction, and re-transmission to guarantee data integrity.
   d. Synchronization of real-time clocks between Controllers, including automatic daylight savings time corrections.
   e. The primary network shall allow the Controllers to access any data from, or send control commands and alarm reports directly to, any other Controller or combination of controllers on the network without dependence upon a central or intermediate processing device. Controllers shall send alarm reports to multiple operator workstations without dependence upon a central or intermediate processing device. The network shall also allow any controller to access, edit, modify, add, delete, back up, restore all system point database and all programs.
   f. The primary network shall allow the Controllers to assign password access and control priorities to each point individually. The logon password (at any PC workstation or portable operator terminal) shall enable the operator to monitor, adjust and control only the points that the operator is authorized for. All other points shall not be displayed at the PC workstation or portable terminal. (e.g. all base building and all tenant points shall be accessible to any base building operators, but only certain base building and tenant points shall be accessible to tenant building operators). Passwords and priorities for every point shall be fully programmable and adjustable.
   g. Devices containing custom programming must reside on the Primary Network

E. Integration
1. BACnet Protocol Integration - BACnet
   a. The neutral protocol used between systems will be BACnet IP, BACnet over Ethernet or BACnet MS/TP except as otherwise defined within the contract documents. All protocols shall comply with the ASHRAE BACnet standard.
   b. A complete Protocol Implementation Conformance Statement (PICS) shall be provided for all BACnet system devices.
   c. The ability to command, share point object data, change of state (COS) data and schedules between the host and BACnet systems shall be provided.
   d. Any/all routers, switches, hubs and CAT 6 wiring required to implement BMS and/or integration to other systems integration to other systems shall be the responsibility of the 0.2 BMS Sub-Contractor to furnish and install. All power and material required for operation of associated routers, switches and hubs shall be furnished and installed by the 0.2 BMS Sub-Contractor from panels with spare circuit locations as approved by the Professional.

2.04 USER INTERFACE

A. Dedicated Web Based User Interface

1. PC Hardware

   a. One (1) Laptop shall be configured to final approval by Client Agency's IT group.

2. Operating System Software

   a. Windows

   b. Where user interface is not provided via browser, provide complete operator workstation software package, including any hardware or software keys. Include the original installation disks and licenses for all included software, device drivers, and peripherals.

   c. Provide software registration cards to the Client Agency for all included software.

B. Distributed Web Based User Interface

1. All features and functions of the dedicated user interface previously defined in this document shall be available on any computer connected directly or via a wide area or virtual private network (WAN/VPN) to the automation network and conforming to the following specifications.

C. User Interface Application Components

1. Operator Interface

   a. An integrated browser-based client application shall be used as the user operator interface program.

   b. All Inputs, Outputs, Setpoints, and all other parameters as defined by the contract documents, or required as part of the system software, shall be displayed for operator viewing, modification, and/or override from the operator interface software.

   c. The user interface software shall provide help menus and instructions for each operation and/or application.

   d. All controller software operating parameters shall be displayed for the operator to view/modify from the user interface. These include: setpoints, alarm limits, time delays, PID tuning constants, run-times, point statistics, schedules, and so forth.

   e. The Operator Interface shall incorporate comprehensive support for functions including, but not necessarily limited to, the following:

      1) User access for selective information retrieval and control command execution

      2) Monitoring and reporting

      3) Alarm, non-normal, and return to normal condition annunciation

      4) Selective operator overrides and other control actions

      5) Information archiving, manipulation, formatting, display and reporting

      6) BMS internal performance supervision and diagnostics

      7) Online access to user HELP menus

      8) Online access to current BMS as-built records and documentation.

         Sequence of operation information, shop drawings and specifications data sheets associated with a system shall be available from the graphic screens associated with that system. This feature shall be fully implemented for all graphic screens created for this project.

      9) Means for the controlled re-programming, re-configuration of BMS operation and for the manipulation of BMS database information in compliance with the prevailing codes, approvals and regulations for individual BMS applications.

   f. The operation of the control system shall be independent of the user interface, which shall be used for operator communications only. Systems that rely on an operator workstation to provide supervisory control over controller execution of the sequences of

operations or system communications shall not be acceptable.

2. Navigation Trees
   a. The system will have the capability to display multiple navigation trees that will aid the operator in navigating throughout all systems and points connected. At minimum provide a tree that identifies all systems on the networks.
   b. Provide the ability for the operator to add custom trees. The operator will be able to define any logical grouping of systems or points and arrange them on the tree in any order. It shall be possible to nest groups within other groups. Provide at minimum 5 levels of nesting.
   c. The navigation trees shall be “dockable” to other displays in the user interface such as graphics. This means that the trees will appear as part of the display but can be detached and then minimized to the Windows task bar or closed altogether. A simple keystroke will reattach the navigation to the primary display of the user interface.
3. Alarms
   a. Alarms shall be routed directly from Network Automation/Control Engines to PCs and servers. It shall be possible for specific alarms from specific points to be routed to specific PCs and servers. The alarm management portion of the user interface shall, at the minimum, provide the following functions:
      1) Log date and time of alarm occurrence.
      2) Generate a “Pop-Up” window, with audible alarm, informing a user that an alarm has been received.
      3) Allow a user, with the appropriate security level, to acknowledge, temporarily silence, or discard an alarm.
      4) Provide an audit trail on hard drive for alarms by recording user acknowledgment, deletion, or disabling of an alarm. The audit trail shall include the name of the user, the alarm, the action taken on the alarm, and a time/date stamp.
      5) Provide the ability to direct alarms to an e-mail address, alphanumeric pager or cell phone text message. This must be provided in addition to the pop-up window described above. Systems that use e-mail and pagers as the exclusive means of annunciating alarms are not acceptable. 0.2 BMS Sub-Contractor shall coordinate implementation of this feature with the Client Agency as part of the work of this project.
      6) Any attribute of any object in the system may be designated to report an alarm.
   b. The BMS shall annunciate diagnostic alarms indicating system failures and non-normal operating conditions.
   c. The BMS shall annunciate application alarms at minimum, as required by the Contract Documents.
4. Reports and Summaries
   a. Reports and Summaries shall be generated and directed to the user interface displays, with subsequent assignment to printers, or disk. As a minimum, the system shall provide the following reports:
      1) All points in the BMS
      2) All points in each BMS application
      3) All points in a specific controller
      4) All points in a user-defined group of points
      5) All points currently in alarm
      6) All points locked out

7) All BMS schedules

8) All user defined and adjustable variables, schedules, interlocks and the like.

b. Summaries and Reports shall be accessible via standard User interface (UI) functions and not dependent upon custom programming or user defined HTML pages.

c. Selection of a single menu item, tool bar item, or tool bar button shall print any displayed report or summary on the system printer for use as a building management and diagnostics tool.

d. The system shall allow for the creation of custom reports and queries via a standard web services XML interface and commercial off-the-shelf software (provided as part of this project) such as Microsoft Access, Microsoft Excel, or Crystal Reports.

5. Schedules

a. A graphical display for time-of-day scheduling and override scheduling of building operations shall be provided. At a minimum, the following functions shall be provided:

1) Weekly schedules

2) Exception Schedules

3) Monthly calendars.

b. Weekly schedules shall be provided for each group of equipment with a specific time use schedule.

c. It shall be possible to define one or more exception schedules for each schedule including references to calendars.

d. Monthly calendars shall be provided that allow for simplified scheduling of holidays and special days for a minimum of five years in advance. Holidays and special days shall be user-selected with the pointing device or keyboard and shall automatically reschedule equipment operation as previously defined on the exception schedules.

e. Changes to schedules made from the User Interface shall directly modify the Network Automation/Control Engine schedule database.

f. Schedules and Calendars shall comply with ASHRAE BACnet Standard.

g. Selection of a single menu item or tool bar button shall print any displayed schedule on the system printer for use as a building management and diagnostics tool.

6. Security

a. Each operator shall be required to log on to the system with a username and password in order to view, edit, add, or delete data.

b. Operator Access: The username and password combination shall define accessible viewing, editing, adding, and deleting privileges for that operator. Users with system administrator rights shall be able to create new users and edit the privileges of all existing users. System Administrators shall also be able to vary and deny each operator's privileges based on the geographic location, such as the ability to edit operating parameters in Building "A", to view but not edit parameters in Building "B", and to not even see equipment in Building "C".

c. Password Policy Rules: System administrator shall invoke policies for minimum password strength, including number of characters, special characters and numbers, upper and lower case, etc.

d. Automatic Log Out: Automatically log out each operator if no keyboard or mouse activity is detected. This auto logoff time shall be user adjustable.

e. Encrypted Security Data: Store system security data including operator passwords in an encrypted format. System shall not display operator passwords.

7. Screen Manager - The User Interface shall be provided with screen management capabilities that allow the user to activate, close, and simultaneously manipulate a minimum

of 4 active display windows plus a network or user defined navigation tree.

8. Dynamic Graphics
    a. The graphics application program shall be supplied as an integral part of the User Interface. Browser or Workstation applications that rely only upon HTML pages shall not be acceptable.
    b. The graphics applications shall include a create/edit function and a runtime function. The system architecture shall support an unlimited number of graphics documents (graphic definition files) to be generated and executed. The graphics shall be able to display and provide animation based on real-time data that is acquired, derived, or entered.
    c. Graphics runtime functions – A maximum of 16 graphic applications shall be able to execute at any one time on a user interface or workstation with 4 visible to the user. Each graphic application shall be capable of the following functions:
        1) All graphics shall be fully scalable
        2) The graphics shall support a maintained aspect ratio.
        3) Multiple fonts shall be supported.
        4) Unique background shall be assignable on a per graphic basis.
        5) The color of all animations and values on displays shall indicate the status of the object attribute.
    d. Operation from graphics – It shall be possible to change values (setpoints) and states in system-controlled equipment by using drop-down windows accessible via the pointing device.
    e. Graphic editing tool – A graphic editing tool shall be provided that allows for the creation and editing of graphic files. The graphic editor shall be capable of performing/defining all animations and defining all runtime binding.
        1) The graphic editing tool shall in general provide for the creation and positioning of point objects by dragging from tool bars or drop-downs and positioning where required.
        2) In addition, the graphic editing tool shall be able to add additional content to any graphic by importing backgrounds in the SVG, BMP or JPG file formats.
    f. Aliasing – Many graphic displays representing part of a building and various building components are exact duplicates, with the exception that the various variables are bound to different field values. Consequently, it shall be possible to bind the value of a graphic display to aliases, as opposed to the physical field tags.
9. Historical trending and data collection
    a. Each Automation/Control Engine shall store trend and point history data for all analog and digital inputs and outputs, as follows:
        1) Any point, physical or calculated, may be designated for trending. Two methods of collection shall be allowed: defined time interval and upon a change of value.
        2) Each Automation/Control Engine shall have the capability to store multiple samples for each physical point and software variable based upon available memory, including an individual sample time/date stamp. Points may be assigned to multiple history trends with different collection parameters.
    b. Trend and change of value data shall be stored within the engine and uploaded to a dedicated trend database or exported in a selectable data format via a provided data export utility. Uploads to a dedicated database shall occur based upon one of the following: user-defined interval, manual command, or when the trend buffers are full. Exports shall be as requested by the user or on a time scheduled basis.

c. All trend sample intervals shall be coordinated and sufficient to support the needs of the commissioning process. All trend data required by the Client Agency's commissioning process shall be provided by the 0.2 BMS Sub-Contractor as part of the work of this project. NO EXCEPTIONS.

d. The system shall provide a configurable data storage subsystem for the collection of historical data. Data can be stored in either Microsoft Access or SQL database format.

e. Trending shall be set to the Client Agency's needs after the commissioning process has taken place. Trending requirements are as follows:

1) All I/O points and setpoints shall be linked to BACnet trend objects. The controller(s) shall record a trend sample every 15 minutes (adj.) for each trend object and save the most recent 120 (adj.) samples.

2) AVs and BVs read/written across 3rd party communication interfaces shall also be treated as I/O points for trending purposes.

3) Refer to Section 230993, paragraph 3.19, Trend Requirements for additional information about trends to be fully implemented by the 0.2 BMS Sub-Contractor as part of the work of this project.

10. Trend data viewing and analysis

a. Provide a trend viewing utility that shall have access to all database points.

b. It shall be possible to retrieve any historical database point for use in displays and reports by specifying the point name and associated trend name.

c. The trend viewing utility shall have the capability to define trend study displays to include multiple trends

d. Displays shall be able to be single or stacked graphs with on-line selectable display characteristics, such as ranging, color, and plot style.

e. Display magnitude and units shall both be selectable by the operator at any time without reconfiguring the processing or collection of data. This is a zoom capability.

f. Display magnitude shall automatically be scaled to show full graphic resolution of the data being displayed.

g. Trend studies shall be capable of calculating and displaying calculated variables including highest value, lowest value and time-based accumulation.

11. WebCRTL User Interface

a. 0.2 BMS Sub-Contractor shall provide and install all computer hardware and software required for the purpose of configuration and consolidation of information and programs required for the delivery of a Task Focused, Web Based Portal to the BMS. The WebCRTL User Interface shall provide a natural, complementary extension to the WebCRTL site management user interface previously described.

b. The user interface architecture shall be implemented to conform to industry standards, so that is can accommodate the required applications provided by the 0.2 BMS Sub-Contractor as well as communicate information to and from any size control system.

c. The exact same user interface shall be accessible from any type of personal computer or mobile device running any type of operating system (ex. iOS, Android, Windows).

d. The interface shall automatically adapt and optimize the information displayed to fit the screen size of the client device and shall also be touch friendly.

e. The user interface shall organize and display information using customer specific locations and spaces. At a minimum, the user interface shall provide:

1) Organization of all space, equipment and point information in a familiar way, reducing the need for extensive training prior to use.

2) A navigation mechanism for users to select the specific location or space to display

information for – only spaces and locations in the navigation tree, nothing more.

3) The ability to search for and/or bookmark any location or space by name for quick access to critical or troublesome areas.

4) The same navigation mechanisms apply across any client device (ex. Smart phone, tablet, personal computer) for consistency and ease of use.

f. Plug-ins and special native app software (ex. Downloaded and installed from an app store) shall not be required to conduct daily operations of buildings and equipment.

g. The user interface shall clearly display equipment relationships without custom graphic generation.

h. The user interface shall provide a single display of all potential issues in a facility including items currently in alarm, warning, override, out-of-service and offline.

i. The user interface shall provide a single display of all activity related to a specific piece of equipment including user changes, discarded user changes, pending alarms, discarded alarms and acknowledged alarms.

j. The user interface shall provide support for up to 100 concurrent users from an unlimited number of individuals with defined password access to the system.

k. Provide the capability to view, command and modify large quantities of similar data in tailored summaries without the use of a secondary application, like a spreadsheet. These summaries shall be automatically generated, or user defined. User defined summaries shall allow up to seven user defined columns describing attributes to be displayed including custom column labels. Up to 100 rows per summary shall be supported.

2.05 CONTROLLERS

A. General: Provide an adequate number of Building Controllers (BC), Advanced Application Controllers (AAC), Smart Actuators (SA), and Smart Sensors (SS) as required to achieve performance as specified by system performance. Every device in the system which executes control logic and directly controls HVAC equipment must conform to a standard BACnet Device profile as specified in ANSI/ASHRAE 135, BACnet Annex L. unless otherwise specified, hardwired actuators and sensors may be used in lieu of communicating actuators, communicating sensors, BACnet Smart Actuators, and BACnet Smart Sensors.

B. BACnet

1. Building Controllers (BCs): Each BC shall conform to BACnet Building Controller (B-BC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L, and shall be listed as a certified B-BC in the BACnet Testing Laboratories (BTL) Product Listing.

2. Advanced Application Controllers (AACs): Each AAC shall conform to BACnet Advanced Application Controller (B-AAC) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-AAC in the BACnet Testing Laboratories (BTL) Product Listing.

3. Smart Actuators (SAs): An actuator which is controlled by a network connection rather than a binary or analog signal (0-10v, 4-20mA, relay, etc.). Each SA shall conform to BACnet Smart Actuator (B-SA) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SA in the BACnet Testing Laboratories (BTL) Product Listing.

4. Smart Sensors (SSs): A sensor which provides information to the BAS via network connection rather than a binary or analog signal (0-10000 ohm, 4-20mA, dry contact, etc.). Each SS shall conform to BACnet Smart Sensor (B-SS) device profile as specified in ANSI/ASHRAE 135, BACnet Annex L and shall be listed as a certified B-SS in the BACnet Testing Laboratories (BTL) Product Listing.

5. BACnet Communication

a. Each controller residing on the ethernet data link shall be capable of providing BACnet/SC capability as described in the above Communication Section.

b. Each BC shall reside on or be connected to a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol using BACnet/IP or BACnet/SC.

c. BACnet routing shall be performed by BCs or other BACnet device routers as necessary to connect BCs to networks of AACs.

d. Each AAC shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Link/Physical layer protocol using BACnet/IP or BACnet/SC, or it shall reside on a BACnet network using the ARCNET Link/Physical layer protocol.

e. Each SA shall reside on a BACnet network using the ARCNET or MS/TP Data Link/Physical layer protocol.

f. Each SS shall reside on a BACnet network using ISO 8802-3 (Ethernet) Data Ling/Physical layer protocol with BACnet/IP addressing, or it shall reside on a BACnet network using ARCNET or MS/TP Data Link/Physical layer protocol.

C. Security

1. Provide BACnet firewall capability as defined in the BACnet standard for controllers that are IP capable.

D. Communication

1. Service Port: Each controller shall provide a service communication port for connection to a Portable Operator's Terminal.

2. Signal Management: BC and ASC operating systems shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and to allow for central monitoring and alarms.

3. Data Sharing: Each BC and AAC shall share data as required with each networked BC and AAC.

4. Stand-Alone Operation. Each piece of equipment shall be controlled by a single controller to provide stand-alone control in the event of communication failure. All I/O points specified for a piece of equipment shall be integral to its controller. Provide stable and reliable stand-alone control using default values or other method for values normally read over the network such as outdoor air conditions, supply air or water temperature coming from source equipment, etc.

E. Environment: Controller hardware shall be suitable for anticipated ambient conditions.

1. Controllers used outdoors or in wet ambient conditions shall be mounted in waterproof enclosures and shall be rated for operation at 29°C to 60°C (20°F to 140°F).

2. Controllers used in conditioned space shall be mounted in dust-protective enclosures and shall be rated for operation at 0°C to 50°C (32°F to 120°F).

F. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to a field-removable modular terminal strip or to a termination card connected by a ribbon cable. Each BC and AAC shall continually check its processor and memory circuit status and shall generate an alarm on abnormal operation. System shall continuously check controller network and generate alarm for each controller that fails to respond.

G. Real-time Clock: Controller shall have a real-time clock to keep track of time in the event of a power failure for up to three (3) days.

H. Memory

1. Controller memory shall support operating system, database, and programming requirements.

2. Each controller shall use volatile memory with battery backed up memory or nonvolatile memory and shall retain BIOS and application programming in the event of power loss.

System shall automatically download dynamic control parameters following power loss.

3. Each AAC shall have 4 GBs eMMC flash memory and 256 MB DDR3 DRAM.

I. Immunity to Power and Noise. Controllers shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage.

J. Transformer. Power supply shall be fused or current limiting and shall be rated at a minimum of 125% of controller power consumption.

2.06 INPUT DEVICES

A. General Requirements

1. Installation, testing, and calibration of all sensors, transmitters, and other input devices shall be provided to meet the system requirements.

B. Temperature Sensors

1. General Requirements:

a. Sensors and transmitters shall be provided, as outlined in the input/output summary and sequence of operations. (0.2 BMS Sub-Contractor shall utilize transmitters where distances involved exceed maximum recommended wire run lengths.)

b. The temperature sensor shall be of the resistance type and shall be either two-wire 1000 ohm nickel RTD, or two-wire 1000 ohm platinum RTD.

c. Thermistor type sensors shall be acceptable for room terminal equipment space temperature sensors provided they meet the accuracy specifications below.

d. The following point types (and the accuracy of each) are required, and their associated accuracy values include errors associated with the sensor, lead wire, and A to D conversion.

Point Type	Accuracy
Room Temp	+/- 0.5°F
Duct Temperature	+/- 0.5°F
Water Temperature *	+/- 0.5°F
All Others	+/- 0.75°F

* excludes central plant chilled water and hot water systems

2. Room Temperature Sensors

a. Room sensors shall be constructed for either surface or wall box mounting.

b. Room sensors shall have the following options when specified:

1) Setpoint buttons.

2) 6 programmable buttons.

3) Digital display.

3. Duct Mount Sensors (Rigid Type)

a. Duct mount sensors shall mount in an electrical box through a hole in the duct and be positioned so as to be easily accessible for repair or replacement.

b. Duct sensors shall be insertion type and constructed as a complete assembly, including lock nut and mounting plate.

c. For outdoor air duct applications, a weatherproof mounting box with weatherproof cover and gasket shall be used.

4. Averaging Sensors (Bendable)

a. For ductwork greater in any dimension than 48 inches and/or where air temperature stratification exists, a bendable averaging sensor with a continuous single element to

sense true average temperature along their entire length shall be used.

b. Capillary supports at the sides of the duct shall be provided to support the sensing string.

5. Humidity Sensors

a. The sensor shall be a solid-state type, relative humidity sensor of the Bulk Polymer Design. The sensor element shall resist service contamination.

b. The humidity transmitter shall be equipped with non-interactive span and zero adjustments, a 2-wire isolated loop powered, 4-20 mA, 0-100% linear proportional output.

c. The humidity transmitter shall meet the following overall accuracy, including lead loss and Analog to Digital conversion. 2% between 20% and 80% RH @ 77 Deg F unless specified elsewhere.

d. Outside air relative humidity sensors shall be installed with a rain proof, perforated cover. The transmitter shall be installed in a NEMA 3R enclosure with sealtite fittings and stainless-steel bushings.

e. A single point humidity calibrator shall be provided, if required, for field calibration. Transmitters shall be shipped factory pre-calibrated.

f. Duct type sensing probes shall be constructed of 304 stainless steel, and shall be equipped with a neoprene grommet, bushings, and a mounting bracket.

g. Acceptable Manufacturers: Johnson Controls, Veris Industries, and Mamac or approved equal.

C. Differential Pressure Transmitters – (Non-Central Plant Systems)

1. General Air and Water Pressure Transmitter Requirements:

a. Pressure transmitters shall be constructed to withstand 100% pressure over-range without damage, and to hold calibrated accuracy when subject to a momentary 40% over-range input.

b. Pressure transmitters shall transmit a 4 to 20 mA output signal.

c. Differential pressure transmitters used for flow measurement shall be sized to the flow sensing device and shall be supplied with Tee fittings and shut-off valves in the high and low sensing pick-up lines to allow the balancing Contractor and Client Agency permanent, easy-to-use connection.

d. A minimum of a NEMA 1 housing shall be provided for the transmitter.

e. Air type: Transmitter shall be provided in a NEMA enclosure with barbed fittings for connection of signal lines.

f. Wet type: Shall be enclosed in a NEMA enclosure with a 5 valve bypass assembly.

g. Wet type with remote transmitters: Shall be enclosed in a NEMA enclosure with either armored (6 ft.) or shielded (10 or 20 ft.) cable, depending on the application provide tees, caps and shutoff valves (for balance testing ports).

2. Low Differential Water Pressure Applications (0” - 20” w.c.)

a. The differential pressure transmitter shall transmit a linear, 4 to 20 mA output in response to variation of flow meter differential pressure or water pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

1) .01 - 20” w.c. input differential pressure range.

2) 4 - 20 mA output.

3) Maintain accuracy up to 20 to 1 ratio turndown.

4) Reference Accuracy: +/- 0.2% of full span.

c. Acceptable Manufacturers: Setra and Mamac.

3. Medium to High Differential Water Pressure Applications (Over 21” w.c.)

a. The differential pressure transmitter shall meet the low pressure transmitter specifications with the following exceptions:

1) Differential pressure range 10” w.c. to 300 PSI.

2) Reference Accuracy: +/- 1% of full span (includes non-linearity, hysteresis, and repeatability).

b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

c. Acceptable Manufacturers: Setra and Mamac.

4. Building Differential Air Pressure Applications (-0.05” to +0.05” w.c. up to -1.0” to +1.0” w.c.)

a. The differential pressure transmitter shall transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

1) -0.05” to +0.05” w.c. up to -1.0” to +1.0” w.c. input differential pressure ranges. Provide range appropriate for system application.

2) 4 - 20 mA output.

3) Maintain accuracy up to 20 to 1 ratio turndown.

4) Reference Accuracy: +/- 0.25% of full span.

c. Acceptable Manufacturers: Setra Model 264.

5. Low Differential Air Pressure Applications (0” to 1.0” w.c. up to 5.0” w.c.)

a. The differential pressure transmitter shall transmit a linear, 4 to 20 mA output in response to variation of differential pressure or air pressure sensing points.

b. The differential pressure transmitter shall have non-interactive zero and span adjustments that are adjustable from the outside cover and meet the following performance specifications:

1) (0.0” - 1.0” up to 5.0” w.c.) input differential pressure ranges. Provide range appropriate for system application.

2) 4 - 20 mA output.

3) Maintain accuracy up to 20 to 1 ratio turndown.

4) Reference Accuracy: +/- 0.25% of full span.

c. Acceptable Manufacturers: Johnson Controls and Setra.

6. Medium Differential Air Pressure Applications (5” to 21” w.c.)

a. The pressure transmitter shall be similar to the Low Air Pressure Transmitter, except that the performance specifications are not as severe. Differential pressure transmitters shall be provided that meet the following performance requirements:

1) Zero & span: (c/o F.S./Deg. F): .04% including linearity, hysteresis and repeatability.

2) Accuracy: +/- 1% F.S. (best straight line) Static Pressure Effect: 0.5% F.S. (to 100

PSIG).

3) Thermal Effects: <+.033 F.S./Deg. F. over 40°F. to 100°F. (calibrated at 70°F.).

b. Standalone pressure transmitters shall be mounted in a bypass valve assembly panel. The panel shall be constructed to NEMA 1 standards. The transmitter shall be installed in the panel with high and low connections piped and valved. Air bleed units, bypass valves, and compression fittings shall be provided.

c. Acceptable manufacturers: Johnson Controls and Setra.

D. Differential Pressure Switches

1. Air type: Shall be diaphragm actuated type with a single-pole, double-throw, snap-acting switch. Motion of the diaphragm shall be restrained by a calibrated spring that can be adjusted to set the exact pressure differential at which the electrical switch will be actuated. Motion of the diaphragm shall be transmitted to the switch button by means of a direct mechanical linkage. Electrical rating shall be 6.0 amps at 120 VAC. Pressure range and temperature limits shall be suitable for the application. Switch shall be utilized in conjunction with static pressure probes when utilized across filters, and a static pressure probe on the low side and a velocity probe on the high side when utilized across a fan.

2. Water type: Shall be diaphragm-actuated type with a single-pole, double-throw snap-acting switch. Motion of the diaphragm shall be restrained by a calibrated spring that can be adjusted to set the exact pressure differential at which the electrical switch will be actuated. Switch shall be utilized in conjunction with shut off valves on the low and high sides of the switch to allow for ease of service.

E. Duct Shielded Static Pressure Probe: Probes shall extend the full width of the duct and contain multiple static pressure sensors located along the exterior surface of the cylindrical probe. Said sensors shall not protrude beyond the surface of the probe. The Duct Static Pressure Traverse Probes(s) shall be of extruded aluminum construction and (except for 3/4" dia. probes with lengths of 24” or less) be complete with threaded end support rod, sealing washer and nut, and mounting plate with a gasket and static pressure signal fitting. The Duct Static Traverse Probe(s) shall be capable of producing a steady, non-pulsating signal of standard static pressure, without need for correction factors, with an instrument accuracy of 1%. Duct Static Pressure Traverse Probe(s) (STAT-probe) shall be as manufactured by Air Monitor Corporation or equal as approved by the Professional.

F. Space Static Pressure Sensing Probes: Probes shall be constructed of brushed aluminum with clear anodized finish and suitable for wall or ceiling mounting. Probes shall sense static pressure within 1% of actual pressure value while subjected to a maximum air flow of up to 1000 FPM from a 360º radial source. Space Static Pressure Sensing Probes shall be model S.A.P. as manufactured by Air Monitor Corporation or equal as approved by the Professional.

G. Shielded Static Outside Air Probe: Probe shall be constructed of 10 ga. Type 316 stainless steel with a 2" diameter FPT connection. The outdoor air probe shall be capable of sensing the outside atmospheric air pressure to within 2% of the actual value when subjected to radial wind velocities up to 40 miles per hour with approach angles up to 30º to the horizontal. The Shielded Static Outside Air Probe shall be the S.O.A.P. as manufactured by Air Monitor Corporation or equal as approved by the Professional

H. Status and Safety Switches

1. General Requirements

a. Switches shall be provided to monitor equipment status, safety conditions, and generate alarms at the BMS when a failure or abnormal condition occurs. Safety switches shall be provided with two sets of contacts and shall be interlock wired to shut down respective equipment.

2. Current Sensing Switches

a. The current sensing switch shall be self-powered with solid-state circuitry and a dry contact output. It shall consist of a current transformer, a solid state current sensing

circuit, adjustable trip point, solid state switch, SPDT relay, and an LED indicating the on or off status. A conductor of the load shall be passed through the window of the device. It shall accept over-current up to twice its trip point range.

b. Current sensing switches shall be used for run status for fans, pumps, and other miscellaneous motor loads.

c. Current sensing switches shall be calibrated to show a positive run status only when the motor is operating under load. A motor running with a broken belt or coupling shall indicate a negative run status.

d. Acceptable manufacturers: Veris Industries

3. Low Temperature Limit Switches

a. The low temperature limit switch shall be of the auto reset type with Double Pole/Single Throw snap acting contacts rated for 16 amps at 120VAC.

b. The sensing element shall be a minimum of 15 feet in length and shall react to the coldest 18-inch section. Element shall be mounted horizontally across duct in accordance with manufacturers recommended installation procedures.

c. For large duct areas where the sensing element does not provide full coverage of the air stream, additional switches shall be provided as required to provide full protection of the air stream.

d. The low temperature limit switch shall be equal to Automated Logic.

I. Miscellaneous Input Devices

1. Damper Position Switches

a. Damper position switches shall be non-mercury construction using a roller ball and mechanical switch.

b. Damper position switches shall contain crank arms to fit ½ inch or 1 inch damper shafts for mounting.

c. Damper position switches shall be single pole double throw (SPDT) configuration.

d. Normally open switch shall make 20 degrees above or below horizontal.

J. Smoke Detector

1. Ionization type air duct detectors shall be furnished as specified elsewhere in Division 26 for installation under Division 23. All wiring from air duct detectors to fire alarm system shall be provided under Division 26, Fire Alarm System. All other wiring not directly to the fire alarm system shall be furnished and installed by this 0.2 BMS Sub-Contractor.

2.07 OUTPUT DEVICES

A. Actuators

1. General Requirements

a. Damper and valve actuators shall be electronic.

2. Electronic Damper Actuators

a. Electronic damper actuators shall be direct shaft mount.

b. Modulating and two-position actuators shall be provided as required by the sequence of operations. Damper sections shall be sized based on actuator manufacturer's recommendations for face velocity, differential pressure and damper type. The actuator mounting arrangement and spring return feature shall permit normally open or normally closed positions of the dampers, as required. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction, and a gear release to allow manual positioning.

c. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more

than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication.

d. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Isolation, smoke, exhaust fan, and other dampers, as specified in the sequence of operations, shall be furnished with adjustable end switches to indicate open/closed position or be hard wired to start/stop associated fan. Two-position actuators, as specified in sequences of operations as “quick acting,” shall move full stroke within 20 seconds. All smoke damper actuators shall be quick acting.

e. All actuators used on outdoor air intake or relief dampers or actuators used on terminal equipment (air handling units and other equipment with outdoor air intakes, etc.) control valves shall be of the spring return to fail-safe position type. Non-spring return actuators shall not be acceptable. Batteries used to provide fail safe operation shall not be acceptable.

B. Control Valves: Factory fabricated, of type, body material, and pressure class based on maximum pressure and temperature rating of piping system, unless otherwise indicated. All valves shall be fully modulating unless otherwise indicated. 0.2 BMS Sub-Contractor shall be responsible for selection of proper control valves for project, in accordance with the parameters defined by the following paragraphs, including sizing, pressure rating, flow coefficient, flow characteristic, close-off rating and allowable leakage factor. Valve construction shall be as follows with NO EXCEPTIONS. Ball valves shall be used for all radiant panels and terminal unit control valves shall be used for CUH.

1. Control Ball Valves 3 inches and smaller (2 inches for 3-way valves): Forged brass body (CuZn39Pb2), chrome plated brass ball and blowout proof stem and EPDM O-rings with minimum 600 psi rating. Valve shall contain glass filled ball insert capable of providing equal percentage flow. Valves shall have allowable media temperature of 20 Deg F to 250 Deg F.

   a. Rating: Minimum 100 psi close off on 2 way valves and 70 psi on 3 way valves.

   b. Medium: Valves shall be used with hot water or cold water with up to 50% glycol.

   c. Sizing:

      1) Minimum 100 psi close off on 2 way valves and 70 psi on three way valves

      2) Maximum differential shall be 35 psi to ensure quiet operation.

   d. Flow Characteristics: 2 way vales shall have equal percentage characteristics. 3 way valves shall have an equal percentage characteristic through the control port and a linear characteristic through the bypass port.

2. Terminal Unit Control Valves: 360 psi forged yellow brass body, nickel plated brass ball, with optimizer insert for modulating applications, blow-out resistant stem, two or three-port as indicated, and threaded ends for chilled or hot water, up to 50% glycol solutions. Actuators shall be as noted above with 5 year warranty. Spring return is required for all Unit Ventilator heating valves and other terminal equipment that has an outside air source. All non-spring return valves must have manual override ability built in to the actuator.

   a. Rating: ANSI class IV, maximum static pressure of 250 psig., minimum fluid temperature of 20ºF and maximum of 250ºF operating conditions.

   b. Sizing: 4 psig. maximum pressure drop at design flow rate, to close against pump shutoff head.

   c. Flow Characteristics: Two-way and three-valves shall have equal percentage characteristics.

3. Actuation: Valve actuators shall be selected to provide proper control, and close-off as required by the application. All valves actuators shall be provided with position indication. Actuators shall be provided with weatherproof option where dictated by the device location.

a. Modulating and two-position actuators shall be provided as required by the sequence of operations. All actuators (except terminal units) shall be furnished with mechanical spring return unless otherwise specified in the sequences of operations. All actuators shall have external adjustable stops to limit the travel in either direction and a gear release to allow manual positioning.

b. Modulating actuators shall accept 24 VAC or VDC power supply, consume no more than 15 VA, and be UL listed. The control signal shall be 2-10 VDC or 4-20 mA, and the actuator shall provide a clamp position feedback signal of 2-10 VDC. The feedback signal shall be independent of the input signal and may be used to parallel other actuators and provide true position indication.

c. Two-position or open/closed actuators shall accept 24 or 120 VAC power supply and be UL listed. Actuators shall be spring return.

d. All actuators used on air handling units and other equipment with outdoor air intakes or entrance ways, etc. control valves shall be of the spring return to fail-safe position type. Non-spring return actuators shall not be acceptable. Batteries used to provide fail safe operation shall not be acceptable. Actuators on VAV's, and other equipment without outdoor air intakes can be fail in place.

e. Acceptable manufacturers: Honeywell, Johnson Controls, Schneider Electric, Belimo or Siemens or approved equal.

C. Control Relays

1. Control Pilot Relays

a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.

b. Mounting Bases shall be snap-mount.

c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.

d. Contacts shall be rated for 10 amps at 120VAC.

e. Relays shall have an integral indicator light and check button.

D. Signal Isolators

1. Isolated DC to DC Transmitters shall:

a. Eliminate ground loop wiring problems.

b. Provide jumper selectable current or voltage inputs.

c. Provide jumper selectable current or voltage outputs.

d. Provide linearity of better than 0.5% of span.

e. Provide isolation of 1000V (DC or AC peak) maximum

f. Provide an operating temperature range of 14 deg. F. to 140 deg. F.

g. Provide an operating humidity range of 5% to 95% RH non-condensing

2.08 MISCELLANEOUS DEVICES

A. Local Control Panels

1. The 0.2 BMS Sub-Contractor shall provide wired panels for each applicable HVAC system, excluding terminal equipment. Panels shall be constructed of furniture grade steel painted to match DDC controller enclosures and shall be located adjacent to the DDC controllers involved. All thermal switches, transformers, power supplies, transducers, signal isolators, etc. shall be mounted, wired and piped in each panel along with all necessary identification tags. Gauges with identification tags shall be provided for each incoming and outgoing pneumatic line. All control panels shall be UL listed. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.

2. Controllers mounted outdoors, such as on or in roof top equipment, shall be mounted within appropriate NEMA rated and size enclosures. Enclosures shall dissipate heat generated

from contents plus any/all solar loading that occurs due to the enclosures installed location to prevent damage to any items contained within enclosure. In turn, enclosure heat shall be thermostatically controlled to prevent damage to any contained devices from condensation or low temperatures. All wire ways and/or conduits entering control enclosures shall be sealed where the wiring enters control enclosure to prevent the migration of air and/or moisture into or out of the enclosure. The mounting location of enclosures shall be coordinated with all applicable trades and the professionals and shall only be mounted where the installed location does not interfere with or cause problems with the unit construction, installation, operation, roof snow build up, future serviceability or future warranty.

3. All panel wiring shall be to and from terminal strips. The use of wire nuts for connection of wiring to or from a common point is not acceptable.
4. All I/O connections on the DDC controller shall be provided via removable or fixed screw terminals.
5. Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.
6. All wiring shall be neatly installed in plastic trays.
7. All wiring shall be identified.
8. A convenience 120 VAC duplex receptacle shall be provided in each enclosure, fused on/off power switch, and required transformers.

B. Power Supplies and Line Filtering

1. Power Supplies: Control transformers shall be UL listed. Furnish Class 2 current-limiting type or furnish over-current protection in primary and secondary circuits for Class 2 service in accordance with NEC requirements. Limit connected loads to 80% of rated capacity.
    a. DC power supply output shall match output current and voltage requirements. Unit shall be full-wave rectifier type with output ripple of 5.0 mV maximum peak-to-peak. Regulation shall be 1.0% line and load combined, with 100-microsecond response time for 50% load changes. Unit shall have built-in over-voltage and over-current protection and shall be able to withstand 150% current overload for at least three seconds without trip-out or failure.
    b. Unit shall operate between 0°C and 50°C (32°F and 120°F). EM/RF shall meet FCC Class B and VDE 0871 for Class B and MILSTD 810C for shock and vibration.
    c. Line voltage units shall be UL recognized and CSA listed.
2. Power Line Filtering
    a. Provide internal or external transient voltage and surge suppression for workstations and controllers. Surge protection shall have:
    b. Dielectric strength of 1000 V minimum
    c. Response time of 10 nanoseconds or less
    d. Transverse mode noise attenuation of 65 dB or greater
    e. Common mode noise attenuation of 150 dB or greater at 40-100 Hz

C. 120 VAC to 24 VAC Power Boxes

1. Furnish and install UL listed, Class 2, UL916 power boxes. Power Boxes shall accept 120 VAC input and provide 24 VAC output. Furnish and install power boxes as required to satisfy connected load requirements. Power boxes shall be NEMA 1 rated enclosure and contain one or multiple outputs. Each 24 VAC output shall contain a combination on/off switch and circuit breaker. Each output shall be an isolated 24VAC 75 or 100 VA output with a red LED for output voltage indication.

D. Thermostats

1. Electric room thermostats of the heavy-duty type shall be provided for unit heaters, cabinet unit heaters, and ventilation fans, where required. All these items shall be provided with concealed adjustment. Finish of covers for all room-type instruments shall match and, unless otherwise indicated or specified, covers shall be manufacturer's standard finish.

E. Thermostat, Humidistat and CO_2 Sensor Guards: All thermostats, humidistats and CO_2 sensors located in public and non-supervised areas shall be fitted with tamperproof Lexan guards. Provide clear plastic lockable covers for thermostats located in classrooms, libraries, auditoriums, gymnasiums, cafeterias, conference corridors, entrance vestibules and all other public spaces.

F. Control Dampers

1. Performance: Test in accordance with AMCA 500-D.
2. Frames: extruded aluminum no exceptions.
3. Blades: aluminum, air foil.
4. Blade Seals: Silicon EPDM.
5. Jamb Seals: Extruded EPDM.
6. Shaft Bearings: Celcon inner bearing and polycarbonate outer bearing (no exceptions)
7. Linkage Bearings: Celcon inner bearing and polycarbonate outer bearing (no exceptions)
8. Leakage: Less than one percent based on approach velocity of 2000 ft/min and 4 inches wg.
9. Maximum Pressure Differential: 6 inches wg.
10. Temperature Limits: -72 to 212 degrees F.
11. Dampers are to be made to size without blank-off plates.
12. Dampers shall be Tamco 1000 for interior duct work and Tamco BF-9000 for outside air or exhaust air dampers.

G. Refrigerant Monitor System – Haloguard IR

1. General - The gas monitoring system shall continuously measure and display the specified gas concentration. The system shall provide visual indicators when preset limits are exceeded. Relay output for alarms and control shall be provided. Sensor shall be provided for the refrigerant used by the chillers. There shall be two sensors per chiller. The system shall consist of split construction with a control module and remote sensing modules. The complete system, including strobe and horn accessories, shall be furnished by the BMS Sub-Contractor and installed by the BMS Sub-Contractor.
2. Refrigerant Monitor
    a. Refrigerant Monitor (single point diffusion type Sensor Modules) shall provide a continuous indication of a refrigerant concentration in air. It shall measure the concentration of a refrigerant in a complex mixture of background gases and be capable of monitoring a refrigerant from 0 to 1000 parts per million (ppm). Each instrument shall be factory calibrated to a certain full-scale value of a specific refrigerant
    b. All Sensor Modules shall use infrared photo-acoustic sensors. These sensors shall give an indication of refrigerant levels without requiring oxygen to be present. Also, the sensors shall not be poisoned or degraded in the presence of most silicon or sulfur compounds. Sensor Modules shall be capable of operation in areas with varying humidity or in areas containing other contaminants and may be used for applications requiring long-term stability and low maintenance.
    c. Each Sensor Module shall be placed in an area where a refrigerant is anticipated or must be controlled. The Module shall operate in the Diffusion style (gas diffuses into the sensor through the opening located at the bottom of the unit). The gas sensor shall determine the refrigerant concentration and output an electrical analog signal proportionate to the concentration.

d. The Sensor Module shall contain all components necessary to properly sample an area for a refrigerant.

e. Sensor Module -The unit shall include:

1) Std: NEMA 12 enclosure, Opt: NEMA 4 enclosure

2) Photoacoustic IR Sensor.

3) Six LED status indicators.

4) 24 VAC operation.

5) Std: 4x5A, dry contact relay SPDT, Opt: 7x10A, dry contact relay SPDT
Opt: 0-5VDC, 4-20mA analog

6) 1000 PPM detection limit.

f. Sensor Module Performance

1)	Sensitivity	1 ppm
2)	Resolution	1 ppm
3)	Warm-Up time	10 minutes
4)	Operating Temp	32 to 120 deg F
5)	Sample Rate	1.5 Lpm in free air

3. Control Module

a. The Control Module shall be a unit which can communicate with up to twenty-four Refrigerant Sensor Modules. The Control Module can be installed remotely from the sensors, thus enabling remote control of the Refrigerant Monitor. The transformer version of the Control Module shall be provided in order to power the remote Sensors Modules.

b. The Control Module instrument shall act as the Master device in the network. The Control Module instrument shall initiate and control all communications on the network. The Control Module instrument shall send out commands and request data from individual sensors. When the instruments are powered up, the Control Module shall automatically detect the number and gas type of all instruments on the network.

c. Control Module - The unit shall be a wall mount type.

1) The enclosure shall be a NEMA 4 or NEMA 12 version

2) The control module shall feature digital signal processing with RS-232 system compatible. A 4-20 mA output and 0-10VDC shall also be available.

3) Control Module shall accept up to 24 remote sensor inputs over a single pair cable.

4) Control Module shall include a Digital Display.

5) Three levels of Alarm and Fault indicators.

6) System configured via the front panel keypad.

7) An 85 Db audible alarm with an acknowledge switch shall be standard on the control module.

8) A visual alarm strobe shall be provided.

9) System power shall be 100/240 VAC 50/60 Hz.

4. Unit Requirements

a. Readout Displays - A (2) line x 20 character alpha numeric display shall be provided for the purpose of displaying the gas concentration, diagnostics, set-up and calibration menu.

b. Visual Alarm Indicators - All alarm indications shall be displayed on the front panel display.

c. Alarm Set Point Levels - Three separate alarm set point levels shall be provided. The set points shall be independently adjustable for any value for a given range. The set points shall provide drive signals to user interface relays. The alarm set points shall have the capability of providing the user a selection of latching or non-latching.

d. Relay Outputs - The alarm set point drive signals shall activate user relays.

1) Number of Relays - As a minimum, one relay for each alarm set point level shall be provided on the control unit.

2) Contact Rating - All relays shall be Form C, single pole, double throw. Dry contacts shall be rated for 5 amps resistive at 240 VAC.

3) Contact Selection - The contacts shall be capable of being selected normally energized or non-energized, latching or non-latching.

4) The Trouble (Fault) relay is normally energized and closed for normal conditions. If a system fault is detected the Trouble relay will de-energize.

e. Malfunction Indication - The readout display above shall display full diagnostics when a fault exists without the use of codes.

f. Audible Alarm - An audible buzzer shall be included, it sounds when one of the three preselected alarm conditions or a trouble condition occurs.

g. Front Panel Controls - The function listed below paragraph shall be accomplished using a keypad readily accessible on the front panel. No tool or special adapters shall be used for:

1) Display of alarm set point level on the readout display

2) Resetting any alarm set point

3) Zero and Span calibration adjustments

h. Output Signals

1) The 4-20 mA output shall have the following features:

a) Scalable to 1-10% of the full scale. The default shall be 100% full scale.

b) The output shall be sourcing current to module ground.

c) For refrigerants, software will have a dead-banding feature not allowing a value less than 10 PPM to be displayed on the front panel.

2) RS-485 using ModBus communication protocol will be included in all sensor modules.

3) The control modules will have an ATO output option of RS-232, 4-20mA, or 0-10VDC.

a) The 10 volt analog output may be used to identify the station being monitored in a multipoint sequencing unit.

5. The Contractor shall provide strobe alarm accessories at the control module as well as at entrances to the chiller room to be activated whenever the Control Module detects an alarm condition. Strobe accessories shall be furnished by the refrigerant monitor manufacturer and installed by the BMS Sub-Contractor.

6. The Contractor shall provide Calibration kit and a sufficient supply of calibration gas to cover start-up, commissioning, and warranty period operation requirements.

7. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. Thermal Gas Systems Inc.

PART 3 – PERFORMANCE / EXECUTION

3.01 BMS SPECIFIC REQUIREMENTS

A. Graphic Displays

1. Provide a BMS flow diagram for each system with all points as indicated on the point list.
2. User shall access the various system schematics via a graphical penetration scheme including dashboard type selection screens to select scheduling and trends.
3. All set-points, parameters, etc. designated as manually adjustable (i.e. adj.) in the sequences of operation shall be directly adjustable from the associated colorgraphic screen or a separate setpoint screen, the latter being directly accessible via a transfer point on the original colorgraphic screen. It shall not be necessary to leave the colorgraphic screen package in order to make the adjustments. NO EXCEPTIONS. Setpoint adjustment shall be a single step process (i.e. not require multiple save operations) and all setpoint changes shall be retained during power outages. Any deviation from these requirements shall be clearly pointed out to the Professional prior to bid.
4. Alarm limit, setpoint and reset schedule values indicated in the specifications or sequences of operation are given as starting points only. Final values shall be established during the commissioning process and provided in hard copy documented format by the 0.2 BMS Sub-Contractor as part of the O & M manual submission at project completion.

B. In addition to the override functions described or implied elsewhere, the BMS shall include the following global overrides at the graphical interface level.

Each AHU System (applies to boxes connected to given AHU only)

Open all VAV boxes fully

Close all VAV boxes fully

All VAV boxes to minimum CFM

All VAV boxes to maximum CFM

Automatic control of all VAV boxes

C. The following graphical screens, as a minimum, shall be developed for this project. For each system or floor plan, the display shall contain the points identified in the Sequence of Operation point list (or available via the interface) as well as associated software points and allow for setpoint changes, overrides etc. Where necessary, multiple graphic screens shall be provided for a unit/system in order to convey the required information in an uncluttered fashion. In addition, on-line access to current BMS as-built record drawings and documentation shall be available from the graphic package. Sequence of operation information, shop drawings and specification data sheets associated with a system shall be available from the graphic screen associated with that system. This feature shall be fully implemented for all graphic screens created for this project. NO EXCEPTIONS. The BMS shall also include implemented override capability of all controller outputs (for controllers provided by the 0.2 BMS Sub-Contractor) via the graphics for an authorized user.

1. Main Screen
2. Weather Station Overview
3. Building Overview with Floor/Area Selection
4. Main Level Floor Plan thermographic floor plan with transfer to terminal units
5. Roof Overview with Equipment Selection
6. Boiler Room Overview with Equipment Selection
7. Hot Water System Overview
8. Hot Water System Setpoints
9. Hot Water Circulating Pumps (including VFD communication interface points)
10. Chilled Water System Overview
11. Chilled Water System Setpoints

12. Chilled Water Circulating Pumps (including VFD communication interface points)
13. AHUs and RTUs
14. AHU and RTUs Setpoints
15. Individual VAV Boxes (one screen per VAV box)
16. Individual Reheat Coils (one screen per reheat coil)
17. Exhaust Fans (one screen per fan/group)
18. Fire Alarm System Interface
19. Equipment “Out-of-Service” Switch Selection (one screen per subsystem)
20. Equipment Lead/Lag Selection (one screen per subsystem)
21. OSS Schedules (one screen per zone)
22. OSS Schedule Overrides (one screen per zone)
23. Holiday Schedules
24. Miscellaneous

D. The project graphics will include implemented “view only” capability for selected personnel.

E. Alarm Requirements

1. All alarm conditions (ALL MTR (*), COS (~), LIMIT (~) and RTN (~) alarm information designated in the I/O Points List) shall be indicated by showing a red alarm icon on the current graphic display. A separate page shall be used to display alarm details. AVs and BVs read/written across 3rd party communication interfaces shall also be treated as I/O points for alarming purposes and alarmed as determined by the Client Agency.
2. Refer to Section 230993, paragraph 3.24, Alarm Requirements for additional information about alarms to be fully implemented by the 0.2 BMS Sub-Contractor as part of the work of this project.

F. Trend Requirements

1. All I/O points and setpoints shall be linked to BACnet trend objects. The controller(s) shall record a trend sample every 15 minutes (adj.) for each trend object and save the most recent 120 (adj.) samples.
2. AVs and BVs read/written across 3rd party communication interfaces shall also be treated as I/O points for trending purposes.
3. Refer to Section 230993, paragraph 3.25, Trend Requirements for additional information about trends to be fully implemented by the 0.2 BMS Sub-Contractor as part of the work of this project.

G. Custom Reports:

1. Provide custom reports as required for this project:

H. Actuation / Control Type

1. Primary Equipment
   a. All damper and valve actuation shall be electric.
2. Terminal Equipment
   a. All damper and valve actuation shall be electric.

I. The 0.2 BMS Sub-Contractor shall meet with the Client Agency to determine routine requirements for all alarm information. Particular attention shall be paid to developing a routine procedure that prevents non-critical alarms from impacting critical system operation. The prioritization and routine shall be fully implemented to the satisfaction of the Client Agency.

3.02 INSTALLATION PRACTICES

A. Existing and New ATC System Installation Scope, Phasing, Implementation, Coordination and

Demolition.

1. SCOPE: It is the intent of this project that new systems will be controlled by the existing BMS. Therefore, it is specifically required by this section that an entirely new Facility Wide BMS system be installed with appropriate DDC controllers on every new mechanical system as defined within sections 230900 and 230993.
2. PHASING: Work of this section shall be coordinated with actual dynamic scheduling of phasing of all other trades. During the renovation process, the 0.2 BMS Sub-Contractor shall address operation of hybrid controls, whereby part of the HVAC equipment is controlled by the existing control system while the other part(s) are controlled by the new BMS, while still maintaining interior environmental conditions that are acceptable to the Client Agency. The intent is to maintain integrated performance of existing automatic temperature control systems and new BMS systems, to the maximum extent possible, throughout the renovation process.
3. IMPLEMENTATION: As soon as a BMS DDC controller is placed into operation, whether temporary or permanent, it shall be connected to the Dedicated Web Based User Interface, the Distributed Web Based User Interface and the G5 Gateway which have already been placed into complete operation with complete functionality for each installed DDC controller. This shall include the installation of the high speed internet service, connection, wiring and devices; all required Ethernet network wiring and devices and all required BMS communication network wiring and devices for each segment placed into operation whether infrastructure is installed temporarily or permanently until such time the complete system can be permanently installed.
4. COORDINATION: The 0.2 BMS Sub-Contractor shall coordinate the existing control system demolition with the work of all the other trades. All portions of the facility that are to remain operational shall have their control systems left intact and operational until that specific phase is due for remodeling. Any controls, tubing and/or wiring that were demolished prematurely, shall be placed back into operation by this Sub-Contractor until the area served is to be remodeled. The 0.2 BMS Sub-Contractor shall demo any/all existing control items, wiring, tubing and etc. that the other trades have not already demolished during the performance of their work. The 0.2 BMS Sub-Contractor shall perform all cutting, patching and painting as required for the removal of the existing control system. Any existing HVAC equipment to remain shall be tied into the new BMS system as required.
5. DEMOLITION: All old terminal devices will be removed, and associated wiring/tubing will be removed back to their source as part of the work of this project. All air lines that must remain active until a later time shall be capped airtight and leak free, where partial removal has been required. Empty conduit(s) that remain can be used by the new BMS as applicable. The 0.2 BMS Sub-Contractor shall coordinate with the Client Agency, prior to any demolition activities by the Mechanical Sub-Contractor or the 0.2 BMS Sub-Contractor, to determine any existing automatic temperature control devices that will be carefully salvaged and turned over to the Client Agency as spare parts.
    a. Where demolition work associated with the existing pneumatic/electric system is indicated by the contract documents, all panels, devices, wiring, and tubing associated with the demolition will be removed under this new project. The 0.2 BMS Sub-Contractor shall be responsible for patching and painting required as a result of the demolition process. Painting and patching shall match surrounding conditions.
    b. All abandoned and all unused pneumatic tubing shall be removed to its point of origin. At the tubing disconnect point, the remaining tubing shall be capped (plastic tubing capped with a barbed plug and copper tubing capped by soldering on a copper cap.) to provide a pressure tight and non-leaking cap.

B. BMS Wiring

1. All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the 0.2 BMS Sub-

Contractor unless specifically shown on the Electrical Drawings under Division 26 Electrical. All wiring shall comply with the requirements of applicable portions of Division 26 and all local and national electric codes, unless specified otherwise in this section.

a. All BMS wiring materials and installation methods shall comply with BMS manufacturer's recommendations.

2. All conduit, fittings, hangers and accessories for control wiring installed under the HVAC Contract shall conform to the levels of quality specified under Division 26.

3. All wiring shall be installed in conduit, and conduit shall be concealed in finished areas, except as hereinafter specified. Power or interlock wiring shall be run in separate conduit from sensor wiring.

4. All new construction thermostat drops shall be installed utilizing conduit with an electrical wall box installed within the wall construction. NO EXCEPTIONS. All wall thermostats and wall sensors located in non-public areas shall be mounted with centerline 42" above the finished floor to comply with ADA mounting height requirements (or as further clarified elsewhere in the contract documents). All thermostats and wall sensors located in restrooms, corridors and other public areas shall be mounted with centerline 7'-0" above the finished floor.

   a. Where wiring cannot be concealed in finished spaces, wiring shall be installed exposed in metal or wire molding as approved by the Client Agency. The Client Agency MUST approve all final thermostat locations and the routing of all surface molding. Wiring exposed in unfinished spaces shall be run in a neat and workmanlike manner parallel to the building lines.

5. All low voltage conductors shall be types as herein indicated. Other types and sizes required by the temperature control manufacturer shall be submitted for approval. Low voltage two conductor wire shall be black twisted (six turns per foot) 16 AWG or 18 AWG wire, as indicated, 1/32, 80 degrees C., 600-volt PVC insulation. Low voltage three conductor wire shall be red, yellow, blue twisted (six turns per foot) 16 AWG or 18 AWG wire as indicated, 1/32, 80 degrees C., 600-volt PVC insulation. Cable shall be as manufactured by Alpha Wire Company, Belden Wire Company, Standard Wire and Cable or approved equal.

6. All control wiring outside of control panels shall be run in rigid conduit or EMT, except as hereinafter specified, and installed in strict accordance with the requirements of The National Electrical Code. Wiring for the control system, except the low voltage conductors, shall be single conductor solid or stranded copper not less than No. 14 AWG, with 600-volt Type THHN insulation, except where the manufacturer requires special types and sizes. Flameproof insulation shall be used where required by the NEC. Wiring for DDC system inputs/outputs shall be No. 18 two conductor with shield installed in accordance with the requirements of The National Electrical Code. Wiring for DDC system communication trunk shall be 2 conductors, 24AWG, stranded shielded low capacitance cable. All wiring in panel construction may be No. 16 or No. 18 AWG copper as recommended by the manufacturer provided same is properly protected and/or is in accordance with the NEC. No temperature control wiring installed under this contract shall be installed in the building lighting and power circuit systems. Communication trunk wiring shall not be installed in raceway and/or enclosures containing Class 1 or other Class 2 wiring.

   a. Cable types shall be color coded for easy identification and troubleshooting

7. BACnet ARCnet or MS/TP communications wiring shall be installed in accordance with ASHRAE/ANSI Standard 135. This includes but is not limited to:

   a. ARCnet

      1) The network shall use shielded, twisted-pair cable with characteristic impedance between 100 nominals. Distributed capacitance between conductors shall be less than 12.5 pF per foot (41 pF per meter.)

      2) The maximum length of an ARCnet segment is 610 meters (2000 ft) with AWG 22

cable.

3) The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.

4) An ARCnet network shall have no T connections.

b. MS/TP

1) The network shall use shielded, twisted-pair cable with characteristic impedance between 100 and 120 ohms. Distributed capacitance between conductors shall be less than 100 pF per meter (30 pF per foot.)

2) The maximum length of an MS/TP segment is 1200 meters (4000 ft) with AWG 18 cable. The use of greater distances and/or different wire gauges shall comply with the electrical specifications of EIA-485

3) The maximum number of nodes per segment shall be 32, as specified in the EIA 485 standard. Additional nodes may be accommodated by the use of repeaters.

4) An MS/TP EIA-485 network shall have no T connections.

8. The use of plenum rated cable shall be permitted above concealed, accessible ceilings.

9. Both conduit and plenum wiring shall be supported from or anchored to structural members. Conduit or plenum wiring supported from or anchored to piping, duct supports, the ceiling suspension system, is not acceptable. Class 2 wiring not installed in conduit shall be supported every 5' from the building structure.

10. If BMS power requirements exceed circuit capacity or circuit quantity as provided by the contract documents, the 0.2 BMS Sub-Contractor shall then extend additional power wiring, complete with required breakers, from an electrical panel, as approved by the professional, at no additional cost to the Client Agency. Where an ATC device requires power and no trade is noted as providing that power on the contract documents, the 0.2 BMS Sub-Contractor shall provide all required power wiring, complete with breakers (where required), from an electrical panel as approved by the professional, at no additional cost to the Client Agency.

11. Where 24 VAC power is required for terminal device controllers, the 0.2 BMS Sub-Contractor shall also be responsible for providing a power box to transform the available 120 VAC. Multiple controllers may be powered from the same power box. Power box loads shall be limited such that only 80% of the available VA is utilized during normal operation.

12. Run pneumatic tubing in straight lines, parallel to the lines of the building, and rack on factory furnished mounting blocks attached to the building structure. Do not bury or conceal tubing and wiring beneath insulation. Locate tubing and wiring clear of access doors, accessible ceilings, lighting fixtures, walkways or any location subject to damage or abrasion.

13. Penetrations:

a. Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.

b. All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

c. All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.

d. Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

C. All input and output devices shall be installed per the manufacturer's recommendations.

D. All sensing elements located in water lines or tanks shall be provided with stainless steel separable sockets. The 0.2 BMS Sub-Contractor shall select the proper location for each separable well and shall provide written installation directions to the mechanical Sub-Contractor for installation. Sensing elements installed in ducts shall be securely anchored, and when long

or averaging sensing elements are used the elements shall be strung through the duct to ensure representative cross-sectional sampling.

E. Temperature sensing and limit devices shall be provided in quantities as required to adequately cover the surface area (1 lineal foot of element for 1 square foot of coil area) of the coil involved. While the contract documents may often indicate that multiple devices are required for a particular coil, not all locations requiring multiple devices are so indicated on the contract documents. The 0.2 BMS Sub-Contractor shall be responsible for field verification of coil surface areas involved and providing the required number of sensing and/or limit devices at all locations, regardless of any quantity omission from the contract documents. Series, parallel or series/parallel circuit reduction to a single input shall not be permitted. NO EXCEPTIONS.

F. Where supply air discharge temperature sensors are located downstream of duct mounted heating coils, the 0.2 BMS Sub-Contractor shall mount the temperature sensor a minimum of six (6) feet from the coil discharge.

G. Automatically controlled dampers shall be provided complete by the Mechanical Sub-Contractor. The 0.2 BMS Sub-Contractor shall furnish and install operators for the dampers. In all instances, the 0.2 BMS Sub-Contractor shall provide the quantity of actuators required to supply the torque requirements specified by the damper manufacturer.

H. The 0.2 BMS Sub-Contractor shall refer to drawings as located by the Engineer. All room temperature sensor locations indicated on the drawings shall be the location for that sensor. The 0.2 BMS Sub-Contractor shall be permitted to make small location changes to avoid interference from furniture, equipment, diffuser locations, or other obstructions that prohibit installation in the located shown on the drawings.

I. The 0.2 BMS Sub-Contractor shall provide room temperature sensor(s) of the following functionality: sensor with unoccupied override, digital display, and setpoint adjust. Refer to drawings for room temperature sensor locations.

J. The 0.2 BMS Sub-Contractor shall coordinate the final location of all BMS control panels indicated on the contract documents with the Mechanical Sub-Contractor, the Electrical Sub-Contractor, and the Client Agency's representative. Such coordination shall take place prior to the 0.2 BMS Sub-Contractor beginning field installation work for the Building Management System and shall become a matter of record in the job meeting minutes for the meeting immediately preceding the start of Building Management System installation. Each control panel shall be anchored per the manufacturer's recommendations.

K. All BMS controllers, panels and input/output interface panels shall be identified with black laminated plastic nameplates with white lettering. All BMS controllers shall also have black laminated plastic tags with white lettering identifying controller IP address. Controller panel identification shall be the same as used on the control drawings such that it can be easily cross referenced with as-built drawings, and shall also include system, area served, etc. All items of equipment within input/output interface panels shall be labeled with an identification that also corresponds with as-built drawings. All items mounted on the face of input/output interface panels shall be identified with black laminated plastic nameplates with white lettering. Identification shall include function and position information where applicable. All field devices shall be identified with black laminated plastic nameplates with white lettering secured with either double-backed tape or metallic strapping. Identification shall be same tag symbol as found on the as-built drawings and shall also include system, area served, etc. In addition, control devices shall also include range data (as applicable) and signal type (4-20 mA, Open/Closed, etc.) information.

L. The 0.2 BMS Sub-Contractor shall provide software to be loaded on the Balancing Sub-Contractor's computer for use in balancing the VAV system. The Balancing Sub-Contractor shall be responsible for delivering his computer to the 0.2 BMS Sub-Contractor's office to have the software loaded and at the same time receive training on proper use of the software package. During the project, the 0.2 BMS Sub-Contractor shall provide additional telephone support to the Balancing Sub-Contractor on proper use of the software package. At the end of the project, the Balancing Sub-Contractor shall be responsible for delivering his computer back to the 0.2 BMS

Sub-Contractor's office to have the balancing software deleted.

M. In addition to any balancing and/or start-up assistance specified elsewhere in this section of the specifications, the 0.2 BMS Sub-Contractor shall include in his bid five (5) days of on-site technician time to aid the Balancing Sub-Contractor in using the DDC system to configure required modes of operation for testing purposes. This time shall be consumed in full day increments, not necessarily concurrent, and must be scheduled with the 0.2 BMS Sub-Contractor a minimum of one (1) week in advance of the actual need date. Should the Balancing Sub-Contractor require additional assistance, he shall be responsible for compensating the 0.2 BMS Sub-Contractor on a time-and-material basis.

N. Fan System Safeties:

1. Each safety shall be wired to its associated BMS controller I/O panel to operate a discrete multi-pole relay. Each safety shall be wired as normally closed and energize its associated multi-pole relay coil under normal conditions. One set of relay contacts shall be wired as an input into the BMS to provide safety status. Another set of contacts shall be series hardwired with the other associated fan safeties to provide a fan system hardwired safety shut down.

2. Hardwired Safeties and Stop/Start Relays: It is the intent of this project that any and all hardwired safeties and stop/start relays are all terminated in the new system I/O panels associated with the controller for each system. The exception to this will be the fire alarm system interface modules provided by the fire alarm system Sub-Contractor, which shall be mounted near each respective starter.

O. The 0.2 BMS Sub-Contractor shall have on-site personnel capable of making programming and hardware changes to the BMS throughout the commissioning process.

P. The 0.2 BMS Sub-Contractor shall provide a full complement of software tools and associated training (and hardware where proprietary devices are involved) for use by the Client Agency during the commissioning process.

Q. The contract documents require a combination of hardwired points (AO, AI, BO and BI) and points (AV and BV) available through the drive communication interface. The 0.2 BMS Sub-Contractor shall not eliminate the hardwired points and use the communication interface instead. Hardwired points are to remain. NO EXCEPTIONS.

R. A single symbol for electric/electronic actuator(s) indicated on the drawings for damper control is not meant to indicate that only one actuator is required. Rather, it indicates that electric/electronic actuation, in the required quantity, is to be provided at that location. In all instances, the 0.2 BMS Sub-Contractor shall provide the quantity of actuators required to supply the torque requirements specified by the damper manufacturer.

S. All air system and all water system setpoint values shall be coordinated with the TAB Sub-Contractor to determine final operating parameter setpoints. All hardwired safety setpoints shall be field verified with the TAB Sub-Contractor.

3.03 START-UP AND CHECK-OUT PROCEDURES

A. The 0.2 BMS Sub-Contractor shall be responsible for developing test plans and procedures to establish that the BMS system functions as described in the Sequence of Operations. The methodology shall address the observations, measurements, adjustments, calibrations and corrections necessary to accomplish the commissioning process. A detailed item-by-item procedure shall be followed for each item of HVAC equipment. Forms used by the 0.2 BMS Sub-Contractor to record the results of the start-up and check-out procedures shall be available for review by the Professional and the Client Agency.

B. The procedures followed shall, as a minimum, incorporate requirements to satisfy the commissioning responsibilities of the 0.2 BMS Sub-Contractor in support of the work of the Client Agency's commissioning process.

C. Where Maintenance Time Reminders, Change-of-State Alarms, Analog Limit Alarms, etc. are to be provided, the 0.2 BMS Sub-Contractor shall verify that each message is sent to the appropriate output device whenever the trigger condition occurs.

D. Where graphics are being provided, the 0.2 BMS Sub-Contractor shall verify that all links from dynamic point displays to the actual hardware and software points are correct. This verification shall involve using each graphic screen to make all setpoint changes, schedule overrides, control overrides etc. and verify that the appropriate changes to the control hardware and panel databases take place.

E. Where implemented trends at the panel level and/or the HMI computer level are to be provided, the 0.2 BMS Sub-Contractor shall demonstrate successful implementation via actual printout of the data being gathered in the case of panel trends, and display, archiving and printout of trend data being gathered at the HMI level.

3.04 COMMISSIONING

A. As part of the work of this project, the 0.2 BMS Sub-Contractor shall be responsible for providing all labor and materials required to satisfy the commissioning responsibilities of the 0.2 BMS Sub-Contractor in support of the work of the Client Agency's Commissioning Agent. Commissioning Package shall be compiled which includes all commissioning documentation as well as a summary of the commissioning results.

B. All points connected to the BAS shall operate fully in accordance with this specification before final completion is determined.

C. Equipment Start-up: Upon completion of installation, all equipment being controlled shall be initially started and tested on site, using a portable operator interface connected to individual controllers.

1. Verify that all inputs are properly being read.
2. Measure, calibrate and adjust all analog inputs, including temperature sensors.
3. Stroke all analog outputs from 0% to 100% and verify all linkage adjustments are accurate.
4. Valves and Dampers shall fully close and provide tight shut-off with no leakage.
5. Verify all digital outputs are properly energizing the controlled device.
6. Adjust setpoints so equipment can run properly. Temporary setpoints and schedules are acceptable for this phase of commissioning. C. Communication Network Start-up: Verify from a host computer that all of the controllers are being addressed from the host. Verify communication speed is acceptable and meets the requirements of this specification.

D. Software Verification: All programs and software functions shall be verified for proper sequence of operation.

3.05 TRAINING

A. The 0.2 BMS Sub-Contractor shall provide 20 Hours of on-site training, broken down into 4-hour sessions, by a system technician who is fully knowledgeable of the specific installation details of the project. This training shall be "hands' on" type. A mutual agreement on the scheduling of this training class will be made between the Client Agency and the 0.2 BMS Sub-Contractor. The intent of this training is that 10 hours will occur before the Client Agency has accepted the project and the rest is to follow shortly thereafter.

B. The training class will use the actual Operator & Maintenance manual that will be submitted for this project.

C. As a minimum, this training will cover the following topics:

1. System Overview
    a. Architecture and Function
2. System Operation
    a. System Access
    b. Operation Monitoring
    c. Exception Reporting and Acknowledge

d. Operation Override

e. Scheduling

f. Editing Programmed Variables

D. The training class will cover topics in a "hands-on" mode.

E. Proper and adequate documentation must be provided, this will include:

1. Accurate as-built drawings and sequences submitted in hard copy and electronic form (the electronic form can be easily updated via a standard Computer Aided Drafted (CAD) program).

2. Technical specification sheets

3. Signed software license agreement (as required)

4. Operator & Maintenance (O & M) manuals

5. Warranty statement

3.06 WARRANTY ACCESS

A. The Client Agency shall grant to the 0.2 BMS Sub-Contractor reasonable access to the BMS system during the warranty period. The Client Agency shall provide, at no cost to the 0.2 BMS Sub-Contractor, a public IP address for the Workstation Server Hardware Station for remote telecommunication during this period. This connection shall be for use by the 0.2 BMS Sub-Contractor with authorization for use by the Client Agency and Professionals. The 0.2 BMS Sub-Contractor shall provide appropriate and different passwords for use by the Client Agency and the Professionals for remote web-based access to the BMS system during the construction period and during the warranty period. Should any additional hardware or software be required to provide functionality as herein defined, the 0.2 BMS Sub-Contractor shall furnish and install such required software and hardware in separate locations for the Client Agency and Professionals as further directed by the Client Agency and Professionals.

B. Internet connection shall provide the following functions:

1. Access to the entire facility control system by the 0.2 BMS Sub-Contractor to provide service and diagnostic support.

2. Complete remote access to all programming tools

3. Auto email notification of desired alarms to a remote site.

4. During the construction period remote web-based access by the Client Agency and Professionals shall be limited to viewing individual system trends, viewing individual system graphics and viewing all system alarms. These capabilities shall be provided for each system as soon as a system is placed into operation, even if operation is on a temporary basis.

5. During the warranty period remote web-based access by Client Agency and Professionals shall include full system access to all specified BMS system features and functionality for all connected systems.

3.07 APPLICATION DEVELOPMENT AND REVIEW

A. The contract documents and the sequences of operation are for conveying general concept only and are not meant to be inclusive of all hardware requirements or all functional sequence requirements. Refer to the complete package of contract drawings. Items mentioned in Sections 230900 and 230993, shown on the contract documents, mentioned in the sequences of operation, or shown on other HVAC drawings shall become part of the work of this project without the necessity of being separately detailed in each of those applicable sections of the contract documents. Reference in one section of the contract documents shall be interpreted to include reference in all other applicable sections. Any additional hardware and/or software required to accomplish functional intent shall be provided (without additional cost to the Client Agency) just as though it were fully detailed throughout the contract documents.

B. The Engineer shall be responsible for providing complete detailed sequences of operation for each piece of equipment or system. The 0.2 BMS Sub-Contractor shall be responsible for implementing the detailed sequences of operation. These detailed sequences shall address all operating modes including, but not limited to, normal, failure, failure recovery. These detailed sequences shall also address all system interaction and operational interfaces and shall be required prior to beginning implementation of the application software and MMI package. The sequences of operation as written infer certain additional functionality in order to accomplish project intent. With that in mind, software review meetings shall be held with the Engineer, Client Agency, and 0.2 BMS Sub-Contractor to finalize details prior to beginning implementation of the application software and MMI package and again at regular intervals during initial operation of the system. Engineer shall coordinate scheduling and recording keeping. Following is a summary of anticipated review meetings and required follow-up actions by the 0.2 BMS Sub-Contractor.

1. Review scope of software to be implemented. This shall be an interchange of ideas and operating characteristics of the equipment and facility. All data relative to system operations and design criteria shall be presented at this time. The 0.2 BMS Sub-Contractor shall gather this data and structure the required software around this information. This shall occur prior to starting any software programming by the control installer. This meeting shall also establish the system and point naming conventions to be used throughout the project by the 0.2 BMS Sub-Contractor. Naming conventions shall be approved by the Engineer and the Client Agency. Graphic screens hierarchy, layout, functionality and operator interaction, including alarming and trending, shall be presented for approval by the Engineer and the Client Agency.
2. After one (1) to three (3) months of cooling system operation, as deemed appropriate by any party, an operations/software review shall be held. Any changes required shall be implemented by the 0.2 BMS Sub-Contractor after this meeting.
3. Prior to the beginning of the next cooling season, a final cooling season software review shall be held to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.
4. After one (1) to three (3) months of heating system operation, as deemed appropriate by any party, an operations/software review shall be held. Any changes required shall be implemented by the 0.2 BMS Sub-Contractor after this meeting.
5. Prior to the beginning of the next heating season, a final heating season software review shall be held to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.
6. After one (1) to three (3) months of Air Handling Unit system operations, as deemed appropriate by any party, an operations/software review shall be held. Any changes required shall be implemented by the 0.2 BMS Sub-Contractor after this meeting.
7. Seasonal operations (winter heating & humidification and summer cooling and Dehumidification), shall be reviewed with software changes implemented.
8. Final software reviews shall be held for each system to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.

END OF SECTION

SECTION 230993

SEQUENCES OF OPERATION FOR HVAC CONTROLS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS, REQUIRED COORDINATION/CLARIFICATIONS

A. Drawings and General Provisions of the contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

B. All work of this Section shall be coordinated and provided by the single 0.2 Building Management System (BMS) Sub-Contractor.

1. Throughout these specifications, any reference to “0.2 BMS Sub-Contractor”, "0.2 ATC Sub-Contractor", "0.2 BAS Control Sub-Contractor", "0.2 Controls Sub-Contractor" or “local field office” shall be interpreted as referring to the 0.2 Building Management System (BMS) Sub-Contractor who shall be the primary manufacturer-owned branch office that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems as further defined for this project by Sections 230900 and 230993 of these contract documents.

C. The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades. Reference the Division 23 Sections for details.

D. The work of this Section shall be as required by the Specifications, Drawings, Point Schedules, Sequences of Operation and Mechanical Systems Commissioning activities.

E. The contract documents and the sequences of operation are for conveying general concept only and are not meant to be inclusive of all hardware requirements or all functional sequence requirements. Refer to the complete package of contract drawings. Items mentioned in Sections 230900 and 230993, shown on the contract documents, or mentioned in the sequences of operation shall become part of the work of this project without the necessity of being separately detailed in each of those applicable sections of the contract documents. Reference in one section of the contract documents shall be interpreted to include reference in all other applicable sections. Any additional hardware and/or software required to accomplish functional intent shall be provided (without additional cost to the Client Agency) just as though it were fully detailed throughout the contract documents.

F. Where a unit is provided with manufacturer furnished (factory) controls, the 0.2 BMS Sub-Contractor, unit manufacturer, and 0.2 Mechanical Contractor shall be responsible for coordinating and evaluating the requirements of the contract documents sequences of operation and defining the read/write operations between the BMS and the factory controls that will be required in order to implement those sequences. Where the BMS vendor will be required to provide/install field hardware to supplement the factory controls, the unit manufacturer will be responsible for providing that information to all BMS vendors listed in the project specifications no later than five (5) days before the bid due date. The manufacturer’s control engineer shall meet (telephone conference calls will be acceptable) with the BMS vendor’s application programmer, in the presence of the Professional, to define and coordinate those read/write communication requirements and provide a hardcopy record for the project O&M Manuals. The Professional shall continue those discussions as necessary in order to establish that both parties understand their responsibilities in relation to the final working product. Should this coordination not take place, the unit manufacturer shall be responsible for reimbursing the Professional, at standard billing rates, for all time spent researching any field start-up, check-out and commissioning problems that are traced to a lack of the prerequisite coordination defined above. The equipment manufacturer and 0.2 BMS Sub-Contractor shall provide any and all package control system modifications required, up to and including complete replacement of the factory provided controls, in order to provide satisfactory system operation acceptable to the Client Agency and the Professional. NO EXCEPTIONS.

G. Where a unit is provided with manufacturer furnished (factory) controls, 0.2 BMS Sub-Contractor, the unit manufacturer, and 0.2 Mechanical Contractor shall be responsible for coordinating and determining that the factory controls, with proper communication to/from the BMS and supplemental field installed hardware (where required), are capable of implementing the sequences of operation as defined by the contract documents. Results that merely "approximate the intent" of the required sequences of operation are not acceptable. NO EXCEPTIONS. In addition, the unit manufacturer shall be responsible for maintaining the read/write coordination requirements, as defined for the initial construction process, throughout a ten (10) year period that begins with the start of the warranty period. Any updates to the factory controls during this ten-year period shall not require any reprogramming on the part of the BMS vendor. Should any reprogramming be required by the BMS vendor, the unit manufacturer shall be responsible for reimbursing the BMS vendor, at standard billing rates, for all time spent to accomplish the required reprogramming.

PART 2 – PRODUCTS (Not used)

PART 3 – SEQUENCES OF OPERATION

3.01 OCCUPIED/UNOCCUPIED CHANGEOVER

A. The DDC system shall provide warm-up/cool-down/occupied/unoccupied changeover for the zones indicated below. Zone temperature sensors shall function to provide representative space temperature information for each zone to the DDC system. The DDC system shall optimize changeover times based on zone temperature. Each zone shall be provided with its own discrete optimization program. Exhaust fans, where not otherwise required to operate because of interlock requirements, shall not be energized until Occupied time. Zoning scheme shall be approved by the Client Agency prior to implementation of any application programming by the 0.2 BMS Sub-Contractor.

1. AHU-1
2. AHU-2
3. AHU-3
4. RTU-1
5. Two (2) additional zones as determined by the Client Agency

B. The DDC system shall include provisions, on a per zone basis, for the user to enter an override time interval which will cause the zone to operate in the occupied mode when it was otherwise scheduled to be in the unoccupied mode.

C. The DDC system shall include Holiday Schedule provisions. Holiday Schedule scheme shall be approved by the Client Agency prior to implementation of any application programming by the 0.2 BMS Sub-Contractor.

D. In addition to providing the ability to schedule the zones individually, the 0.2 BMS Sub-Contractor shall provide the ability to schedule all zones from a single schedule. The BMS operator will provide a manual input to the BMS to select between individual and global scheduling options.

3.02 OPTIMUM START/STOP

A. Optimum Start - Heating Mode

1. When the outside air temperature is less than the heating changeover temperature and the space temperature is below the occupied heating setpoint, the OSS program shall control in the heating mode.
2. Beginning at the maximum start time, OSS shall calculate the time required to bring the controlled space up to the occupied heating setpoint.
3. At the calculated start time, the DDC System shall switch the appropriate zone to on. The outdoor air dampers shall remain closed during the warm-up cycle segment of the optimum start process and be released to operate normally at scheduled occupancy (people in the building) time.

B. Optimum Stop - Heating Mode

1. At the scheduled vacancy time less the maximum programmed stop time limit, the OSS program shall calculate the heating stop time.
2. At the calculated heating stop time, the DDC System shall switch the appropriate zone to the Unoccupied Mode.

C. Optimum Start - Cooling Mode

1. When the outside air temperature is greater than the cooling changeover temperature and the space temperature is above the occupied cooling setpoint, the OSS program shall control in the cooling mode.
2. Beginning at the maximum start time, OSS shall calculate the time required to bring the controlled space down to the occupied cooling setpoint.
3. At the calculated start time, the DDC System shall switch the appropriate zone to on. The outdoor air dampers shall remain closed during the cool-down cycle segment of the optimum start process and be released to operate normally at scheduled occupancy (people in the building) time.

D. Optimum Stop - Cooling Mode

1. At the scheduled vacancy time less the maximum programmed stop time limit, the OSS program shall calculate the cooling stop time.
2. At the calculated cooling stop time, the DDC System shall switch the appropriate zone to the Unoccupied Mode.

E. OSS Adaptive Operation

1. The OSS program shall monitor its heating and cooling performance for each cycle of operation.
2. Using data obtained during start up, the OSS adaptation program shall modify the OSS operating tables to correct for any errors that may occur and adapt the building's OSS program to the building's mass and thermal characteristics.
3. Separate calculations and tables shall be maintained for Optimum Start Heat, Optimum Start Cool, Optimum Stop Heat and Optimum Stop Cool.

3.03 FAN PRESSURE OPTIMIZATION

A. The BMS shall continuously monitor the damper position of all VAV terminal units. The discharge duct static pressure shall be sensed directly at the discharge of each air handler. The sensor must be mounted in a non-turbulent location. A second duct static pressure sensor shall be mounted near the inlet to the most distant VAV box in the system. This second static sensor shall be used to limit the reset range of the unit discharge duct static pressure sensor reset range.

1. When any VAV damper is more than 75% (adj.) open, the supply fan discharge duct static pressure setpoint shall be reset upward by 0.1 in W.C. (adj.), at a frequency of 15 minutes (adj.), until no damper is more than 75% (adj.) open, or the static pressure setpoint has reset upward to the system maximum duct static pressure setpoint, or the AHU variable-frequency drive is at the maximum speed setting.
2. When all VAV dampers are less than 65% (adj.) open, the supply fan discharge duct static pressure setpoint shall be reset downward by 0.1 in W.C.(adj.), at a frequency of 15 minutes (adj.), until at least one damper is more than 65% open, or the static pressure setpoint has reset downward to the system minimum duct static pressure setpoint, or the AHU variable-frequency drive is at the minimum speed setting.
3. The control bands, setpoint increment values, setpoint decrement values and adjustment frequencies shall be adjusted to maintain maximum static pressure optimization with stable system control and maximum comfort control.
4. The BMS shall have the capability to allow the operator to exclude “problem” zones that should not be considered when determining the optimized setpoint.
5. The BMS shall also read the status of the supply air static pressure sensor and display the active duct static pressure reading on the status screen.

6. The BMS shall also identify, and display to the user, the VAV box that serves the Critical Zone (that is, the zone with the most wide-open VAV damper). This information shall update dynamically as the location of the Critical Zone changes based on building load, and duct static pressure setpoint optimization control.
7. Fan Pressure Optimization Enable/Disable Switch: The operator shall have the ability, via the colorgraphics package, to designate when the fan pressure optimization software shall be engaged. A toggle point shall be available to designate this condition. Once the optimization routine has been enabled, it shall remain in operation until the toggle point is manually reset. Separate toggle points shall be provided for each VAV air handling system.
8. During the commissioning process, the 0.2 BMS Sub-Contractor shall demonstrate the performance of fan pressure optimization.

3.04 PUMP PRESSURE OPTIMIZATION

A. The BMS shall continuously monitor the control valve position of all air handling units and terminal heating equipment.
1. At system startup, the pump pressure setpoint shall be 100% (adj.) of the maximum pressure setpoint.
2. When any control valve is more than 95% (adj.) open, the pump pressure setpoint shall be reset upward by 10% of the current pump pressure setpoint at a frequency of every 2 minutes until no valve is more than 95% (adj.) open, or the pump pressure setpoint has reset upward to the system maximum setting, or the pump variable frequency drive(s) are at their maximum setting.
3. When all control valves are less than 85% (adj.) open, the pump pressure setpoint shall be reset downward by 5% of the current pump pressure setpoint at a frequency of every 2 minutes until at least one valve is more than 85% (adj.) open, or the pump's flow rate is equal to the boiler'(s) minimum flow rate, or the pump variable frequency drive(s) are at their minimum setting.
4. The control bands, setpoint increments, setpoint decrements, and adjustment frequencies shall be adjusted to maintain maximum pump pressure optimization with stable system control.
5. The BMS shall have the capability to allow the operator to exclude "problem" control valves that should not be considered when determining the optimized setpoint.
6. Pump Pressure Optimization Enable/Disable Switch: The operator shall have the ability, via the colorgraphics package, to designate when the pump pressure optimization software shall be engaged. A toggle point shall be available to designate this condition. Once the optimization routine has been enabled, it shall remain in operation until the toggle point is manually reset.
7. During the commissioning process, the 0.2 BMS Sub-Contractor shall demonstrate the performance of pump pressure optimization.

3.05 DEMAND CONTROL VENTILATION

A. The BMS shall include a time-of-day schedule to indicate whether a zone is normally occupied or unoccupied. When the schedule indicates that the zone is normally unoccupied, the required outdoor airflow for the zone shall be zero. When the schedule indicates that the zone is normally occupied, the required outdoor airflow for the zone shall equal the design outdoor airflow (based on design occupancy), unless the zone is equipped with a carbon dioxide (CO_2) sensor. The following guidelines shall generally apply, as further modified by actual sequences of operation hereinafter.

B. RTUs and AHUs: The outdoor-air dampers shall be controlled to deliver required outdoor airflow at all load conditions. On RTUs and AHUs only, the actual outdoor airflow may be sensed at the outdoor air intake as further defined in the points list.
1. For those zones equipped with a CO_2 sensor only, the required outdoor airflow for the zone shall be continuously calculated using the measured CO_2 concentration as an

indicator of the current per-person ventilation rate during the regularly scheduled occupied mode.

3.06 VAV BOX AUTO CALIBRATION

A. The BMS shall provide the ability to automatically commission and calibrate the VAV Air System. The following tests shall be performed, at a minimum:

1. Calibration of the damper
2. Verification of the air flow through the VAV box
3. Verification of the local reheat performance

B. The building automation system (BMS) shall provide the ability to initiate the auto-commissioning/auto-calibration command directly from the user interface. Special service tools shall not be required

C. The BMS shall provide the ability to stagger the auto-commissioning/auto-calibration sequence for groups of VAV boxes to allow the sequence to be performed during occupied hours, if necessary

D. An auto-commissioning report for the VAV Air System shall be generated that contains the results of the auto-commissioning/auto-calibration tests. This report shall contain, at a minimum, the following information for each VAV box in the system:

1. Name of VAV box
2. Date and time the VAV box was tested
3. Presence of any alarms
4. Space temperature
5. Space temperature setpoint
6. Active airflow (in CFM)
7. Active airflow setpoint (in CFM)
8. Air valve / damper position when the VAV box reaches 40% of the maximum cooling airflow setpoint
9. Air valve / damper position when the VAV box reaches 100% of the maximum cooling airflow setpoint
10. Discharge air temperature of the VAV box when the VAV local fan is off (omit if the VAV box does not have a local fan)
11. Discharge air temperature of the VAV box when the VAV local fan is on (omit if the VAV box does not have a local fan)
12. Discharge air temperature of the VAV box when the hydronic heat is active (omit if the VAV box does not have a local hydronic reheat)

3.07 COMMUNICATION INTERFACES

A. The mechanical or electrical equipment supplier shall provide all required on site time to coordinate, checkout and confirm BMS communication interface operation to the satisfaction of the project 0.2 BMS Sub-Contractor. On site visits shall be scheduled by the 0.2 BMS Sub-Contractor through the mechanical or electrical Sub-Contractor as appropriate for the equipment being interfaced to.

B. The mechanical or electrical equipment supplier shall also provide all required on site time to coordinate, checkout and confirm BMS communication interface operation to the satisfaction of the project Commissioning Agent. On site visits shall be scheduled by the Commissioning Agent through the mechanical or electrical Sub-Contractor as appropriate for the equipment being interfaced to.

3.08 SPECIAL SEQUENCE REQUIREMENTS

A. Upon a loss of power, the BMS shall reset all systems as required to begin an organized time delayed (adj.) mechanical system restart.

B. Control algorithms shall incorporate software to automatically limit damper (and control valve) travel based on outdoor air temperature. As the outdoor air temperature changes, the software shall dynamically adjust/reset damper (and control valve) travel limits in order to provide for tighter control. As an example, all air handling unit control algorithms shall include a feature to reduce the amount that the outdoor air damper can open (i.e. move toward the fully open position) as the outdoor air temperature drops below 40 deg F (adj.).

C. The 0.2 BMS Sub-Contractor shall make sure that air handling unit application programs that implement sequences of operation do not overlap operation of the heating and cooling coils such that both coils have their control valves open at the same time.

D. Carbon Dioxide Demand Control Ventilation: Space or return air mounted CO2 detectors shall be furnished and installed on systems where indicated on the points lists. During the occupied mode, when in the heating cycle or cooling cycle, the unit shall be at the scheduled minimum outdoor air setting. As the CO2 sensor's setpoint of 800 PPM (adj.) is approached the DDC controller shall increase the minimum outdoor air damper position open, to maintain CO2 level below the CO2 level setpoint. During the ventilation mode up to 100% outdoor air can be used, subject to the low limit discharge sensor setpoint. During the warmup, cool down and unoccupied modes of operation the CO2 function shall be locked out.

AI Space or Return Air CO2 Level for Each Indicated Area

E. Economizer Change Over / Minimum Air Position:

1. On HVAC units with 1 stage of DX cooling and no hot gas bypass, the economizers shall be positioned to minimum position at 55 deg. F. (adj.) outdoor air temperature. The DX shall be enabled for use at the same setpoint temperature.
2. On HVAC units with 1 stage of DX cooling and hot gas bypass or multiple stages of DX cooling, the economizers shall be positioned to minimum position at 74 deg. F. (adj.) outdoor air temperature. The DX shall be enabled for use at 55 deg. F. (adj.) outdoor air temperature.
3. AHU/RTAHU/RTU with VAV's Economizer, minimum outdoor air percent settings:
    a. The VAV's served by the AHU/RTAHU/RTU should be driven to min cfm. The AHU/RTAHU/RTU VFD setpoint shall be adjusted manually until all boxes are satisfied.
    b. With the AHU's fan at minimum speed, the TAB shall set the outdoor air damper to minimum outdoor air.
    c. Record the OA damper position and AHU/RTAHU/RTU VFD speed.
    d. The VAV's served by the AHU/RTAHU/RTU should be set to max cfm setpoint and AHU/RTAHU/RTU SAF VFD adjusted manually until all boxes are satisfied (no VAVs open more than 95%).
    e. With the AHU's fan at maximum speed, the TAB shall set the outdoor air damper to minimum outdoor air.
    f. Record the OA damper position and AHU/RTAHU/RTU VFD speed.
    g. With the outdoor air temperature below economizer enable setpoint (adj.) the minimum outdoor air position shall be adjusted between the above setpoints as the supply fan ramps from minimum to maximum speed.

F. In rooms where multiple units serve a common room, even if there are multiple space temperature sensors, the DDC system shall utilize one common control loop so that all control functions are controlled by one common control loop. This is to eliminate the units fighting each other while trying to maintain space temperature setpoints.

G. Several sequences hereinafter indicate that a manual override switch (depress for 3 seconds) on the room sensor will activate the occupied mode for a period of one hour (adj.). Locations where this override function is to be provided shall be designated and approved by the Client Agency prior to implementation of any application programming by the 0.2 BMS Sub-Contractor.

H. All setpoints, parameters, etc. designated as manually adjustable (i.e. adj.) in the sequences of operation shall be directly adjustable from the colorgraphics. The associated colorgraphic screen or a separate setpoint screen, the latter being directly accessible via a transfer point on the original colorgraphic screen shall provide for the adjustment function. It shall not be necessary to leave the colorgraphic screen package in order to make the adjustments. NO EXCEPTIONS

I. Hardware safeties (freezestat, high/low static, smoke detector, etc.) shall be automatic reset type. DDC controller software shall include provisions to automatically restart equipment after alarm condition clears. In addition, controller software shall lock-out auto restart capability after a safety trips 3 (adj.) times in a 12-hour period. Auto restart capability lock-out shall be alarmed at the central operator workstation as well as text messaged to designated Client Agency personnel. Smoke detectors shall only be resettable via the fire alarm system.

1. When auto restart capability has been locked out, the operator must also toggle a safety shutdown sequence reset software flag before the DDC system will attempt to restart the air handling unit. The operator should inspect the air handling unit for probable cause of the alarm before toggling the software flag. After the software flag has been cleared, an air handling unit restart sequence can be initiated.

J. Hardware safeties (freezestat, high/low static, smoke detector, etc.) shall be hardwired to their associated starter, VFD, etc. The hardware terminal device shall include an auxiliary set of contacts for input of alarm condition to the DDC system. Hardware safety alarm trips shall be alarmed at the central operator workstation as well as text messaged to designated Client Agency personnel.

K. The 0.2 BMS Sub-Contractor shall provide all wiring, point mapping, programming, check out and verification by providing a BACnet interface to EACH piece of equipment listed with BACnet communication, provided under the 0.2 Heating Contract. Each piece of equipment shall be provided with BACnet interface card by the manufacture supplier. Coordinate BACnet interface type with that supplier. Where AO, AI, BO and/or BI points are listed in the points lists, these points shall be hardwired DDC system I/O points and NOT COMMUNICATED POINTS – NO EXCEPTIONS.

L. The 0.2 BMS Sub-Contractor shall meet with the Client Agency to determine routing requirements for all alarm information. Particular attention shall be paid to developing a routing procedure that prevents non-critical alarms from impacting critical system operation. The prioritization and routing shall be fully implemented to the satisfaction of the Client Agency.

M. Manual Outdoor Air Damper Control:

1. Force Outdoor Air Dampers Close: The 0.2 BMS Sub-Contractor, working in conjunction with the Professional and Client Agency, shall develop and implement a plan for operating the air handling systems, to the extent possible, to protect the building environment from outside airborne attack. The mitigation plan shall include provisions for future utilization of a sensor to automatically initiate the protection sequence. In the interim, a colorgraphic screen input shall be used to initiate the protection sequence. In all instances, a manual reset command entered via a colorgraphic screen shall be required to return the air handling systems to the normal mode of operation. The 0.2 BMS Sub-Contractor shall make any revisions to the plan implementation scheme as directed by the Professional and Client Agency during the warranty period.

2. Force Outdoor Air Dampers Open: The 0.2 BMS Sub-Contractor, working in conjunction with the Professional and Client Agency, for operating the air handling systems, to ventilate the building environment from inside airborne attack. In the interim, a colorgraphic screen input shall be used to initiate the protection sequence. This is a manual command entered via a colorgraphic screen to enable/disable and to return the air handling systems to the normal mode of operation. This command is only able to be enable by an operator with high sign on as directed by the Client Agency.

N. Remote Condensing Units

1. The 0.2 BMS Sub-Contractor shall be responsible to furnish and install all required wiring from DX coil locations to the condensing unit locations for all required control and interlock

wiring such as wiring to enable/disable, control and alarm the DX cooling and wiring to provide operation of any liquid line solenoid valves.

O. Building Outdoor Air Conditions

1. The BMS system shall monitor the outdoor air temperature, outdoor air humidity, and carbon dioxide at a location where the sun does not shine. These temperature, humidity and carbon dioxide sensors shall be used to monitor and control the various sequences of operation as defined throughout this document.

AI Outdoor Air Temperature
AI Outdoor Air Humidity
AI Outdoor Air Carbon Dioxide

P. Duct Damage Prevention

1. In order to prevent damage to any duct, if any provided air side equipment is of other than the "Basis of Design" air side equipment and if any of the provided air side equipment produces a dead headed air static pressure that exceeds the specified return or supply duct static pressure ratings, then the 0.2 BMS Sub-Contractor shall furnish, install, and monitor the status(es) of duct static pressure shut down safety switch(es) at all required locations where the closure of any type of damper can cause a fan dead headed condition that exceeds the duct ratings.

BI Duct Static Safety Shut Down ~

Q. Occupied/Unoccupied Zone Dehumidification and Reheat Process

1. Colorgraphic screens shall summarize the dehumidification cycle parameters and status on a zone-by-zone basis. Separate return air or space relative humidity setpoints (adj.) shall be provided for each HVAC control zone.
2. A zone dehumidification cycle can be initiated during both the occupied and unoccupied cycles of operation. Dehumidification will be disabled whenever the outdoor air temperature drops below 55 deg F (adj.). The hot water system shall be available during the cooling season to provide the reheat portion of a dehumidification cycle as required.
    a. The Unoccupied Cycle Zone Dehumidification/Reheat Process shall provide only one complete cycle per every 8 hours (adj.) of unoccupied interval per each control zone.
    b. Separate zone temperature and relative humidity setpoints
3. Operation of the zone dehumidification cycle requires certain enhancements to the normal operation of the hot water system, chilled water system, and air handling systems as hereinafter defined. For example, operation of the zone reheat mode will likely require that outdoor air temperature lockout or manual seasonal lockout be automatically overridden in order to enable operation of the hot water system. Another example could require that CO2 damper control be automatically overridden during the Zone Dehumidification Mode – Summer Occupied Cycle. These and other similar automatic overrides necessary to accommodate operation of the zone dehumidification cycle shall be fully incorporated into the work of this project by the 0.2 BMS Sub-Contractor. NO EXCEPTIONS.
4. Where an air handling unit serves a single zone, a space air relative humidity sensor shall determine the need for a zone dehumidification cycle. Where an air handling unit serves multiple zones, the return air relative humidity sensor(s) shall be used to determine the need for a zone dehumidification cycle. Where multiple zones are involved, the following criteria shall apply:
    a. When the return air relative humidity sensor rises above 55% RH (adj.), the DDC system shall initiate a dehumidification sequence.
    b. The DDC system shall position the outdoor air dampers to minimum open position (adj.) as a first step in the dehumidification process. The DDC system shall return the outdoor air dampers to normal program control when the relative humidity drops below setpoint (adj.) (return air or space as defined above).
5. The BMS shall start and stop the air handling equipment, the chilled water system, and the

hot water system as required to support the zone dehumidification requirements. Start-up and shut down of the chilled water system and the hot water system shall follow the sequences defined hereinafter. Any hot water system outdoor air temperature enable interlocks shall be suspended during dehumidification cycle reheat mode operation.

a. If not already running, then the chilled water system shall be enabled. Chilled water available shall be determined by the BAS system sensing a chilled water supply temperature of 48 deg. F. (adj.) or lower with a chilled water pump operating.

b. Control valves on the air handling equipment shall be fully opened to their respective cooling coils. Allow adequate time delay for respective control valves to completely change positions prior to activation of fans. Control valves shall revert to normal program control whenever the space/zone relative humidities reach setpoint.

c. Outdoor air dampers on all air conditioning equipment shall be positioned to the minimum open position (adj.).

d. The supply fans on the air conditioning equipment shall be started if not already running.

e. On air conditioning equipment with DX cooling, the DX cooling shall be fully enabled with the hot gas reheat modulating by a discharge temperature low limit set point of 50 deg. F (adj.) added to the discharge temperature sensor.

f. The BMS shall monitor space temperature and enable the hot water system whenever the average space temperature of the space/zones involved drops 3 deg. F. (adj.) below setpoint. This shall also apply to zones without high humidities, that are not part of a dehumidification sequence but are nonetheless impacted by the reduced supply air temperature coming from the air handling unit.

g. The BMS shall terminate the zone dehumidification sequence whenever the space/return air relative humidities return to setpoint.

h. The chilled water system and the hot water system shall operate as per zone dehumidification or reheat requirements. If chilled water is no longer required, the chilled water system shall be de-energized until needed again. Also, if the hot water system is no longer required the hot water heating system shall be de-energized until needed again.

6. The BMS shall trend OAT, OAH, average zone relative humidity, worst case zone relative humidity, average zone space temperature, and worst-case zone space temperature every 3 minutes during the dehumidification process.

7. Refer to the individual air handling unit sequences of operation for additional details of the associated dehumidification sequences of operation.

AI Relative Humidity **~**

R. Alarms

***** DENOTES MAINTENANCE TIME REMINDER (MTR)

~ DENOTES CHANGE OF STATE OR ANALOG LIMIT ALARM (and RETURN TO NORMAL)

All MTR, COS, LIMIT and RTN ALARM information designated in the following I/O points lists shall also be fully implemented as part of the work of this project.

3.09 COLORGRAPHICS

A. Refer to Section 230900 paragraph 3.01 C. for colorgraphic screen requirements.

3.10 HOT WATER SYSTEM

A. The hot water system shall have the ability to be started and stopped automatically or manually (via BI override), through the DDC system. The hot water system shall always be “online” throughout all seasons for the use of reheating coils. The DDC system shall automatically start and stop the duplex hot water circulating pump system and enable the boiler control system. In the absence of operator selection (via logic blocks) of the lead pump, the DDC system shall automatically provide lead/lag operation for the duplex pumping system. When an accumulated run time of 300 hours (adj.) is reached for the lead pump, the control system shall

automatically switch the previous lag unit to be the current lead unit until the run hours limit is reached. Once selected for automatic operation, the DDC system shall start the lead hot water pump before enabling the boiler system. A software override provision shall be incorporated to allow the operator to designate a specific pump as lead for a given period of time regardless of the 300 hour (adj.) changeover interval.

B. The building hot water heating system consists of two (2) hot water boilers with boiler runaround pumps. The hot water boilers shall operate in a LEAD/LAG rotation. When rotation is due, the previous LAG unit becomes the new LEAD unit, and the previous LEAD unit becomes the new LAG unit.

C. System hot water shall be supplied via two (2) constant speed hot water pumps. If a pump is in operation when the run time limit is reached, the lag unit shall start in addition to the lead unit until the lag unit's current switch has proved status. Then the designated lead unit will ramp down and stop while the lag unit ramps up and the units' LEAD/LAG rotation will then shift.

D. For constant volume pumps provided with a VFD, the VFD shall be used to provide soft start ramp capabilities for the pump motor. Upon pump start-up, the BMS shall ramp pump speed to setpoint as established by the TAB contractor to provide required air flow. Setpoint shall be adjustable at the colorgraphics by an operator with sufficient password credentials.

E. A current switch across each pump shall provide pump proof of operation. Should the lead pump fail, the control system shall automatically energize the lag pump after a 15 second (adj.) time delay and trigger the pump rotation previously described. An alarm shall be sent to the Operator Workstation and paging system upon pump failure verification.

F. Colorgraphics "Boiler Out-Of-Service" Switch: The operator shall have the ability, via the colorgraphics package, to designate when a boiler is out-of-service and hence not available for use in automatic sequence rotation to satisfy load conditions. A toggle point shall be available on a per boiler basis, total of (2), to designate this condition. Once a boiler has been designated as out-of-service, it shall remain as such until the toggle point is manually reset. For simplification purposes, it will be assumed that no boiler is designated as out-of-service while it is currently running.

G. Colorgraphics "Hot Water Pump-Out-Of-Service" Switch: The operator shall have the ability, via the colorgraphics package, to designate when a hot water pump is out-of-service and hence not available for use in automatic sequence rotation to satisfy load conditions. A toggle point shall be available on a per hot water pump basis, total of (2), to designate this condition. Once a pump has been designated as out-of-service, it shall remain as such until the toggle point is manually reset. For simplification purposes, it will be assumed that no pump is designated as out-of-service while it is currently running.

H. Software provisions shall be incorporated to allow the operator to designate the hot water system to be disabled during a specific interval of time (i.e. the summer months) regardless of outdoor air temperature.

I. The boilers shall cycle off when the pumps are off.

J. The BMS shall give and receive signals to/from the boiler supplier provided "Boiler Control Panel", as per the point matrix hereinafter, to begin making hot water. All reset shall be accomplished through the boiler controls.

K. The Boiler Control Panel, provided by the boiler equipment supplier, shall control operation of the boilers. A relay field installed on each boiler shall provide boiler proof of operation. Should a lead boiler fail, the boiler control system shall automatically energize the lag boiler after an adjustable time delay. The runaround pump on the failed boiler shall be stopped. An alarm shall be sent to the Operator Workstation and paging system upon boiler failure verification. Should one boiler not be able to maintain hot water reset schedule, a second boiler shall be cycled on to maintain reset schedule. Reset schedule operation shall contain adjustable time delays to prevent boiler short cycling. When multiple boilers are required to maintain reset schedule, the operating boilers shall be cycled on and off together. When a boiler is no longer required and the burner has been stopped for 2 minutes (adj.), the associated run around pump shall be off.

1. The fully adjustable hot water reset schedule is as follows:

Occupied Schedule

OAT	HW Supply Temperature
0 deg F	180 deg F
60 deg F	155 deg F

Unoccupied Schedule

OAT	HW Supply Temperature
0 deg F	180 deg F
60 deg F	140 deg F

Reheat Schedule

OAT	HW Supply Temperature
0 deg F	160 deg F
60 deg F	140 deg F

The boilers shall not be operated below a 135 deg F returning water supply temperature as sweating may occur.

L. Emergency Shutdown System: Shall be furnished and installed by boiler supplier.

M. All required Interlock and control wiring of the boilers and the Boiler Control Panel shall be provided by the boiler equipment supplier.

N. The Boiler Control Panel shall provide an auxiliary contact to indicate activation of the Emergency Shutdown System. The BMS shall interface to this contact closure. An alarm shall be generated at the BMS whenever the emergency shutdown system is activated.

O. The “Boiler Control Panel” supplier shall provide a BACnet IP communication interface for the boiler plant “Boiler Control Panel” for use by the 0.2 BMS Sub-Contractor in integrating the boiler control system with the BMS. The 0.2 BMS Sub-Contractor shall coordinate with the boiler control panel supplier, prior to submitting ATC submittal, to verify the specific read/write requirements of the communication interface for this project.

BOILER AND HOT WATER SYSTEMS POINTS MATRIX BETWEEN BMS AND BOILER CONTROL PANEL

	BMS SYSTEM OBJECTS				BOILER SYSTEM OBJECTS	
ITEM	TYPE	ACCESS TYPE	GENERAL POINT DESCRIPTION	Active/Inactive or UNITS	TYPE	ACCESS TYPE
1	AI	Write	Outdoor Air Temperature	Degrees F.	AV	Read
2	BO	Write	Heating System On or Off	On/Off	BV	Commandable
3	AV	Read	Building Hot Water Return Temperature	Degrees F.	AI	Write
4	AV	Read	Building Hot Water Supply Temperature	Degrees F.	AI	Write
5	AV	Read	Hot Water Supply Temperature Set Point	Degrees F.	AV	Write
6	AV	Read	Boiler #1 Hot Water Supply Temperature	Degrees F.	AI	Write
7	AV	Read	Boiler #2 Hot Water Supply Temperature	Degrees F.	AI	Write

8	BV	Read	Boiler #1 Enabled/Disabled	Enabled/Disabled	BO	Write
9	BV	Read	Boiler #1 Status	On/Off	BI	Write
10	AV	Read	Boiler #1 Firing Percentage	Percent	AV	Write
11	BV	Read	Boiler #1 Fuel Valve Status	Open/Closed	BI	Write
12	BV	Read	Boiler #1 Down on Failure	Normal/Alarm	BV	Write
13	BV	Read	Boiler #1 Flame Failure	Normal/Alarm	BI	Write
14	AV	Read	Boiler #1 Fill Pressure	PSI	AI	Write
15	BV	Read	Boiler #1 Run Around Pump Command	Start/Stop	BO	Write
16	BV	Read	Boiler #1 Run Around Pump Status	On/Off	BI	Write
17	AV	Read	Boiler #1 Return Water Temperature	Degrees F.	AI	Write
18	BV	Read	Boiler #1 Lead	Lead	BV	Write
19	BV	Read	Boiler #1 Lag	Lag	BV	Write
20	BV	Read	Boiler #2 Enabled/Disabled	Enabled/Disabled	BO	Write
21	BV	Read	Boiler #2 Status	On/Off	BI	Write
22	AV	Read	Boiler #2 Firing Percentage	Percent	AV	Write
23	BV	Read	Boiler #2 Fuel Valve Status	Open/Closed	BI	Write
24	AV	Read	Boiler #2 Fill Press	PSI	AI	Write
25	BV	Read	Boiler #2 Run Around Pump Command	Start/Stop	BO	Write
26	BV	Read	Boiler #2 Run Around Pump Status	On/Off	BI	Write
27	AV	Read	Boiler #2 Return Water Temperature	Degrees F.	AI	Write
28	BV	Read	Boiler #2 Down on Failure	Normal/Alarm	BV	Write
29	BV	Read	Boiler #2 Flame Failure	Normal/Alarm	BI	Write
30	BV	Read	Boiler #2 Lead	Lead	BV	Write
31	BV	Read	Boiler #2 Lag	Lag	BV	Write
32	BV	Write	Occupied Reset Schedule Required	On/NA	BV	Commandable
33	BV	Write	Unoccupied Reset Schedule Required	On/NA	BV	Commandable
34	BV	Write	Reheat Reset Schedule Required	On/NA	BV	Commandable
35	BO	Write	Hot Water Pump P-6 Start/Stop	On/Off	BV	Read

36	BI	Write	Hot Water Pump P-6 Status	On/Off	BV	Read
37	AO	Write	Hot Water Pump P-6 Speed Control	Percent	AV	Read
38	BO	Write	Hot Water Pump P-7 Start/Stop	On/Off	BV	Read
39	BI	Write	Hot Water Pump P-7 Status	On/Off	BV	Read
40	AO	Write	Hot Water Pump P-7 Speed Control	Percent	AV	Read
41	BV	Read	Emergency Boiler Shut Down	Normal/Alarm	BI	Write

3.11 CHILLER AND CHILLED WATER CONTROL

A. Cooling tower and associated controls shall be existing to remain. Cooling tower controls shall be incorporated into new chilled water system sequencing as further defined.

B. The chiller, tower and pumps shall be started and stopped automatically based on outdoor air temperature and building (zone) occupancy cycle, or manually (via BI override), through the DDC system. Software provisions shall be incorporated to allow the operator to designate the chiller system to be disabled during a specific interval of time (i.e. the winter months) regardless of the outdoor air temperature. Chilled water flow shall be variable volume with minimum flow control. Chiller/Chilled water pump sequence shall start when any zone served by chilled water is in the cool down or occupied mode and the outdoor air exceeds 60 deg. F. (adj.) and the BAS, via the set parameters, enables the pumps to start.

C. The chilled water pump's speed shall be controlled via differential pressure sensor(s) located where shown on the drawings.

The start process shall be:

Start chilled water pump.
Start condenser water pump.
Start the tower fan at minimum speed.
Start the chiller after 3-minute delay. Chilled water flow and condenser water flow must be proven before the chiller can start.

The stop process shall be:

Stop chiller.
Stop the tower fan.
After a 5 minute delay, stop the chilled water pump and the condenser water pump.

D. Pump status shall be proven by a current sensing relay. Upon proof of pump operation, chilled water system differential pressure sensors (located as noted on the building chilled water piping) shall be used to modulate the speed of the VFD drives to maintain system differential pressure. Initial setpoint shall be 12 PSI (adj.) with final setpoint determined by TAB Contractor. The DDC system shall select worst case remote differential pressure as the basis for modulating the chilled water pump VFD. The colorgraphics package shall include a provision for allowing the operator to eliminate a faulty reading from consideration.

E. The condenser pump ramps up and operates at constant speed to provide constant flow through the chiller condenser bundle.

F. Once the chiller is enabled to run by the DDC system, the chiller shall operate via its packaged controls. The DDC system shall supply a chilled water supply temperature offset to the manufacturer's packaged controls in order to accomplish supply water temperature reset. Chilled water supply temperature shall be 42 deg F (adj.) at 90 deg F (adj.) outdoor air temperature and linearly reset to 46 deg F (adj.) at 65 deg F (adj.) outdoor air temperature. Chiller run status and chiller alarm status shall be monitored. The 0.2 BMS Sub-Contractor shall be responsible for providing the required hardware interface in order to allow for chiller start/stop, chiller run status monitoring, chiller alarm status monitoring and supply water temperature reset by the Building Automation System (BAS). All outputs from the chiller

controller which will serve as inputs to the BAS shall be ungrounded. Likewise, all outputs from the BAS which will serve as inputs to the chiller controller shall be ungrounded. The chiller controller shall be capable of receiving a 4 – 20 mA input signal to accomplish supply water temperature reset.

G. If a pump current switch or chiller manufacturers flow switch should fail to energize, indicating a lack of pump operation or flow through the chillers, the chiller shall be disabled, the pumps shall be de-energized, and an alarm shall be sent to the Operator Workstation and paging system.

H. Flow through the chiller can only be reduced by amount scheduled on drawings. Confirm with chiller manufacturer. The 0.2 BMS Sub-Contractor shall provide flow meter to be installed in the chilled water supply piping as shown on the chilled water flow schematic. Chilled water pump VFD minimum speed shall be locked out to always provide minimum flow through the chiller.

I. When the primary chilled water system is enabled the cooling tower and condenser water pump control loop is enabled. The condensing water pump shall be energized as previously described. As the condenser water supply temperature increases above setpoint of 85 degrees F (adj.), the cooling tower fans are started at minimum speed. The cooling tower fan variable frequency drive is modulated to maintain the condenser water setpoint (adj.). When the condenser water supply temperature decreases, the cooling tower fan is modulated toward minimum speed. With the cooling tower fan at minimum speed, a further decrease in condenser water supply temperature causes the fan to cycle off. Software provisions shall be incorporated to allow the operator to select condenser water reset to further optimize chiller efficiency. The 0.2 BMS Sub-Contractor shall coordinate with the chiller supplier to implement a condenser water reset schedule. Reset schedule points shall be as determined by the chiller manufacturer.

J. Chiller interlock power and control wiring to accomplish desired results shall be installed by the 0.2 BMS Sub-Contractor as recommended by the refrigeration machine manufacturer.

K. Software provisions shall be incorporated to allow the operator to designate the chiller system to be disabled during a specific interval of time (i.e. the winter months) regardless of the outdoor air temperature.

L. An alarm shall be generated at the computer if the chilled water temperature is above the desired setpoint for a given adjustable time. There shall also be an alarm generated on a pump failure as sensed by a current switch.

M. An alarm shall be generated and the chilled water system shall be shut down on a rise in refrigerant level above a preset alarm point.

3.12 REFRIGERANT MONITORING AND EXHAUST SYSTEM

A. New refrigerant monitoring system shall be provided as part of this project. Existing exhaust fan serving chiller room shall be utilized for refrigerant exhaust upon refrigerant monitor alarm.

B. The 0.2 BMS Sub-Contractor shall provide and install a refrigerant monitoring system to monitor for refrigerant leaks, enable refrigerant exhaust system when required, enable refrigerant alarm strobe lights and alarm horns when required, and disable chiller and boilers when required. Glass break switches shall be provided where indicated on the drawings and start refrigerant exhaust system and disable chiller system and hot water boilers when activated. Strobe(s), alarm horn(s) and glass break switch(es) shall be furnished by the 0.2 BMS Sub-Contractor.

C. Refrigerant Monitoring Panel: The refrigerant monitor shall provide continuous monitoring of space conditions and provide three levels of alarming with relay outputs that designate leak, spill and evacuation concentrations. Gas alarms and system fault conditions are indicated by visual and audible alarms. A system fault relay output shall be provided. A 4 to 20 ma output shall be provided representing the space refrigerant level. The 0.2 BMS Sub-Contractor shall be responsible to install system and provide all interlock and control wiring.

D. Refrigerant Emergency Exhaust System: On a rise in refrigerant level above a preset alarm point, an alarm contact output from the refrigerant monitoring panel shall signal the BMS that

an alarm condition exists. The BMS shall in turn start the exhaust fan. The reverse sequence shall occur on a return to normal of the alarm condition.

E. Where appropriate, motor operated intake dampers and/or discharge dampers be hardwire interlocked with the exhaust fan such that the damper(s) open on a call for the exhaust fan to run.

F. Refrigerant Alarm Strobes, Alarm Horn and Glass Break Switches: As a part of the Refrigerant Monitoring System installation, alarm strobe light(s) shall be ceiling mounted and installed in the center of the chiller room where visible from all directions. Alarm horn(s) shall be installed at locations to provide an audible signal at all locations within the room. Glass break switch(s) shall be installed inside and outside the chiller room at all exits/entrances.

G. The 0.2 BMS Sub-Contractor shall provide all required interlock wiring to accomplish these sequences of operation.

3.13 NEW DUAL TEMPERATURE WATER PUMPS (P-3, 4, & 5)

A. New dual temperature pumps shall be provided under the scope of this project.

B. 0.2 BMS Sub-Contractor shall utilize existing sequences of the existing dual temperature pumps.

3.14 SINGLE ZONE CONSTANT VOLUME AIR HANDLING UNIT - HW HEATING/VENTILATING/CW COOLING W/ HW DUCT REHEAT COIL (AHU-1)

A. The unit is equipped with supply and return isolation/smoke dampers. Stopping of the unit fans, by normal operation or by operation of a safety, shall then cause the isolation/smoke dampers to close. End switches on the isolation/smoke dampers shall provide isolation/smoke damper full open or full closed status to the control system. On each unit start up, the isolation/smoke dampers must be fully open prior to enabling the fans to start.

B. When the Unit is commanded to start, the following shall occur:

1. Unit mounted smoke dampers (supply and return) shall be verified OPEN.
2. Upon verification that all unit smoke dampers are OPEN, the supply fan VFDs shall be commanded to START. At this time the VFDs will slowly ramp up to minimum speed.

Fan status shall be monitored via a current sensing relay. The BAS system shall delay 30 seconds (adj.) after receiving fan run status verification before placing the VFDs under control of the TAB Contractor setpoint.

All smoke dampers (within the air handling units) must be proven “OPEN” to allow the fan systems to operate. The damper OPEN end switches shall be “soft-wired” to prevent the fan systems from starting if all smoke dampers are not OPEN. Should the smoke dampers not prove open within 30 seconds (adj.), the BMS shall command the smoke dampers closed, shut down the fans, generate an alarm, and abandon the remainder of the AHU start sequence. Should the air handling unit be commanded off by the BMS, the supply fans shall shut down and all smoke dampers shall close.

C. When the air handling unit is in the shutdown mode, the supply fan shall be de-energized. The outdoor air damper and relief air damper shall be closed and the return air damper shall be open. The hot water coil control valve shall be open. If necessary, the heating coil control valve shall be controlled to maintain a temperature of 40 deg F (adj.) as sensed by the cooling coil discharge air temperature sensor. The cooling coil control valve shall be fully closed to the cooling coil.

D. Warm-Up Mode: When indexed to the warm-up mode by the DDC system, the unit supply fan shall run continuously, the outdoor air damper and relief air damper shall be closed, the return air damper shall be open, and the space temperature sensor shall modulate the heating coil control valve open to the heating coil to achieve space temperature setpoint (adj.). The cooling coil control valve shall be fully closed to the cooling coil.

E. Heating Mode Occupied Cycle: When indexed to the occupied heating mode by the DDC system, the unit fan shall run continuously and the modulating outdoor air damper shall be controlled to maintain a minimum outdoor air position (adj.), subject to CO2 Control. The cooling coil control valve shall be fully closed to the cooling coil. When the space temperature

is below the effective heating setpoint (adj.), the heating coil control valve shall open to the heating coil and the outside air damper shall be controlled to maintain a minimum open position (adj.), subject to CO2 Control. As the space temperature rises to the desired temperature setpoint, the heating coil control valve shall modulate closed to the heating coil. On a continued rise above space temperature setpoint, the outside air dampers shall be modulated toward the open position. The economizer shall position up to 100% outdoor air in order to maintain space setpoint. A mixed air thermostat shall limit the outside air damper if mixed air temperature drops below heating coil scheduled entering air temperature (adj.).

F. Cool-Down Mode: When indexed to the cool-down mode by the DDC system, the supply fan shall run continuously, the outdoor air damper shall be closed, the return air damper shall be open, and the space temperature sensor shall modulate the cooling coil control valve open to the cooling coil to achieve space temperature setpoint (adj.). The heating coil control valve shall be fully closed to the heating coil.

G. Cooling Mode Occupied Cycle: When indexed to the occupied cooling mode by the DDC system, the unit supply fan shall run continuously and the modulating minimum outdoor air dampers shall first open to their scheduled minimum outdoor air flow (adj.), subject to CO2 control. The cooling shall operate as further defined below.

1. Chilled Water Cooling: When the O.A. Enthalpy is above 24 BTU per pound of dry air (adj.), the outdoor air dampers shall be at minimum position, subject to CO2 control, the return air dampers shall be positioned accordingly and the space temperature sensor shall modulate the chilled water coil control valve to achieve space temperature setpoint (adj.).
2. Hybrid Mode Cooling: When the O.A. Enthalpy is between 18 and 24 BTU per pound of dry air (adj.), the outside and return air dampers shall position for economizer operation to maintain mixed air temperature and the space temperature sensor shall modulate the chilled water coil control valve to maintain space temperature setpoint (adj.).
3. Economizer Cooling: When the O.A. Enthalpy is below 18 BTU per pound of dry air (adj.), the outside and return air dampers shall be modulated to maintain space temperature setpoint (adj.) subject to mixed air thermostat which shall close the outside air damper if mixed air temperature drops below the heating coil scheduled entering air temperature (adj.). The cooling coil control valve shall be fully closed to the coil.

H. Unoccupied Mode: When the air handling unit is in the unoccupied mode, the unit fans shall be de-energized, the outdoor air damper and relief air damper shall be closed, and the return air damper shall be open. Whenever the space temperature is below night set-back limits (adj.), the unit fan shall function (cycle) as described for the warm-up mode to maintain reduced space temperature setpoint (adj.). Whenever the space temperature is above night set-up limits (adj.), the unit fan shall function (cycle) as described for the cool-down mode to maintain elevated space temperature setpoint (adj.). The unoccupied cooling setpoint shall be capable of being set sufficiently high so as to effectively disable cooling during the unoccupied mode. A manual override switch (depress for 3 seconds) will activate the occupied mode for a period of one hour (adj.). The 0.2 BMS Sub-Contractor shall coordinate with the Client Agency regarding locations with active unoccupied cycle override buttons.

I. CO2 Damper Control: A space CO2 sensor/transmitter shall provide continuous monitoring of CO2 levels. During the occupied mode, the outdoor air damper control may be overridden by the CO2 sensor to maintain the ventilation air requirements. A space CO2 sensor, through the DDC system, shall function to modulate the outdoor air dampers to the open position, overriding minimum outdoor air requirements, in order to maintain space CO2 levels at 800 ppm (adj.) setpoint. The reverse sequence shall occur on a drop in CO2 level. If mixed air temperature rises, the outdoor air dampers shall modulate open as previously described to maintain setpoint temperature. During the unoccupied mode the CO2 sensor shall have no impact on the respective AHU operation.

J. Dehumidification Control: The DDC system shall maintain space humidity at 55% RH maximum (adj.) during summer operation. Refer to OCCUPIED/UNOCCUPIED ZONE DEHUMIDIFICATION AND REHEAT PROCESS for additional sequence information. When a dehumidification process is initiated, the DDC system shall reset AHU discharge air temperature setpoint down to 52 deg F (adj.) to provide dehumidification to the space. The

DDC system shall return AHU discharge air temperature setpoint to its optimized value when the average space humidity drops below setpoint. Dehumidification will be disabled whenever the outdoor air temperature drops below 55 deg F (adj.). The DDC system shall modulate the duct reheat coils control valves to maintain space temperature setpoint during operation in the dehumidification mode.

K. Supply Fan VFD: For constant volume fans provided with a VFD, the VFD shall be used to provide soft start ramp capabilities for the supply fan motor. Upon fan start-up, the BMS shall ramp fan speed to setpoint as established by the TAB Contractor to provide required air flow. Setpoint shall be adjustable at the colorgraphics by an operator with sufficient password credentials.

L. Safeties:

1. Low-limit thermostats (freezestats) serpentined on the heating coil discharge shall de-energize the fans, close the outside and relief air dampers, open the return air damper, and fully open the heating coil control valve to the coil, if coil discharge temperature drops below 40 deg F (adj.).
2. The EC shall furnish and install fire alarm control modules at each fan motor VFD to de-energize the fans as per the fire alarm system requirements. The EC shall furnish and install fire alarm status modules at each unit duct mounted smoke detector to provide detector status to the BMS system. The 0.2 BMS Sub-Contractor shall monitor the status of each of these fire alarm modules. Whenever a supply air or return air smoke detector trips, FACMRs from the FAS shall close appropriate dampers and stop the fans. The FACMR shall function to notify the BMS, via the contact closure interface, that the FAS has shut down the unit upon sensing a smoke condition within the unit. When fans and/or smoke dampers are de-energized by the fire alarm system, the BMS shall close the outdoor air dampers and the relief air dampers, open the return air dampers, open the heating control valve to the heating coil, close the chilled water control valve to the coil, and close the reheat coil control valve to the coil. When the smoke condition is cleared and the associated detector(s) reset, FACMRs shall return the smoke dampers to their normally open position. Damper end switches shall be used to verify that the smoke dampers return to their normal positions. After the smoke detector(s) reset(s), the DDC system will attempt to restart the AHU.
3. Static Pressure Switches: Static pressure switches shall be used for fan system shutdown operations based upon high supply and/or low return static pressure. Static pressure switches shall be automatic reset devices. Static pressure limit switches shall be set at the limit device to “hardwire” stop the fan system. Static pressure switch settings shall be “set” during fan testing with the TAB contractor and confirmed with the commissioning process. Each static pressure switch range shall be selected for the operating static pressures required for the associated fan systems.

M. Hot water coil in-line circulating pumps shall start whenever the respective coil control valve is open or whenever the outdoor air temperature falls below 40 deg F (adj.). Pump operation status shall be monitored and reported to the BMS system.

N. Where required, exhaust fans shall be controlled to operate in conjunction with specific air handling units.

O. Where fintube radiation is used in conjunction with the air handling unit heating coil, the fintube radiation shall be the first on and last off.

P. Fan Status: A current sensing switch shall provide proof of fan operation and shall enable control loops.

Q. Fan Start/Stop Failure: If a supply fan fails to start or stop 30 seconds (adj.) after being commanded to do so, as determined by the status of the appropriate current switch, an appropriate alarm shall be provided throughout the DDC network.

R. Loss of supply fan status indications shall cause the air handler to revert to the unoccupied mode as a reference condition prior to any re-start attempt.

S. Filter Status: Filter status shall be provided via a differential pressure switch installed across the filter bank. Static pressure probes shall be installed on each side of the filter bank in conjunction with the transducer. Copper tubing installed in lieu of static probes is not acceptable. If the differential pressure switch across filter section indicates a dirty filter, an appropriate alarm shall be provided at the operator's workstation.

T. Relief Air Damper Control: A plenum static pressure sensor located in the common return/relief air plenum, referenced to space, shall modulate the relief air damper to maintain plenum static pressure setpoint when the unit is operational in an occupied heating or cooling mode. In all other modes of operation, the relief air damper shall be fully closed. The DDC system shall modulate the relief air damper to maintain relief plenum pressure setpoint of 0.15 in. W.C. (adj.).

U. The relief air louver motorized damper shall open when the AHU outdoor air damper opens to minimum position or greater. The backdraft dampers shall then relieve air as required.

V. UV Lighting Alarm: The DDC system shall monitor the UV lighting panel and on an alarm condition, an appropriate alarm shall be provided at the operator's workstation.

W. Abnormal Temperatures: If any of the supply air, return air, mixed air, or coil discharge temperatures deviates from normal operating parameters, as determined by the appropriate temperature sensor(s), an appropriate alarm shall be provided at the operator's workstation.

X. Abnormal Humidity: If the return air humidity or space humidity deviates from normal operating parameters, as determined by the appropriate relative humidity sensor(s), an appropriate alarm shall be provided throughout the DDC network.

Y. Maintenance Time Reminders: Run Time shall be totalized for the individual fans. When pre-determined (adj.) run hours are exceeded, an appropriate maintenance time reminder shall be provided at the operator's workstation.

3.15 MULTI ZONE CONSTANT VOLUME AIR HANDLING UNIT - HW HEATING/VENTILATING/CW COOLING W/ HW DUCT REHEAT COILS (AHU-3)

A. The unit is equipped with supply and return isolation/smoke dampers. Stopping of the unit fans, by normal operation or by operation of a safety, shall then cause the isolation/smoke dampers to close. End switches on the isolation/smoke dampers shall provide isolation/smoke damper full open or full closed status to the control system. On each unit start up, the isolation/smoke dampers must be fully open prior to enabling the fans to start.

B. When the Unit is commanded to start, the following shall occur:

1. Unit mounted smoke dampers (supply and return) shall be verified OPEN.
2. Upon verification that all unit smoke dampers are OPEN, the supply fan VFDs shall be commanded to START. At this time the VFDs will slowly ramp up to minimum speed.

Fan status shall be monitored via a current sensing relay. The BAS system shall delay 30 seconds (adj.) after receiving fan run status verification before placing the VFDs under control of the TAB Contractor setpoint.

All smoke dampers (within the air handling units) must be proven "OPEN" to allow the fan systems to operate. The damper OPEN end switches shall be "soft-wired" to prevent the fan systems from starting if all smoke dampers are not OPEN. Should the smoke dampers not prove open within 30 seconds (adj.), the BMS shall command the smoke dampers closed, shut down the fans, generate an alarm, and abandon the remainder of the AHU start sequence. Should the air handling unit be commanded off by the BMS, the supply fans shall shut down and all smoke dampers shall close.

C. When the air handling unit is in the shutdown mode, the supply fan shall be de-energized. The outdoor air damper and relief air damper shall be closed and the return air damper shall be open. The hot water coil control valve shall be open. If necessary, the heating coil control valve shall be controlled to maintain a temperature of 40 deg F (adj.) as sensed by the cooling coil discharge air temperature sensor. The cooling coil control valve shall be fully closed to the cooling coil.

D. Warm-Up Mode: When indexed to the warm-up mode by the DDC system, the unit supply fan shall run continuously, the outdoor air damper and relief air damper shall be closed, the return air damper shall be open, and the supply air temperature sensor shall modulate the heating coil control valve open to the heating coil to achieve supply air temperature reset schedule setpoint (adj.). The cooling coil control valve shall be fully closed to the cooling coil.

E. Heating Mode Occupied Cycle: When indexed to the occupied heating mode by the DDC system, the unit fan shall run continuously and the modulating outdoor air damper shall be controlled to maintain a minimum outdoor air position (adj.), subject to CO2 Control. The cooling coil control valve shall be fully closed to the cooling coil. When the supply air temperature is below the supply air temperature reset schedule setpoint (adj.), the heating coil control valve shall open to the heating coil and the outside air damper shall be controlled to maintain a minimum open position (adj.), subject to CO2 Control. As the supply air temperature rises to the desired temperature setpoint, the heating coil control valve shall modulate closed to the heating coil. On a continued rise above space temperature setpoint, the outside air dampers shall be modulated toward the open position. The economizer shall position up to 100% outdoor air in order to maintain space setpoint. A mixed air thermostat shall limit the outside air damper if mixed air temperature drops below heating coil scheduled entering air temperature (adj.).

F. Cool-Down Mode: When indexed to the cool-down mode by the DDC system, the supply fan shall run continuously, the outdoor air damper shall be closed, the return air damper shall be open, and the supply air temperature sensor shall modulate the cooling coil control valve open to the cooling coil to achieve supply air temperature reset schedule setpoint (adj.). The heating coil control valve shall be fully closed to the heating coil.

G. Cooling Mode Occupied Cycle: When indexed to the occupied cooling mode by the DDC system, the unit supply fan shall run continuously and the modulating minimum outdoor air dampers shall first open to their scheduled minimum outdoor air flow (adj.), subject to CO2 control. The cooling shall operate as further defined below.

   1. Chilled Water Cooling: When the O.A. Enthalpy is above 24 BTU per pound of dry air (adj.), the outdoor air dampers shall be at minimum position, subject to CO2 control, the return air dampers shall be positioned accordingly and the supply air temperature sensor shall modulate the chilled water coil control valve to achieve supply air temperature reset schedule setpoint (adj.).

   2. Hybrid Mode Cooling: When the O.A. Enthalpy is between 18 and 24 BTU per pound of dry air (adj.), the outside and return air dampers shall position for economizer operation to maintain mixed air temperature and the supply air temperature sensor shall modulate the chilled water coil control valve to maintain supply air temperature reset schedule setpoint (adj.).

   3. Economizer Cooling: When the O.A. Enthalpy is below 18 BTU per pound of dry air (adj.), the outside and return air dampers shall be modulated to maintain supply air temperature setpoint (adj.) subject to mixed air thermostat which shall close the outside air damper if mixed air temperature drops below the heating coil scheduled entering air temperature (adj.). The cooling coil control valve shall be fully closed to the coil.

H. Unoccupied Mode: When the rooftop unit is in the unoccupied mode, the supply fans shall be de-energized. The outdoor air damper shall be closed and the return air damper shall be open. On a need for unoccupied heating by an area, the unit shall be placed into a “Warm Up” mode of operation. When all areas are satisfied, the unit shall be de-energized. On a need for unoccupied cooling by an area, the unit shall be placed into a “Cool Down” mode of operation. When all areas are satisfied, the unit shall be de-energized. Unoccupied cooling setpoints shall be capable of being set sufficiently high so as to effectively disable cooling during the unoccupied mode. A manual override switch (depress for 3 seconds) on the individual room sensors will activate the occupied mode for a period of one hour (adj.). The 0.2 BMS Sub-Contractor shall coordinate with the Client Agency regarding locations with active unoccupied cycle override pushbuttons.

I. The supply air temperature shall be capable of being reset according to outdoor air temperature, with the reset schedule being fully adjustable from the colorgraphics. The supply air temperature reset schedule shall initially be:

OAT	SAT
40 deg. F. & less	65 deg. F.
80 deg. F. & greater	55 deg. F.

J. CO2 Damper Control: A return air CO2 sensor/transmitter shall provide continuous monitoring of CO2 levels. During the occupied mode, the outdoor air damper control may be overridden by the CO2 sensor to maintain the ventilation air requirements. A return air CO2 sensor, through the DDC system, shall function to modulate the outdoor air dampers to the open position, overriding minimum outdoor air requirements, in order to maintain space CO2 levels at 800 ppm (adj.) setpoint. The reverse sequence shall occur on a drop in CO2 level. If mixed air temperature rises, the outdoor air dampers shall modulate open as previously described to maintain setpoint temperature. During the unoccupied mode the CO2 sensor shall have no impact on the respective AHU operation.

K. Dehumidification Control: The DDC system shall maintain return air humidity at 55% RH maximum (adj.) during summer operation. Refer to OCCUPIED/UNOCCUPIED ZONE DEHUMIDIFICATION AND REHEAT PROCESS for additional sequence information. When a dehumidification process is initiated, the DDC system shall reset AHU discharge air temperature setpoint down to 52 deg F (adj.) to provide dehumidification to the space. The DDC system shall return AHU discharge air temperature setpoint to its optimized value when the average space humidity drops below setpoint. Dehumidification will be disabled whenever the outdoor air temperature drops below 55 deg F (adj.). The DDC system shall modulate the duct reheat coils control valves to maintain space temperature setpoint during operation in the dehumidification mode.

L. Supply Fan VFD: For constant volume fans provided with a VFD, the VFD shall be used to provide soft start ramp capabilities for the supply fan motor. Upon fan start-up, the BMS shall ramp fan speed to setpoint as established by the TAB Contractor to provide required air flow. Setpoint shall be adjustable at the colorgraphics by an operator with sufficient password credentials.

M. Safeties:

1. Low-limit thermostats (freezestats) serpentined on the heating coil discharge shall de-energize the fans, close the outside and relief air dampers, open the return air damper, and fully open the heating coil control valve to the coil, if coil discharge temperature drops below 40 deg F (adj.).

2. The EC shall furnish and install fire alarm control modules at each fan motor VFD to de-energize the fans as per the fire alarm system requirements. The EC shall furnish and install fire alarm status modules at each unit duct mounted smoke detector to provide detector status to the BMS system. The 0.2 BMS Sub-Contractor shall monitor the status of each of these fire alarm modules. Whenever a supply air or return air smoke detector trips, FACMRs from the FAS shall close appropriate dampers and stop the fans. The FACMR shall function to notify the BMS, via the contact closure interface, that the FAS has shut down the unit upon sensing a smoke condition within the unit. When fans and/or smoke dampers are de-energized by the fire alarm system, the BMS shall close the outdoor air dampers and the relief air dampers, open the return air dampers, open the heating control valve to the heating coil, close the chilled water control valve to the coil, and close the reheat coil control valve to the coil. When the smoke condition is cleared and the associated detector(s) reset, FACMRs shall return the smoke dampers to their normally open position. Damper end switches shall be used to verify that the smoke dampers return to their normal positions. After the smoke detector(s) reset(s), the DDC system will attempt to restart the AHU.

3. Static Pressure Switches: Static pressure switches shall be used for fan system shutdown operations based upon high supply and/or low return static pressure. Static pressure switches shall be automatic reset devices. Static pressure limit switches shall be set at the limit device to “hardwire” stop the fan system. Static pressure switch settings shall be

"set" during fan testing with the TAB contractor and confirmed with the commissioning process. Each static pressure switch range shall be selected for the operating static pressures required for the associated fan systems.

N. Hot water coil in-line circulating pumps shall start whenever the respective coil control valve is open or whenever the outdoor air temperature falls below 40 deg F (adj.). Pump operation status shall be monitored and reported to the BMS system.

O. Where required, exhaust fans shall be controlled to operate in conjunction with specific air handling units.

P. Fan Status: A current sensing switch shall provide proof of fan operation and shall enable control loops.

Q. Fan Start/Stop Failure: If a supply fan fails to start or stop 30 seconds (adj.) after being commanded to do so, as determined by the status of the appropriate current switch, an appropriate alarm shall be provided throughout the DDC network.

R. Loss of supply fan status indications shall cause the air handler to revert to the unoccupied mode as a reference condition prior to any re-start attempt.

S. Filter Status: Filter status shall be provided via a differential pressure switch installed across the filter bank. Static pressure probes shall be installed on each side of the filter bank in conjunction with the transducer. Copper tubing installed in lieu of static probes is not acceptable. If the differential pressure switch across filter section indicates a dirty filter, an appropriate alarm shall be provided at the operator's workstation.

T. Relief Air Damper Control: A plenum static pressure sensor located in the common return/relief air plenum, referenced to space, shall modulate the relief air damper to maintain plenum static pressure setpoint when the unit is operational in an occupied heating or cooling mode. In all other modes of operation, the relief air damper shall be fully closed. The DDC system shall modulate the relief air damper to maintain relief plenum pressure setpoint of 0.15 in. W.C. (adj.).

U. The relief air louver motorized damper shall open when the AHU outdoor air damper opens to minimum position or greater. The backdraft dampers shall then relieve air as required.

V. UV Lighting Alarm: The DDC system shall monitor the UV lighting panel and on an alarm condition, an appropriate alarm shall be provided at the operator's workstation.

W. Abnormal Temperatures: If any of the supply air, return air, mixed air, or coil discharge temperatures deviates from normal operating parameters, as determined by the appropriate temperature sensor(s), an appropriate alarm shall be provided at the operator's workstation.

X. Abnormal Humidity: If the return air humidity or space humidity deviates from normal operating parameters, as determined by the appropriate relative humidity sensor(s), an appropriate alarm shall be provided throughout the DDC network.

Y. Maintenance Time Reminders: Run Time shall be totalized for the individual fans. When pre-determined (adj.) run hours are exceeded, an appropriate maintenance time reminder shall be provided at the operator's workstation.

3.16 VARIABLE VOLUME AIR HANDLING UNIT - HW HEATING/VENTILATING/CW COOLING (AHU-2)

A. When the air handling unit is in the shutdown mode, the supply fan shall be de-energized. The outdoor air damper and relief air damper shall be closed and the return air damper shall be open. The hot water coil control valve shall be open. If necessary, the heating coil control valve shall be controlled to maintain a temperature of 40 deg F (adj.) as sensed by the cooling coil discharge air temperature sensor. The cooling coil control valve shall be fully closed to the cooling coil.

B. Warm-Up Mode: When indexed to the warm-up mode by the DDC system, the unit supply fan shall run continuously, the outdoor air damper and relief air damper shall be closed, the return air damper shall be open, and the supply air temperature sensor shall modulate the heating coil control valve open to the heating coil to achieve supply air temperature reset schedule setpoint (adj.). The cooling coil control valve shall be fully closed to the cooling coil.

C. Heating Mode Occupied Cycle: When indexed to the occupied heating mode by the DDC system, the unit fan shall run continuously and the modulating outdoor air damper shall be controlled to maintain a minimum outdoor air position (adj.), subject to CO2 Control. The cooling coil control valve shall be fully closed to the cooling coil. When the supply air temperature is below the supply air temperature reset schedule setpoint (adj.), the heating coil control valve shall open to the heating coil and the outside air damper shall be controlled to maintain a minimum open position (adj.), subject to CO2 Control. As the supply air temperature rises to the desired temperature setpoint, the heating coil control valve shall modulate closed to the heating coil. On a continued rise above space temperature setpoint, the outside air dampers shall be modulated toward the open position. The economizer shall position up to 100% outdoor air in order to maintain space setpoint. A mixed air thermostat shall limit the outside air damper if mixed air temperature drops below heating coil scheduled entering air temperature (adj.).

D. Cool-Down Mode: When indexed to the cool-down mode by the DDC system, the supply fan shall run continuously, the outdoor air damper shall be closed, the return air damper shall be open, and the supply air temperature sensor shall modulate the cooling coil control valve open to the cooling coil to achieve supply air temperature reset schedule setpoint (adj.). The heating coil control valve shall be fully closed to the heating coil.

E. Cooling Mode Occupied Cycle: When indexed to the occupied cooling mode by the DDC system, the unit supply fan shall run continuously and the modulating minimum outdoor air dampers shall first open to their scheduled minimum outdoor air flow (adj.), subject to CO2 control. The cooling shall operate as further defined below.

1. Chilled Water Cooling: When the O.A. Enthalpy is above 24 BTU per pound of dry air (adj.), the outdoor air dampers shall be at minimum position, subject to CO2 control, the return air dampers shall be positioned accordingly and the supply air temperature sensor shall modulate the chilled water coil control valve to achieve supply air temperature reset schedule setpoint (adj.).
2. Hybrid Mode Cooling: When the O.A. Enthalpy is between 18 and 24 BTU per pound of dry air (adj.), the outside and return air dampers shall position for economizer operation to maintain mixed air temperature and the supply air temperature sensor shall modulate the chilled water coil control valve to maintain supply air temperature reset schedule setpoint (adj.).
3. Economizer Cooling: When the O.A. Enthalpy is below 18 BTU per pound of dry air (adj.), the outside and return air dampers shall be modulated to maintain supply air temperature setpoint (adj.) subject to mixed air thermostat which shall close the outside air damper if mixed air temperature drops below the heating coil scheduled entering air temperature (adj.). The cooling coil control valve shall be fully closed to the coil.

F. Unoccupied Mode: When the rooftop unit is in the unoccupied mode, the supply fans shall be de-energized. The outdoor air damper shall be closed and the return air damper shall be open. On a need for unoccupied heating by an area, the unit shall be placed into a “Warm Up” mode of operation. When all areas are satisfied, the unit shall be de-energized. On a need for unoccupied cooling by an area, the unit shall be placed into a “Cool Down” mode of operation. When all areas are satisfied, the unit shall be de-energized. Unoccupied cooling setpoints shall be capable of being set sufficiently high so as to effectively disable cooling during the unoccupied mode. A manual override switch (depress for 3 seconds) on the individual room sensors will activate the occupied mode for a period of one hour (adj.). The 0.2 BMS Sub-Contractor shall coordinate with the Client Agency regarding locations with active unoccupied cycle override pushbuttons.

G. The supply air temperature shall be capable of being reset according to outdoor air temperature, with the reset schedule being fully adjustable from the colorgraphics. The supply air temperature reset schedule shall initially be:

OAT	SAT
40 deg. F. & less	65 deg. F.
80 deg. F. & greater	55 deg. F.

H. CO2 Damper Control: A return air CO2 sensor/transmitter shall provide continuous monitoring of CO2 levels. During the occupied mode, the outdoor air damper control may be overridden by the CO2 sensor to maintain the ventilation air requirements. A return air CO2 sensor, through the DDC system, shall function to modulate the outdoor air dampers to the open position, overriding minimum outdoor air requirements, in order to maintain space CO2 levels at 800 ppm (adj.) setpoint. The reverse sequence shall occur on a drop in CO2 level. If mixed air temperature rises, the outdoor air dampers shall modulate open as previously described to maintain setpoint temperature. During the unoccupied mode the CO2 sensor shall have no impact on the respective AHU operation.

I. Dehumidification Control: The DDC system shall maintain return air humidity at 55% RH maximum (adj.) during summer operation. Refer to OCCUPIED/UNOCCUPIED ZONE DEHUMIDIFICATION AND REHEAT PROCESS for additional sequence information. When a dehumidification process is initiated, the DDC system shall reset AHU discharge air temperature setpoint down to 52 deg F (adj.) to provide dehumidification to the space. The DDC system shall return AHU discharge air temperature setpoint to its optimized value when the average space humidity drops below setpoint. Dehumidification will be disabled whenever the outdoor air temperature drops below 55 deg F (adj.). The DDC system shall modulate the VAV box reheats to maintain space temperature setpoint during operation in the dehumidification mode.

J. Supply Fan Static Pressure Control: The remote supply air duct static pressure sensors (located as generally indicated on the drawings) shall modulate the supply air fan VFD to maintain a supply air duct static pressure setpoint of 1.20 in. W.C. (adj.). The duct static pressure transducers shall be referenced to the service space via a space type shielded static pressure probe. The VFD speed shall be varied as required to maintain remote static setpoint subject to the high supply fan static pressure limit.

   1. Static pressure sensor “static limits” shall be set in software to “soft-wire” stop the fan system based on software limits set during fan testing with the TAB Contractor and confirmed with the Client Agency’s Commissioning Agent. Each static sensor range shall be selected for the operating static pressures required for the fans and duct static pressure operation.

   2. Fan pressure optimization, if enabled, shall not be initiated until the occupied cycle has been in operation for at least 30 minutes (adj.).

K. Safeties:

   1. Low-limit thermostats (freezestats) serpentined on the heating coil discharge shall de-energize the fans, close the outside and relief air dampers, open the return air damper, and fully open the heating coil control valve to the coil, if coil discharge temperature drops below 40 deg F (adj.).

   2. The EC shall furnish and install fire alarm control modules at each fan motor VFD to de-energize the fans as per the fire alarm system requirements. The EC shall furnish and install fire alarm status modules at each unit duct mounted smoke detector to provide detector status to the BMS system. The 0.2 BMS Sub-Contractor shall monitor the status of each of these fire alarm modules. Whenever a supply air or return air smoke detector trips, FACMRs from the FAS shall close appropriate dampers and stop the fans. The FACMR shall function to notify the BMS, via the contact closure interface, that the FAS has shut down the unit upon sensing a smoke condition within the unit. When fans are de-energized by the fire alarm system, the BMS shall close the outdoor air dampers and the relief air dampers, open the return air dampers, open the heating control valve to the heating coil, and close the chilled water control valve to the coil. After the smoke detector(s) reset(s), the DDC system will attempt to restart the AHU.

L. Hot water coil in-line circulating pumps shall start whenever the respective coil control valve is open or whenever the outdoor air temperature falls below 40 deg F (adj.). Pump operation status shall be monitored and reported to the BMS system.

M. Where required, exhaust fans shall be controlled to operate in conjunction with specific air handling units.

N. Fan Status: A current sensing switch shall provide proof of fan operation and shall enable control loops.

O. Fan Start/Stop Failure: If a supply fan fails to start or stop 30 seconds (adj.) after being commanded to do so, as determined by the status of the appropriate current switch, an appropriate alarm shall be provided throughout the DDC network.

P. Loss of supply fan status indications shall cause the air handler to revert to the unoccupied mode as a reference condition prior to any re-start attempt.

Q. Filter Status: Filter status shall be provided via a differential pressure switch installed across the filter bank. Static pressure probes shall be installed on each side of the filter bank in conjunction with the transducer. Copper tubing installed in lieu of static probes is not acceptable. If the differential pressure switch across filter section indicates a dirty filter, an appropriate alarm shall be provided at the operator's workstation.

R. Relief Air Damper Control: A plenum static pressure sensor located in the common return/relief air plenum, referenced to space, shall modulate the relief air damper to maintain plenum static pressure setpoint when the unit is operational in an occupied heating or cooling mode. In all other modes of operation, the relief air damper shall be fully closed. The DDC system shall modulate the relief air damper to maintain relief plenum pressure setpoint of 0.15 in. W.C. (adj.).

S. The relief air louver motorized damper shall open when the AHU outdoor air damper opens to minimum position or greater. The backdraft dampers shall then relieve air as required.

T. UV Lighting Alarm: The DDC system shall monitor the UV lighting panel and on an alarm condition, an appropriate alarm shall be provided at the operator's workstation.

U. Abnormal Temperatures: If any of the supply air, return air, mixed air, or coil discharge temperatures deviates from normal operating parameters, as determined by the appropriate temperature sensor(s), an appropriate alarm shall be provided at the operator's workstation.

V. Abnormal Humidity: If the return air humidity or space humidity deviates from normal operating parameters, as determined by the appropriate relative humidity sensor(s), an appropriate alarm shall be provided throughout the DDC network.

W. Maintenance Time Reminders: Run Time shall be totalized for the individual fans. When pre-determined (adj.) run hours are exceeded, an appropriate maintenance time reminder shall be provided at the operator's workstation.

3.17 CONSTANT VOLUME ROOFTOP UNIT – GAS HEATING/VENTILATING/DX COOLING (RTU-1)

A. The rooftop unit is provided with factory mounted controls with BACnet MS/TP controls. The 0.2 BMS Sub-Contractor shall connect to the unit with BACnet to control and monitor the unit. Points not being provided by the manufacturer shall be supplied by the 0.2 BMS Sub-Contractor.

B. When the rooftop unit is in the shutdown mode, the supply fans shall be de-energized. The outdoor air damper shall be closed, and the return air damper shall be open. The gas control valve(s) on the gas heater shall modulate to maintain a heating coil leaving air temperature of 45 deg F. Mechanical cooling shall be disabled.

C. Warm-Up Mode: When indexed to the warm-up mode by the DDC system, the supply fan shall run continuously, the outdoor air damper shall be closed, the return air damper shall be open, and the space temperature sensor shall control the gas valve(s) on the gas heater to achieve space temperature setpoint (adj.). Mechanical cooling shall be disabled.

D. Heating Mode Occupied Cycle: When indexed to the occupied heating mode by the DDC system, the unit fans shall run continuously and the modulating outdoor air damper shall be controlled to maintain a minimum outdoor air position (adj.). The DX cooling shall be de-energized. When the space temperature is below the space temperature setpoint (adj.), as listed hereinafter, the gas valve(s) shall open to the gas heater and the outside air damper shall be controlled to maintain a minimum open position (adj.). As the space temperature rises to the desired reset schedule setpoint, the gas valve(s) shall close to the gas heater. On a continued rise above setpoint (adj.), the outside air dampers shall be modulated toward the open position.

The economizer shall position up to 100% outdoor air in order to maintain space temperature setpoint. A mixed air thermostat shall limit the outside air damper if mixed air temperature drops below heating coil scheduled entering air temperature (adj.).

E. Cool-Down Mode: When indexed to the cool-down mode by the DDC system, the supply fan shall run continuously, the outdoor air damper shall be closed, the return air damper shall be open, and the space temperature sensor shall stage the DX system to achieve space temperature setpoint (adj.). Mechanical cooling shall not be enabled until the outdoor air temperature rises above 55 deg F (adj.). Otherwise economizer mode cooling shall be utilized. Gas heating shall be disabled.

F. Cooling Mode Occupied Cycle: When indexed to the occupied cooling mode by the DDC system, the unit supply fan shall run continuously and the modulating outdoor air damper shall first open to its scheduled minimum outdoor air position (adj.), subject to CO2 Control. The cooling shall operate as further defined below.

1. DX Cooling: When the O.A. Enthalpy is above 24 BTU per pound of dry air (adj.), the outdoor air damper shall be at minimum position, the return air damper shall be positioned accordingly, and the space temperature sensor shall stage the DX cooling to achieve space temperature setpoint (adj.).
2. Hybrid Mode Cooling: When the O.A. Enthalpy is between 18 and 24 BTU per pound of dry air (adj.), the outside and return air dampers shall position for economizer operation to maintain mixed air temperature and the space temperature sensor shall stage the DX cooling to maintain space temperature setpoint (adj.).
3. Economizer Cooling: When the O.A. Enthalpy is below 18 BTU per pound of dry air (adj.), the outside and return air dampers shall be modulated to maintain space temperature reset schedule setpoint (adj.) subject to mixed air thermostat which shall close the outside air damper if mixed air temperature drops below the heating coil scheduled entering air temperature (adj.). The DX cooling shall be disabled.

G. Unoccupied Mode: When the air handling unit is in the unoccupied mode, the unit fans shall be de-energized, the outdoor air damper and relief air damper shall be closed, and the return air damper shall be open. Whenever the space temperature is below night set-back limits (adj.), the unit fan shall function (cycle) as described for the warm-up mode to maintain reduced space temperature setpoint (adj.). Whenever the space temperature is above night set-up limits (adj.), the unit fan shall function (cycle) as described for the cool-down mode to maintain elevated space temperature setpoint (adj.). The unoccupied cooling setpoint shall be capable of being set sufficiently high so as to effectively disable cooling during the unoccupied mode. A manual override switch (depress for 3 seconds) will activate the occupied mode for a period of one hour (adj.). The 0.2 BMS Sub-Contractor shall coordinate with the Client Agency regarding locations with active unoccupied cycle override buttons.

H. CO2 Damper Control: A space CO2 sensor/transmitter shall provide continuous monitoring of CO2 levels. During the occupied mode, the outdoor air damper control may be overridden by the CO2 sensor to maintain the ventilation air requirements. A space CO2 sensor, through the DDC system, shall function to modulate the outdoor air dampers to the open position, overriding minimum outdoor air requirements, in order to maintain space CO2 levels at 800 ppm (adj.) setpoint. The reverse sequence shall occur on a drop in CO2 level. If mixed air temperature rises, the outdoor air dampers shall modulate open as previously described to maintain setpoint temperature. During the unoccupied mode the CO2 sensor shall have no impact on the respective RTU operation.

I. Dehumidification Control: The DDC system shall maintain space humidity at 55% RH maximum (adj.) during summer operation. Refer to OCCUPIED/UNOCCUPIED ZONE DEHUMIDIFICATION AND REHEAT PROCESS for additional sequence information. When a dehumidification process is initiated, the DX cooling shall be fully enabled with the hot gas reheat modulating to maintain space temperature setpoint (adj.). The dehumidification mode shall be terminated when the unit return air humidity reaches setpoint. (adj.) as sensed by the return air humidity sensor(s). Dehumidification will be disabled whenever the outdoor air temperature drops below 55 deg F (adj.).

J. Supply Fan VFD: For constant volume fans provided with a VFD, the VFD shall be used to provide soft start ramp capabilities for the supply fan motor. Upon fan start-up, the BMS shall ramp fan speed to setpoint as established by the TAB Contractor to provide required air flow. Setpoint shall be adjustable at the colorgraphics by an operator with sufficient password credentials.

K. Safeties:

1. Supply/Return Air Smoke Condition: The EC shall furnish and install fire alarm control modules at each fan motor VFD to de-energize the fans as per the fire alarm system requirements. The EC shall furnish and install fire alarm status modules at each duct mounted smoke detector to provide detector status to the BMS system. The 0.2 BMS Sub-Contractor shall monitor the status of each of these fire alarm modules. Whenever a supply air or return air smoke detector trips, FACMRs from the FAS shall close appropriate dampers and stop the fans. The FACMR shall function to notify the BMS, via the contact closure interface, that the FAS has shut down the unit upon sensing a smoke condition within the unit. When fans are de-energized by the fire alarm system, the BMS shall close the outdoor air damper, open the return air damper, and disable the gas heat and DX cooling. After the smoke detector(s) reset(s), the DDC system will attempt to restart the RTU.

2. The unit shall be provided with refrigerant leak detection system by the unit manufacturer. The 0.2 BMS Sub-Contractor shall monitor the refrigerant detection device and provide an alarm upon leak detection. Upon activation of the leak detection system, the DDC system shall energize the unit fans (if not already running), disable the gas heat and DX cooling, close the outdoor air damper, and open the return air damper.

L. Exhaust Fan Control: The unit powered exhaust fan shall modulate to maintain building pressure setpoint. Whenever the building pressure rises above the building pressure setpoint (adj.) by the deadband amount (adj.), the exhaust fan shall energize and ramp up to maintain building pressure setpoint. The reverse shall occur on a fall in building pressure below setpoint by the deadband amount.

M. The unit discharge air temperature sensor shall also provide low and high limit temperature control functions. On a rise in discharge air temperature above 130 deg F (adj.) or a drop in discharge air temperature below 45 deg F (adj.) the BMS shall de-energize the unit and generate an appropriate high or low discharge air temperature alarm. Upon an abnormal supply air condition, the BMS shall de-energize the unit fan, close the outdoor air damper, open the return air damper, and de-energize the gas heater(s) and the DX cooling.

N. Where required, exhaust fans shall be controlled to operate in conjunction with specific rooftop units.

O. Fan Status: A current sensing switch shall provide proof of fan operation and shall enable control loops.

P. Fan Start/Stop Failure: If a supply fan fails to start or stop 30 seconds (adj.) after being commanded to do so, as determined by the status of the appropriate current switch, an appropriate alarm shall be provided throughout the DDC network.

Q. Loss of supply fan status indications shall cause the rooftop unit to revert to the unoccupied mode as a reference condition prior to any re-start attempt.

R. Filter Status: Filter status shall be provided via a differential pressure switch installed across the filter bank. Static pressure probes shall be installed on each side of the filter bank in conjunction with the transducer. Copper tubing installed in lieu of static probes is not acceptable. If the differential pressure switch across filter section indicates a dirty filter, an appropriate alarm shall be provided at the operator's workstation.

S. UV Lighting Alarm: The DDC system shall monitor the UV lighting panel and on an alarm condition, an appropriate alarm shall be provided at the operator's workstation.

T. Abnormal Temperatures: If any of the supply air, return air, mixed air, or coil discharge temperatures deviates from normal operating parameters, as determined by the appropriate temperature sensor(s), an appropriate alarm shall be provided at the operator's workstation.

U. Abnormal Humidity: If the return air humidity or space humidity deviates from normal operating parameters, as determined by the appropriate relative humidity sensor(s), an appropriate alarm shall be provided throughout the DDC network.

V. Maintenance Time Reminders: Run Time shall be totalized for the individual fans. When pre-determined (adj.) run hours are exceeded, an appropriate maintenance time reminder shall be provided at the operator's workstation.

3.18 KITCHEN HOOD MAKE-UP/EXHAUST SYSTEM

A. Make-up air unit shall be provided with a terminal strip interface that will allow the BMS to turn the supply fan on / off, enable / disable the gas furnace, and open / close the intake damper. Manufacturer provided controls shall modulate the gas burner to maintain discharge temperature and control all safeties after being enabled by the BMS. The 0.2 BMS Sub-Contractor will provide all hardware and software required to interlock the MAU, the kitchen hood exhaust fan, and the Ansul system as further defined below. The 0.2 BMS Sub-Contractor shall also mount and wire the discharge air temperature sensor for the MAU if it comes shipped loose with the unit.

B. The BMS shall start the kitchen hood ventilation system whenever the kitchen hood system start/stop switch (provided by the 0.2 BMS Sub-Contractor) is activated (manual mode) or the exhaust duct temperature sensor exceeds setpoint (automatic mode). Under normal operation, the BMS shall first start the exhaust fan. Upon verification of exhaust fan run status, the BMS shall then open the make-up air unit outdoor air damper and, upon verification of damper open status, start the supply fan and enable the gas heat. The BMS shall only enable the gas heat when the outdoor air temperature is below 60 deg F (adj.). Except as hereinafter clarified, the BMS shall interlock the make-up air unit to operate whenever the exhaust fan operates. An alarm shall be generated whenever any damper fails to open/close or any fan system fails to start or stop 30 seconds (adj.) after being commanded to do so.

C. 0.2 BMS Sub-Contractor shall furnish and install a wall mounted discharge temperature setpoint adjuster to provide local discharge air setpoint adjustment. Local setpoint adjuster shall allow set point adjustment from 55 deg. F. to 80 deg. F.

D. The make-up air unit shall be disabled whenever the exhaust duct temperature sensor drops below setpoint (automatic mode) or the kitchen hood system start/stop switch is de-activated (manual mode). The BMS shall monitor the exhaust duct temperature sensor. On a rise in temperature above setpoint, the BMS shall start the exhaust fan and make-up air unit. On a drop in hood temperature below setpoint the BMS shall stop the exhaust fan and make-up air unit. Hood exhaust fan shall operate for a minimum of 15 minutes (adj.) after the hood temperature switch deactivates.

E. The BMS shall also interlock the hood control system with the Ansul system. Upon the Ansul system being activated, the BMS shall start the kitchen hood exhaust fan (if not already running) and disable the kitchen hood make up air unit. (Some local code officials prefer to de-energize the exhaust fan upon activation of the Ansul system. The 0.2 BMS Sub-Contractor shall verify with the Authority Having Jurisdiction how the exhaust fan is to be controlled and proceed as directed.)

F. Safeties: The EC shall furnish and install fire alarm control modules at each fan motor starter to de-energize the fans as per the fire alarm system requirements. When fans are de-energized by the fire alarm system, the BMS shall close the outdoor air dampers and disable the gas heat. The EC shall furnish and install fire alarm status modules at each unit duct mounted smoke detector to provide detector status to the 0.2 BMS Sub-Contractor . The 0.2 BMS Sub-Contractor shall monitor the status of each of these modules.

G. The BMS operator shall be able to manually override the BO points below to operate the supply and exhaust sub-systems separately.

H. All interlock control and power wiring shall be by the 0.2 BMS Sub-Contractor.

3.19 DIRECT DIGITAL VAV BOX

A. General: 120 VAC power shall be supplied to a junction box by the project 0.4 Electrical Sub-Contractor. It will be the 0.2 BMS Sub-Contractor's responsibility to provide any and all power

conversion and distribution required to properly power the VAV box control system. A maximum of four VAV boxes shall be served by each power conversion/distribution device.

B. The 0.2 BMS Sub-Contractor shall provide a control algorithm that also defines a reheat minimum flow value (adj.) in addition to the minimum flow (adj.) and maximum flow (adj.) values for the VAV box. During the heating mode of operation, the flow setpoint for the VAV box shall be the reheat minimum flow if that value is greater than the cooling minimum flow. During the cooling mode of operation, VAV box flow shall increase from cooling minimum flow to cooling maximum flow as the space temperature increases through the cooling throttling range centered around the cooling setpoint. During the heating mode of operation, VAV box flow shall be reheat minimum flow and the reheat control valve shall modulate from 0% open to 100% open as the space temperature drops one heating throttling range below heating setpoint. Heating and cooling setpoints shall be such that the heating setpoint cannot occur within the cooling throttling range.

C. Warm-up Mode: The DDC network shall initiate the warm-up mode for the DDC VAV boxes. In the warm-up mode with the space temperature below the morning warm-up setpoint, the controller shall provide maximum CFM in conjunction with the area heating system(s) to area served. As warm-up setpoint is approached, the controller shall modulate the CFM to its minimum setting and heating coil(s) closed. In areas with auxiliary radiation (such as fintube, radiant panels or convectors) in conjunction with reheat coils, the reheat coils shall be the first to close with the auxiliary radiation closing after the reheat coil. The warm-up mode shall be terminated locally at the controller when warm-up setpoint is reached, or remotely from the DDC network at zone occupied time.

D. Occupied Mode: Controller shall modulate damper actuator and reheat coil valve to maintain local space temperature setpoint within the minimum and maximum air flows as configured within the controller or as provided via the DDC network. Note, when no hot water is available from the heating system (determined by a combination of hot water supply temperature and hot water pump run status), the boxes shall operate with “zero” as a minimum air flow.

E. Unoccupied mode: The damper actuator shall be positioned as required to allow the box to operate in the reheat or cooling mode as dictated by the space temperature in order to maintain unoccupied reduced or elevated space temperature setpoints.

F. A discharge air temperature sensor shall be provided for indication and/or troubleshooting at each reheat coil.

G. The room sensor shall have an integral plug for connection by the balancing contractor for setting the required airflow rates (as defined by the contract documents) for each box. Once the balancing contractor has set the flows, the information may be uploaded to the central system from the balancing contractor’s laptop to define final system operating parameters.

H. Constant Volume – Reheat Boxes shall be controlled identical to the variable volume box except that the volume damper will be set by the balancing contractor to deliver a fixed volume of air at all times except when no hot water is present, then the boxes shall go to 10% (adj.) of their scheduled CFM for the minimum flow.

3.20 DUCT REHEAT COILS – HOT WATER

A. The 0.2 BMS Sub-Contractor shall furnish all required power.

B. Occupied Mode: The DDC system shall modulate the hot water valve to maintain space temperature setpoint.

C. Unoccupied mode: The DDC system shall modulate the hot water valve to maintain unoccupied reduced temperature set points.

D. A discharge air temperature sensor shall monitor the supply air temperature to the room.

E. Where applicable, in areas with auxiliary finned tube radiation in conjunction with duct reheat coils, the when the outdoor air temperature rises above 45 deg F (adj.), the auxiliary heat control valve shall be driven fully closed and the reheat coil shall be used to maintain space temperature. When the outdoor air temperature drops below 45 deg F (adj.), the auxiliary heat control valve shall be driven fully open as stage 1 of heat and the reheat coil shall be used as stage 2 of heat to maintain space temperature.

3.21 EXHAUST FAN CONTROL - DDC DAY/NIGHT OPERATION

A. Where scheduled on the drawings, a relay shall be provided for general exhaust fans which shall function to allow the DDC system to operate the exhaust fan continuously during the “occupied” cycle of operation and stop the exhaust fan during the “warm-up”, “cool down” and “unoccupied” cycles of operation. The exhaust fans shall not run until the DDC system has also commanded the appropriate source(s) of make-up air (air handling units) for that zone to run in the “occupied” cycle. Control wiring will be furnished and installed by the 0.2 BMS Sub-Contractor. A separate digital output point shall be provided for each exhaust fan(s). This digital output shall be in addition to that provided for day/night changeover of other HVAC equipment in that zone.

B. Fan Status: A current sensing switch shall provide proof of fan operation. If a fan fails to start or stop 30 seconds (adj.) after being commanded to do so, as determined by the status of the appropriate current switch, an appropriate alarm shall be provided at the operator’s workstation.

C. All power wiring, (except for power wiring from the power panel, through the motor protection/control device to the motor, which shall be by the EC) interlock wiring and control wiring shall be by the 0.2 BMS Sub-Contractor.

3.22 DISHWASHER EXHAUST FAN

A. The dishwasher exhaust fan shall be controlled by a hardwired interlock with the dishwasher.

B. The local on/off switch with pilot light and all power wiring, interlock wiring and control wiring shall be by the 0.4 Electrical Contractor.

C. The 0.2 BMS Sub-Contractor shall provide a current switch to monitor exhaust fan status and dishwasher status for interlock control verification.

3.23 FINNED TUBE RADIATORS WITH DDC CONTROL

A. 0.2 BMS Sub-Contractor is responsible for all power, power wiring requirements and control wiring requirements to all controllers and controlled devices for finned tube control.

B. An electronic DDC thermostat shall cycle a two-way control valve to maintain space temperature. This DDC thermostat shall be networked to the BMS.

C. On a fall in space temperature below the heating setpoint, the 2-way valve shall be opened to maintain space temperature. The reverse sequence shall occur on a rise in space temperature. During the "Unoccupied" cycle the DDC thermostat shall maintain a separate, unoccupied space temperature (adj.).

D. Where finned tube are sequenced with other devices (i.e. AHUs, RTUs), the radiation control valve shall be sequenced to be the first control valve to open on a call for heat and the last to close on a call for ventilation / cooling.

3.24 ALARM REQUIREMENTS

A. All alarm conditions (ALL MTR (*****), COS (**~**), LIMIT (**~**) and RTN (**~**) ALARM INFORMATION DESIGNATED IN THE POINTS LIST) shall be separately annunciated and their occurrence indicated by showing a red alarm icon on the current graphic display. A separate page shall be used to display alarm details. AVs and BVs read/written across 3rd party communication interfaces shall also be treated as I/O points for alarming purposes and alarmed as determined by the Client Agency.

B. The 0.2 BMS Sub-Contractor shall meet with the Client Agency to determine routine requirements for all alarm information. Particular attention shall be paid to developing a routine procedure that prevents non-critical alarms from impacting critical system operation. The prioritization and routine shall be fully implemented to the satisfaction of the Client Agency. The 0.2 BMS Sub-Contractor, working in conjunction with Client Agency, shall implement automatic email of selected alarms to the designated Client Agency personnel. Additional method(s) of alarm annunciation shall be coordinated with the Client Agency.

C. The following alarm conditions, as further detailed by the Client Agency, shall also be detected and an appropriate alarm generated. The 0.2 BMS Sub-Contractor, working in conjunction with Client Agency, shall implement automatic email of selected alarms to the designated Client Agency personnel. Additional method of alarm annunciation shall be coordinated with the Client

Agency.

1. Device failed to start/stop
2. Damper position feedback does not agree with commanded position
3. Control valve position feedback does not agree with commanded position
4. Chiller safety fault alarm
5. Chiller cycling fault alarm
6. Chiller warning fault alarm
7. Cooling tower vibration alarm
8. High/low chiller evaporator pressure
9. High/low chiller condenser pressure
10. Refrigerant monitor alarm
11. VFD alarm
12. VFD communication interface points as determined by Client Agency
13. High/low chilled water supply temperature
14. High/low chilled water return temperature
15. High/low chilled water system differential pressure
16. High/low condenser water supply temperature
17. High/low condenser water return temperature
18. Freeze Alarm
19. Dirty filter
20. Smoke detector alarm
21. High/low mixed air temperature
22. High/low heating coil discharge air temperature
23. High/low cooling coil discharge air temperature
24. High/low supply air temperature
25. High/low space temperature
26. High/low AHU static pressure alarm
27. High/low duct static pressure alarm
28. High/low hot water supply temperature
29. High/low hot water return temperature

D. The 0.2 BMS Sub-Contractor shall meet with the Client Agency to determine routing requirements for all alarm information. Particular attention shall be paid to developing a routing procedure that prevents non-critical alarms from impacting critical system operation. The prioritization and routing shall be fully implemented to the satisfaction of the Client Agency.

E. The 0.2 BMS Sub-Contractor shall provide custom alarm reports as required for this project.

3.25 TREND REQUIREMENTS

A. All I/O points and setpoints shall be linked to trend objects. The controller(s) shall record a trend sample every 15 minutes (adj.) for each trend object and save the most recent 120 (adj.) samples.

B. AVs and BVs read/written across 3rd party communication interfaces shall also be treated as I/O points for trending purposes.

C. The following trends shall be implemented and automatically archived to the server as part of this project to aid in operating the building for maximum energy efficiency. Point selection shall be consistent with available memory and coordinated with the Client Agency prior to implementation. The 0.2 BMS Sub-Contractor, working in conjunction with Client Agency's

Representative, shall implement automatic email of selected trends to the designated Client Agency's Representative personnel.

1. Chilled water system overview – number of points and/or trends as determined by the Client Agency's Representative
2. Chilled water system flows – number of points and/or trends as determined by the Client Agency's Representative
3. Chilled water system tonnage profiles (with OAT, OAH)
4. Chiller tonnage, KW and KW/ton profiles
5. Chiller - number of points and/or trends as determined by the Client Agency's Representative
6. CWP #1 - number of points and/or trends as determined by the Client Agency's Representative
7. Total Chilled Water Flow and associated CWP (individual and total) KW performance
8. Total Chilled Water Flow and associated differential pressure profiles
9. Condenser water system – number of points and/or trends as determined by the Client Agency's Representative
10. Condenser water system flows – number of points and/or trends as determined by the Client Agency's Representative
11. Condenser water system load profiles (with OAT, OAH)
12. Cooling Tower load, KW and KW/ton profiles
13. Cooling Tower - number of points and/or trends as determined by the Client Agency's Representative
14. CDP #1 - number of points and/or trends as determined by the Client Agency's Representative
15. Total Condenser Water Flow and associated CDP (individual and total) KW performance (with OAT, OAH)
16. Total Condenser Water Flow and associated Cooling Tower (individual and total) KW performance (with OAT, OAH)
17. Air handling units – trending done for each individual unit (AHU-1, AHU-2, etc.) number of points and/or trends as determined by the Client Agency's Representative
18. Variable volume boxes – representative boxes selected by the Client Agency's Representative, number of points and/or trends as determined by the Client Agency's Representative
19. Exhaust system – number of points and/or trends as determined by the Client Agency's Representative
20. VFD communication interface points - number of points and/or trends as determined by the Client Agency's Representative
21. Hot water system overview – number of points and/or trends as determined by the Client Agency's Representative
22. Hot water system flows – number of points and/or trends as determined by the Client Agency's Representative
23. HWP #1 - number of points and/or trends as determined by the Client Agency's Representative
24. HWP #2 - number of points and/or trends as determined by the Client Agency's Representative

D. Custom Reports

1. The 0.2 BMS Sub-Contractor shall provide custom trend reports as required for this project.

3.26 WARRANTY

A. The local field office shall warranty the BMS as described in Section 230900, paragraph 1.8 Warranty. The work of this Section will be subject to the warranty requirements of Section 230900, paragraph 1.10 Warranty.

3.27 WARRANTY ACCESS

A. The local field office shall provide warranty access as described in Section 230900, paragraph 3.6 Warranty Access. The work of this Section will be subject to the warranty access requirements of Section 230900, paragraph 3.6 Warranty Access.

3.28 APPLICATION DEVELOPMENT AND REVIEW

A. The control drawings and the sequences of operation are for conveying general concept only and are not meant to be inclusive of all hardware requirements or all functional sequence requirements. Refer to the complete package of contract drawings for equipment quantity and location information. Items mentioned in Sections 230900 and 230993, shown on the control drawings, mentioned in the sequences of operation or shown on other HVAC drawings shall become part of the work of this project without the necessity of being separately detailed in each of those applicable sections of the contract documents. Reference in one section of the contract documents shall be interpreted to include reference in all other applicable sections. Any additional hardware and/or software required to accomplish functional intent shall be provided (without additional cost to the Client Agency) just as though it were fully detailed on the contract documents.

B. The 0.2 BMS Sub-Contractor shall be responsible for providing complete detailed sequences of operation for each piece of equipment or system regardless of the completeness and clarity of the sequences in the contract documents. These detailed sequences shall address all operating modes including, but not limited to, normal, failure, failure recovery. These detailed sequences shall also address all system interaction and operational interfaces and shall be required prior to beginning implementation of the application software and MMI package. The sequences of operation as written infer certain additional functionality in order to accomplish project intent. With that in mind, software review meetings shall be held with the Professional, Client Agency, and 0.2 BMS Sub-Contractor to finalize details prior to beginning implementation of the application software and MMI package and again at regular intervals during initial operation of the system. Professional shall coordinate scheduling and recording keeping. Following is a summary of anticipated review meetings and required follow-up actions by the 0.2 BMS Sub-Contractor.

1. Review scope of software to be implemented. This shall be an interchange of ideas and operating characteristics of the equipment and facility. All data relative to system operations and design criteria shall be presented at this time. The 0.2 BMS Sub-Contractor shall gather this data and structure the required software around this information. This shall occur prior to starting any software programming by the control installer. This meeting shall also establish the system and point naming conventions to be used throughout the project by the 0.2 BMS Sub-Contractor. Naming conventions shall be approved by the Professional and the Client Agency. Colorgraphic screens hierarchy, layout, functionality and operator interaction, including alarming and trending, shall be presented for approval by the Professional and the Client Agency.
2. After one (1) to three (3) months of cooling season operation, as deemed appropriate by any party, an operations/software review shall be held. Any changes required shall be implemented by the 0.2 BMS Sub-Contractor after this meeting.
3. Prior to the beginning of the next cooling season, a final cooling season software review shall be held to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.
4. After one (1) to three (3) months of heating season operation, as deemed appropriate by any party, an operations/software review shall be held. Any changes required shall be implemented by the 0.2 BMS Sub-Contractor after this meeting.
5. Prior to the beginning of the next heating season, a final heating season software review

shall be held to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.

6. After one (1) to three (3) months of Air Handling Unit system operations, as deemed appropriate by any party, an operations/software review shall be held. Any changes required shall be implemented by the 0.2 BMS Sub-Contractor after this meeting.
7. Seasonal operations (winter heating & humidification and summer cooling and Dehumidification), shall be reviewed with software changes implemented.
8. Final software reviews shall be held for each system to review the operational sequences, resolve any issues that may have occurred and/or implement desired software changes to enhance the system operation.

END OF SECTION

SECTION 230995

VARIABLE FREQUENCY DRIVES

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.01 VARIABLE FREQUENCY MOTOR SPEED CONTROL DRIVES (1-29 HP VFD'S)

A. Description

1. This specification is to cover a complete Adjustable Frequency motor Drive (AFD) consisting of a Six (6) pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor of less than 30HP-480-3-60. It is required that the drive manufacturer have an existing:
    a. Sales representative exclusively for HVAC products, with expertise in HVAC Systems and controls.
    b. An independent service organization and repair depot.
    c. Drive Equipment will be purchased in Pittsburgh, Pa. through the local Drive Sales Representatives' Office.
2. The drive manufacturer shall supply the drive and all necessary controls as herein specified. The manufacturer shall have been engaged in the production of this type of equipment for a minimum of twenty years.
3. The Contractor shall furnish all drives for installation at job site; under no circumstances will drives be supplied by or shipped to other Equipment Manufacturer's for handling/re-shipment. This is to maintain optimum warranty coverage and eliminate drive damage, losses related to second party handling/storage of drives and multiple Drive manufacturers on the same Project.
4. VFDs for Stair Tower Pressurization Fans shall be equipped with a fused control power transformer (100 VA minimum with size requirements coordinated with the ATC Contractor), HOA selector switch (as specified herein), red "run" pilot light, green "stop" pilot light, 2 NO/2 NC auxiliary contacts, and any other options as indicated on the contract documents.
5. VFDs for Stair Tower Pressurization Fans shall be furnished with "key" operable "hand-auto" selector switches in lieu of standard H-O-A selector switches.
6. VFDs for Stair Tower Pressurization Fans shall include a 3 phase voltage monitor with a set of dry contacts for monitoring by the BMS.

B. Quality Assurance

1. Referenced Standards:
    a. Institute of Electrical and Electronic Engineers (IEEE)
    b. Standard 519-1992, IEEE Guide for Harmonic Content and Control.
    c. Underwriters laboratories
    d. UL508C
    e. National Electrical Manufacturer's Association (NEMA)

f. ICS 7.0, AC Adjustable Speed Drives

g. IEC 16800 Parts 1 and 2

2. Qualifications:

a. AFDs and options shall be UL listed as a complete assembly. AFD's that require the customer to supply external fuses for the AFD to be UL listed are not acceptable. The base AFD shall be UL listed for 100 KAIC without the need for input fuses.

b. Acceptable Manufacturers:

1) ABB ACH 550 Series. (Basis of Design)

2) Eaton 9000X Series.

3) Square "D"

4) AFDs that are manufactured by a third party and "brand labeled" are not acceptable.

5) Drive will be supplied with an Input Circuit Breaker Disconnect Switch- But No-By-Pass.

6) Equal as approved by the Professional

C. Submittals

1. Submittals shall include the following information:

a. Outline dimensions, conduit entry locations and weight.

b. Customer connection and power wiring diagrams.

c. Complete technical product description including a complete list of options provided.

d. Complete documentation indicating compliance to IEEE 519 – harmonic analysis for this particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).

1) The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Calculations at the transformer are not acceptable. Any additional equipment required to meet this performance will be the responsibility of the contractor with no additional cost to the Client Agency.

2) Any filters or reactors provided to meet the required compliance with IEEE 519 shall be identified in the submittal.

3) Calculations shall include **ALL VFD's** specified for the jobsite, including those that may not be provided by this manufacturer. VFD's considered in the calculations shall be identified by the equipment served.

4) The .2 Contractor shall coordinate the transfer of information to the VFD manufacturer from all trades providing equipment furnished with VFD's and shall also acquire the necessary single line diagrams from PJ Dick / Barton Malow for use by the VFD manufacturer. If additional information is required to produce a complete harmonic analysis, the Contractor shall submit a written request to PJ Dick / Barton Malow for the needed information.

D. Adjustable Frequency Drives

1. The AFD package as specified herein shall be enclosed in a UL Listed NEMA Enclosure, completely assembled and tested by the manufacturer in an ISO9001 facility. Enclosures for indoor installation shall be NEMA 1 Rated. **Enclosures for outdoor installation shall be NEMA 4 stainless steel, no exceptions**. The AFD tolerated voltage window shall allow the AFD to operate from a line of +30% nominal, and -35% nominal voltages as a minimum.

2. Environmental operating conditions: 0 to 40°C continuous. AFD's that can operate at 40° C intermittently (during a 24 hour period) are not acceptable and must be oversized. Altitude 0 to 3300 feet above sea level, less than 95% humidity, non-condensing.
3. All AFDs shall have the following standard features:
    a. All AFDs shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating.
    b. The keypad shall include Hand-Off-Auto selections and manual speed control. The drive shall incorporate "bumpless transfer" of speed reference when switching between "Hand" and "Auto" modes. There shall be fault reset and "Help" buttons on the keypad. The Help button shall include "on-line" assistance for programming and troubleshooting.
    c. There shall be a built-in time clock in the AFD keypad. The clock shall have a battery back up with 10 years minimum life span. The clock shall be used to date and time stamp faults and record operating parameters at the time of fault. If the battery fails, the AFD shall automatically revert to hours of operation since initial power up. The clock shall also be programmable to control start/stop functions, constant speeds, PID parameter sets and output relays. There shall be four (4) separate, independent timer functions that have both weekday and weekend settings.
    d. The AFD shall have cooling fans that are designed for easy replacement. The fans shall be designed for replacement without requiring removing the AFD from the wall or removal of circuit boards.
    e. The overload rating of the drive shall be 110% of its normal duty current rating for 1 minute every 10 minutes, 130% overload for 2 seconds. The minimum FLA rating shall meet or exceed the values in the NEC/UL table 430-150 for 4-pole motors.
    f. The AFD shall have integral 3% impedance line reactors to reduce the harmonics to the power line and to add protection from AC line transients. The 3% impedance may be from dual (positive and negative DC bus) reactors, or 3% AC line reactors. AFD's with only one DC reactor shall add AC line reactors.
    g. The input current rating of the AFD shall be no more than 3% greater than the output current rating. AFD's with higher input current ratings require the upstream wiring, protection devices and source transformers to be oversized per NEC 430-2.
    h. The AFD shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition.
    i. The AFD's shall include a coordinated AC transient protection system consisting of a 4- 120 Joules (Phase to Phase and Phase to Ground) MOV's (Metal Oxide Varistors) a capacitor clamp, and 3% impedance reactors, as well as a 1600V rated Diode Bridge.
4. All AFDs to have the following adjustments:
    a. Two (2) PID Setpoint controllers shall be standard in the drive, allowing pressure or flow signals to be connected to the AFD, using the microprocessor in the AFD for the closed loop control. The AFD shall have 250 ma of 24 VDC auxiliary power and be capable of loop powering a transmitter supplied by others. The PID setpoint shall be adjustable from the AFD keypad, analog inputs, or over the communications bus. There shall be two parameter sets for the first PID that allow the sets to be switched via a digital input, serial communications or from the keypad for night setback, summer/winter setpoints, etc. There shall be an independent, second PID loop that can utilize the second analog input and modulate one of the analog outputs to maintain setpoint of an independent process (ie. valves, dampers, etc.). The setpoints shall be set in Engineering units and not require a percentage of the transducer input.
    b. Two (2) programmable analog inputs shall accept current or voltage signals.

c. Two (2) programmable analog outputs (0-20ma or 4-20 ma). The outputs may be programmed to output proportional to Frequency, Motor Speed, Output Voltage, Output Current, Motor Torque, Motor Power (kW), DC Bus voltage, Active Reference, and other data.

d. Six (6) programmable digital inputs for maximum flexibility in interfacing with external devices typically programmed as follows:

e. There shall be a run permissive circuit for damper or valve control. Regardless of the source of a run command (keypad, input contact closure, time-clock control, or serial communications) the AFD shall provide a dry contact closure that will signal the damper to open (AFD motor does not operate). When the damper is fully open, a normally open dry contact (end-switch) shall close. The closed end-switch is wired to an AFD digital input and allows AFD motor operation. Two separate safety interlock inputs shall be provided. The safety status shall also be transmitted over the serial communications bus.

f. Three (3) programmable digital Form-C relay outputs. The relays shall include programmable on and off delay times and adjustable hysteresis. The relays shall be rated for maximum switching current 8 amps at 24 VDC and 0.4 A at 250 VAC; Maximum voltage 300 VDC and 250 VAC; continuous current rating 2 amps RMS. Outputs shall be true form C type contacts; open collector outputs are not acceptable.

g. Two independently adjustable accel and decel ramps.

h. The Keypad shall include a backlit LCD display. The display shall be in complete English words for programming and fault diagnostics (alpha-numeric codes are not acceptable).

i. The keypad shall utilize the following assistants:

   Start-up assistants.

   Parameter assistants

   Maintenance assistant

   Troubleshooting assistant

j. All applicable operating values shall be capable of being displayed in engineering (user) units. A minimum of three operating values from the list below shall be capable of being displayed at all times:

   Output Frequency

   Motor Speed (RPM, %, or Engineering units)

   Motor Current

   Calculated Motor Torque

   Calculated Motor Power (kW)

   DC Bus Voltage

   Output Voltage

k. The AFD shall include a fireman’s override input. Upon receipt of a contact closure from the fireman’s control station, the AFD shall operate at an adjustable preset speed. The mode shall override all other inputs (analog/digital, serial communication, and all keypad commands) and force the motor to run at the adjustable, preset speed. “Override Mode” shall be displayed on the keypad. Upon removal of the override signal, the AFD shall resume normal operation.

5. Serial Communications

a. The AFD shall have a BACnet port as standard. Optional protocols may be Modbus, Johnson Controls N2 bus, and Siemens Building Technologies FLN, LonWorks, Profibus, Ethernet, and DeviceNet shall be available. Each individual drive shall have the Selected protocol factory installed in the base AFD. The use of third party gateways and multiplexers is not acceptable. All protocols shall be "certified" by the governing authority. Use of non-certified protocols is not allowed.

b. It will be the responsibility of each drive manufacturer to insure that the correct Serial Communication for this Project has been selected and installed in each drive at the Manufacturers Factory.

c. The BACnet connection shall be an RS485, MSTP interface operating at 9.6, 19.2, 38.4, or 76.8 Kbps. The connection shall be tested by the BACnet Testing Labs (BTL) and be BTL Listed. The BACnet interface shall conform to the BACnet standard device type of an Applications Specific Controller (B-ASC).

d. The interface shall support all BIBBs defined by the BACnet standard profile for a B-ASC.

e. If additional hardware is required to obtain the BACnet interface, the AFD manufacturer shall supply one BACnet gateway per drive. Multiple AFDs sharing one gateway shall not be acceptable.

f. Serial communication capabilities shall include, but not be limited to; run-stop control, speed set adjustment, PID control adjustments. The drive shall have the capability of allowing the DDC to monitor feedback such as process variable feedback, output speed / frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), and drive temperature. The DDC shall also be capable of monitoring the AFD relay output status, digital input status, and all analog input and analog output values. All diagnostic warning and fault information shall be transmitted over the serial communications bus. Remote AFD fault reset shall be possible. The following additional status indications and settings shall be transmitted over the serial communications bus – keypad "Hand" or "Auto" selected, the ability to change the PID setpoint, and the ability to force the unit to bypass (if bypass is specified). The DDC system shall also be able to monitor if the motor is running in the AFD mode or bypass mode (if bypass is specified) over serial communications. A minimum of 15 field parameters shall be capable of being monitored.

6. The AFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. This control shall be independent of any AFD function. For example, the analog outputs may be used for modulating chilled water valves or cooling tower bypass valves. The drive's digital (relay) outputs may be used to actuate a damper, open a valve or control any other device that requires a maintained contact for operation. In addition, all of the drive's digital and analog inputs shall be capable of being monitored by the DDC system.

7. The drives shall be monitored through the Serial Communication but additionally incorporate a hard wired analog input for speed control of the drives and a binary input for the Starting and Stopping of the drives.

8. EMI / RFI filters. All AFD's shall include EMI/RFI filters. The onboard filters shall allow the AFD assembly to be CE Marked and the AFD shall meet product standard EN 61800-3 for the First Environment restricted level.

9. All AFD's through 25HP shall be protected from input and output power mis-wiring. The AFD shall sense this condition and display an alarm on the keypad.

E. Input Circuit Breaker Disconnect Switch.

1. Door interlocked padlockable circuit breaker that will disconnect all input power from the drive and all internally mounted options.

2. Fused AFD, Fast acting fuses exclusive to the AFD – fast acting fuses allow the AFD to disconnect from the line prior to clearing upstream branch circuit protection. Drive designs, which have no such fuses, will not be accepted. The drive shall provide single-phase motor protection in the AFD modes. The following operators shall be provided:

   a. Drive mode selector

      The following indicating lights (LED type) shall be provided. A test mode or push to test feature shall be provided.

   b. Power-on (Ready)

   c. Run enable (safeties) open

   d. Drive mode select damper opening

   e. Drive running

   f. Drive fault

   g. Safety open

   h. Damper opening

   i. Damper end-switch made

3. The digital inputs for the system shall accept 24V.

   Customer Interlock Terminal Strip – provide a separate terminal strip for connection of freeze, fire, smoke contacts, and external start command. All external safety interlocks shall remain fully functional whether the system is in Hand or Auto modes (not functional in Fireman's Override 2). The remote start/stop contact shall operate in AFD.

   a. The second fireman's override mode remains as above and ignore all keypad and digital inputs to the system (run until destruction). Class 20 or 30 (selectable) electronic motor overload protection shall be included.

F. Installation

1. Installation shall be the responsibility of the .4 Contractor. The contractor shall install the drive in accordance with the recommendations of the AFD manufacturer as outlined in the installation manual.

2. Power wiring shall be completed by the.4 Contractor. The contractor shall complete all wiring in accordance with the recommendations of the AFD manufacturer as outlined in the installation manual.

G. Start-Up

1. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Client Agency, and a copy kept on file at the manufacturer.

H. Product Support

1. Factory trained application engineering and service personnel that are thoroughly familiar with the AFD products offered shall be locally available at both the specifying and installation locations. A 24/365 technical support line shall be available on a toll-free line.

2. A computer based training CD or 8-hour professionally generated video (VCR format) shall be provided to the Client Agency at the time of project closeout. The training shall include installation, programming and operation of the AFD, bypass and serial communication.

I. Warranty

1. Warranty shall be 36 months from the date of certified start-up, not to exceed 42 months from the date of shipment. The warranty shall include all parts, labor, travel time and expenses. There shall be 365/24 support available via a toll free phone number.

2.02 VARIABLE FREQUENCY MOTOR SPEED CONTROL DRIVES (30-150 HP VFD'S)

For variable torque applications with normal duty load requirements 30HP through 150 HP at 480VAC.

A. Acceptable Manufacturers:
   1. ABB Model ACH800 ULH. (Basis of Design)
   2. Eaton Model CPX/CFX9000 Series.
   3. Square “D”

B. General
   1. This specification describes an Ultra-Low Harmonic AC variable speed/torque Direct Torque Control™ (DTC™) Drive used to control the speed/torque of a NEMA design B induction motor. The drive must also provide an optional operational mode for scalar or V/Hz operation.
   2. The Drive shall be manufactured by a firm with at least ten (20) years experience in the production of this type of equipment.
   3. This specification is to cover a complete Adjustable Frequency motor Drive (AFD) consisting of pulse width modulated (PWM) inverter designed for use on a standard NEMA Design B induction motor. It is required that the drive manufacturer have an existing:
      a. Local Sales representative exclusively for HVAC products, with expertise in HVAC systems and controls.
      b. Local independent service organization and repair depot.
      c. All Drive Equipment will be purchased in Pittsburgh Pa. through the local Drive Sales Representatives’ Office.
   4. The Controls Contractor shall furnish all drives. Drives, which are to be installed into the Roof Top Units, will be shipped in Air Ride Trailers to the Manufacturer to provide protection of the Drive Equipment during shipping and handling. Roof Top Manufacturers must use extreme care during the handling/re-shipment of the drive equipment. This is to maintain optimum warranty coverage and eliminate drive damage and losses related to second party handling/storage of drives.

C. Quality Assurance
   1. The Drive manufacturing facility shall be ISO 9001 and 14001 certified.
   2. The Drive shall be UL listed, or Canadian UL listed, or CSA listed and comply with EMC Directive 89/336 EEC, Low Voltage Directive 73/23 EEC and Machinery Directive 98/37 EC in accordance with the European Union’s CE directive.
   3. All printed circuit boards shall be completely tested and burned-in before being assembled into the completed Drive. The Drive shall then be subjected to a preliminary functional test, minimum one (1) hour burn-in and computerized final test. The burn-in shall be at 104°F (40°C), at full rated load, or cycled load. Drive input power shall be continuously cycled for maximum stress and thermal variation.
   4. The Drive shall utilize efficient IGBT technology throughout the entire Drive manufacturer’s Power and Voltage range.
   5. The Drive shall utilize the same communications architecture, utilizing plug-in communications cards, for high-speed noise immune connectivity throughout the entire Drive manufacturer’s Power range.
   6. The Drive manufacturer shall have an analysis laboratory to evaluate the failure of any component. The failure analysis lab shall allow the manufacturer to perform complete electrical testing, x-ray components, and decap or delaminate components and analyze failures within the component.
   7. The Drive shall utilize surface mount technology in the manufacturing of internal printed circuit boards and electronics, for maximum reliability.

D. Submittals

1. Submittals shall include the following information:
    a. Outline dimensions, conduit entry locations and weight.
    b. Customer connection and power wiring diagrams.
    c. Complete technical product description including a complete list of options provided.
    d. Complete documentation indicating compliance to IEEE 519 – harmonic analysis for this particular jobsite including total harmonic voltage distortion and total harmonic current distortion (TDD).
        1) The VFD manufacturer shall provide calculations; specific to this installation, showing total harmonic voltage distortion is less than 5%. Calculations at the transformer are not acceptable. Any additional equipment required to meet this performance will be the responsibility of the contractor with no additional cost to the Client Agency.
        2) Any filters or reactors provided to meet the required compliance with IEEE 519 shall be identified in the submittal.
        3) Calculations shall include **ALL VFD's** specified for the jobsite, including those that may not be provided by this manufacturer. VFD's considered in the calculations shall be identified by the equipment served.
        4) The .2 Contractor shall coordinate the transfer of information to the VFD manufacturer from all trades providing equipment furnished with VFD's and shall also acquire the necessary single line diagrams from PJ Dick / Barton Malow for use by the VFD manufacturer. If additional information is required to produce a complete harmonic analysis, the Contractor shall submit a written request to PJ Dick / Barton Malow for the needed information.

E. Products

1. Adjustable Frequency Drives
    a. The drives 30HP and Greater shall be Ultra-Low Harmonic AFD with an active AC to DC rectifier utilizing the latest isolated gate bipolar transistor (IGBT) technology.
    b. All Drives which are installed in this building and are not installed in the Roof Top Units will be supplied with a Drive Input Circuit Breaker Disconnect Switch but No-By-Pass.
    c. Refer to paragraph F. below for the Specification covering the Automatic By-Passes, Dual Power Feed Drive Systems, Dual Drive Installation and the operation and sequence for the Multi- Fan Drive arrangement for the Roof Top Units.
    d. Enclosures for indoor installation shall be NEMA 1 rated. **Enclosures for outdoor installation shall be NEMA 4 stainless steel, no exceptions**.
2. Harmonics Mitigation Devices
    a. All harmonic mitigation devices must be internal to the AFD enclosure and supplied as a complete engineered solution.
    b. The input current to the AFD shall have a total harmonic content less than 5% at the input terminals on any power system and under all operating conditions. AFD shall maintain the line side displacement power factor at no less than 0.96, regardless of speed and load.
3. Ratings
    a. The Drive shall be rated to operate from 3-phase power at 230VAC to 500VAC +10/-10%, 48Hz to 63Hz. The Drive efficiency shall be 98% or better at full speed and load.
    b. The overvoltage trip level shall be a minimum of 30% over nominal, and the undervoltage trip level shall be a minimum 35% under the nominal voltage.

c. Output voltage and current ratings shall match the adjustable frequency operating requirements of standard 460VAC, 3ph, 60Hz, NEMA design A or NEMA design B motors. The overload current capacity shall be 110% of rated current for one (1) minute out of five (5). Output frequency shall be adjustable between 0Hz and 300Hz. Operation above motor nameplate shall require programming changes to prevent inadvertent high-speed operation. The drive's switching pattern shall be continually adjusted to provide optimum motor flux and avoid the high-pitched audible noise produced by motors energized by conventional PWM drives. The drive shall be furnished in a UL Type 1 listed enclosure rated for operation at ambient temperatures between 0° and 40°C at an altitude not exceeding 3300 feet, with relative humidity less than 95% and no condensation allowed. The drive shall be protected from atmospheric contamination by chemical gasses and solid particles pre IEC 721-3-3, classes 3C2 and 3S2. The drive shall be protected from vibration per IEC 68-2-6 (max. sinusoidal displacement 1 mm, 5Hz to 13.2Hz and max. acceleration 7m/s2, 13.2Hz to 100Hz).

4. Control Functions and Adjustments

a. An intelligent start-up assistant shall be provided as standard. The Start-up assistant will guide the user through all necessary adjustments to optimize operation and will include "plug and produce" operation, which recognizes the addition of options/fieldbus adapters and provides the necessary adjustment assistance.

b. Start-up data entries shall include motor nameplate power, speed, voltage, frequency and current.

c. A motor parameter ID function shall automatically define the motor equivalent circuit used by the sensorless vector torque controller.

d. A PID speed/torque loop regulator shall be provided with an autotune function as well as manual adjustments.

e. A selection of six (6) preprogrammed application macro parameter sets shall be provided to minimize the number of different parameters to be set during start-up. Macros included as standard are as follows: Factory Default, Hand/Auto, PID Control, Sequential Control, and Torque Control. A selection of two (2) user defined macros shall are also be available.

f. Start/Stop control functions shall include two (2) or three-(3) wire start/stop, coast/ramp stop selections, optional dynamic braking and flux braking.

g. The AFD shall be capable of starting into a rotating load (forward or reverse) and accelerate or decelerate to reference without safety tripping or component damage (flying start). The AFD shall also be capable of flux braking at start to stop a reverse spinning motor prior to ramp.

h. The AFD shall have the ability to automatically restart after an overcurrent, overvoltage, undervoltage, or loss of input signal protective trip. The number of restart attempts, trial time, and time between reset attempts shall be programmable.

i. Accel/Decel control functions shall include two (2) sets of ramp time adjustments with linear and three (3) s-curve ramp selections.

j. Speed/Torque control functions shall include:

1) Adjustable min./max. speed and/or torque limits

2) Selection of up to 15 preset speed settings or external speed control

3) Three (3) sets of critical speed lockout adjustments.

4) A built-in PID controller to control a process variable such as pressure, flow or fluid level.

5) Reference signal processing shall include increase/decrease floating point control and control of both speed/torque and direction using a “joystick” reference signal. Two (2) analog inputs shall be programmable to form a reference by addition, subtraction, multiplication, minimum selection or maximum selection.

5. Output control functions shall include:
   a. Flux optimization to limit the audible noise produced by the motor and to maximize efficiency by providing the optimum magnetic flux for any given speed/torque operating point.
   b. Current and torque limit adjustments to limit the maximum Drive output current and the maximum torque produced by the motor. These limits shall govern the inner loop torque regulator to provide tight conformance with the limits with minimum overshoot.
   c. A torque regulated operating mode with adjustable torque ramp up/down and speed/torque limits.
   d. The Drive shall be capable of sensing a loss of load (broken belt / broken coupling) and signal the loss of load condition. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus. Relay output shall include programmable time delays that will allow for drive acceleration from zero speed without signaling a false underload condition.
   e. The Drive shall have programmable “Sleep” and “Wake up” functions to allow the drive to be started and stopped from the level of a process feedback signal.
6. Two (3) programmable critical frequency lockout ranges to prevent the AFD from operating the load continuously at an unstable speed.
   a. Static and Dynamic Performance
      1) Open loop static speed regulation shall be 0.1% to 0.3% (10% of motor slip). When motor speed feedback is provided from a suitable encoder, closed loop speed regulation shall be 0.01% or better. Dynamic speed accuracy shall be 0.3-0.4 %-sec or better open loop and 0.1-0.2 %-sec or better-closed loop.
7. Operator Control Panel (Keypad)
   a. Each Drive shall be equipped with a front mounted operator control panel (keypad) consisting of a four- (4-) line by 20-character back-lit alphanumeric display and a keypad with keys for Run/Stop, Local/Remote, Increase/Decrease, reset, menu navigation and parameter select/save.
   b. All parameter names, fault messages, warnings and other information shall be displayed in complete English words or standard English abbreviations to allow the user to understand what is being displayed without the use of a manual or cross-reference table.
   c. Other languages selectable in addition to American English (Am) shall be as follows: English (European), French, Spanish, Portuguese, German, Italian, Dutch, Danish, Swedish, Finnish, Czech and Polish.
   d. The Display shall have contrast adjustment provisions to optimize viewing at any angle.
   e. The control panel shall include a feature for uploading parameter settings to control panel memory and downloading from the control panel to the same drive or to another drive.
   f. All Drives throughout the entire power range shall have the same customer interface, including digital display, and keypad, regardless of horsepower rating.
   g. The keypad is to be used for local control, for setting all parameters, and for stepping through the displays and menus.

h. The keypad shall be removable and insertable under drive power, capable of remote mounting, and shall have its own non-volatile memory.

8. During normal operation, one (1) line of the control panel shall display the speed reference, and run/stop forward/reverse and local/remote status. The remaining three (3) lines of the display shall be programmable to display the values of any three (3) operating parameters. At least 26 selections shall be available including the following:
   a. Speed/torque in percent (%), RPM or user-scaled units
   b. Output frequency, voltage, current and torque
   c. Input voltage, power and kilowatt hours
   d. Heatsink temperature and DC bus voltage
   e. Status of discrete inputs and outputs
   f. Values of analog input and output signals
   g. Values of PID controller reference, feedback and error signals
   h. Control interface inputs and outputs shall include:
9. I/O Capabilities
   a. Six (6) discrete inputs, all independently programmable with at least 25 input function selections. Inputs shall be designed for “dry contact” inputs used with either an internal or external 24 VDC source.
   b. Three (3) form C relay contact outputs, all independently programmable with at least 30 output function selections. Relay contacts shall be rated to switch 2 Amps at 24VDC or 115/230VAC. Function selections shall include indications that the drive is ready, running, reversed and at set speed/torque. General and specific warning and fault indications shall be available. Adjustable supervision limit indications shall be available to indicate programmed values of operating speed, speed reference, current, torque and PID feedback.
   c. Three (3) analog inputs, one (1) +/- 0VAC - 10VAC and two (2) 4mA - 20mA, all independently programmable with at least ten (10) input function selections. A differential input isolation amplifier shall be provided for each input. Analog input signal processing functions shall include scaling adjustments, adjustable filtering and signal inversion. If the input reference (4-20mA or 2-10V) is lost, the AFD shall give the user the option of the following: (1) stopping and displaying a fault, (2) running at a programmable preset speed, (3) hold the AFD speed based on the last good reference received, or (4) cause a warning to be issued, as selected by the user. The drive shall be programmable to signal this condition via a keypad warning, relay output and/or over the serial communications bus.
   d. Two (2) analog outputs providing 4mA to 20mA signals. Outputs shall be independently programmable to provide signals proportional to at least 12 output function selections including output speed, frequency, voltage, current and power.
10. Serial communications
   a. Serial communication interface are available for a wide selection of communication protocols. Standard are as follows: Modbus, BACnet, Johnson Controls N2 bus, Siemens FLN. Communications modules shall be connected to the drive by fiber optic cables. I/O shall be accessible through the serial communications.
11. It will be the responsibility of each drive manufacturer to insure that the correct Serial Communication for this Project has been selected and installed in each drive at the Manufacturers Factory.

12. Serial communication capabilities shall include, but not be limited to, run-stop control; speed set adjustment, proportional/integral/derivative PID control adjustments, current limit, and accel/decel time adjustments. The drive shall have the capability of allowing the Distributed Drive Controller (DDC) to monitor feedback such as process variable feedback, output speed/frequency, current (in amps), % torque, power (kW), kilowatt hours (resettable), operating hours (resettable), relay outputs, and diagnostic warning and fault information. Additionally, remote Local Area Network (LAN) VFD fault reset shall be possible. A minimum of 15 field parameters shall be capable of being monitored. The DDC system shall be able to monitor if the motor is running in the AFD mode or bypass mode (if bypass is specified) over serial communications.
13. The AFD shall allow the DDC to control the drive's digital and analog outputs via the serial interface. The serial communications interface shall allow for Digital Output DO (relay) control and Analog Output (AO) control. This control shall be independent of any AFD function. Examples of possible DO usage are as follows: Opening check valves, opening discharge valves, starting auxiliary equipment, etc. In addition, the status of the DO's is available over the communications link. Examples of possible AO usage are as follows: Controlling a bypass valve position, throttling valve position, etc. In addition, the status of the AO's is available over the communications link.
14. The drives shall be monitored through the Serial Communication but additionally incorporate a hard wired analog input for speed control of the drives and a binary input for the Starting and Stopping of the drives.
15. The AFD shall have built-in to its logic fifteen (15) blocks of adaptive programming capable of twenty (20) different functions. These blocks shall be connectable to drive actual signals and functions allowing the user to tailor the drive to the specific application requirements without additional hardware. These blocks shall be programmable through the standard operator panel and through the use of a DriveAP Microsoft Windows□-based software.
16. A fiber optic communication port shall also be provided for personal computer interface. Microsoft Windows-based software shall be available for drive setup, diagnostic analysis, monitoring and control. The software shall provide real time graphical displays of drive performance.
17. Protective Functions
    a. For each programmed warning and fault protection function, the drive shall display a message in complete English words or Standard English abbreviations. The five (5) most recent fault messages and times shall be stored in the drive's fault history.
    b. The drive shall include internal MOV's for phase to phase and phase to ground line voltage transient protection.
    c. Output short circuit and ground fault protection rated for 65,000 amps shall be provided per UL508C without relying on line fuses. Motor phase loss protection shall be provided.
    d. The drive shall provide electronic motor overload protection qualified per UL508C.
    e. Protection shall be provided for AC line or DC bus overvoltage at 130% of maximum rated voltage or undervoltage at 65% of min. rated voltage and input phase loss.
    f. A power loss ride through feature will allow the drive to remain fully operational after losing power as long as kinetic energy can be recovered from the rotating mass of the motor and load.
    g. Stall protection shall be programmable to provide a warning or stop the drive after the motor has operated above a programmed torque level for a programmed time limit.
    h. Underload protection shall be programmable to provide a warning or stop the drive after the motor has operated below a selected underload curve for a programmed time limit.

i. Over-temperature protection shall provide a warning if the power module temperature is less than 5□C below the over-temperature trip level.

j. Input terminals shall be provided for connecting a motor thermistor (PTC type) to the drive's protective monitoring circuitry. An input shall also be programmable to monitor an external relay or switch contact (klixon).

F. Automatic/Manual Bypass Package for Drives Serving Multiple Fan Motors in the Roof Top Units.

1. These VFD's shall be designed with Dual Input Circuit Breaker Disconnect Switches to accept Redundant Power Feeds from Two (2) Different Power Sources. Additionally these Units will be supplied with automatic/manual bypass including contactors electrically interlocked to allow for transfer of motors to a Dual mounted VFD in this same enclosure in the event of a VFD fault. Additional service switch shall be provided at the VFD to isolate each of the drive for service. Bypass package shall be integral to the drive cabinet and include main door-interlocked circuit breaker disconnect with padlockable handle. Each of these Drives will feed Six (6) individual Fan Motors will have motor overload protection, individual disconnect means and branch circuit protection within the drive cabinets.

2. The bypass function is configured entirely of standard industrial control components. It includes two electrically interlocked contactors, drive isolation service switch, motor overload relay, control power transformer with primary and secondary fusing, and cover mounted Drive-Off-Bypass selector switch, BYPASS pilot light and EXTERNAL/MOL FAULT pilot light.

3. Fast acting, current limiting drive input fuses are provided as standard. Faster than circuit breakers and most other fuses, the drive fuses are included to limit damage and allow for possible drive repair if a short circuit or ground fault should develop in the drive input bridge. For drives at the higher ratings, it is generally more economical to repair rather than replace the drive. Drive fuses are also intended to provide for immediate operation of the bypass function after such a fault.

G. Multiple VFD drive panels

1. Multiple VFD drive panels shall be furnished (for installation in the rooftop air handlers) consisting of the following:

a. VFD drives (2 rated @ 125 HP @ 460 volt three phase power).

b. VFD drive shall provide power to six (6) fan motors each rated @ 15 HP.

c. VFD drives power input - output transfer switch contactors.

d. Panel mounted selector switch for local – remote selection for the Lead – Lag drive.

e. Switch shall be labeled: Lead A/Lag B – Auto – Lead B/Lag A

f. Input and output contactors on each drive.

g. Input – Output contactors shall allow automatic transfer of drive power from Lead Drive to Lag Drive for fan motor operation. (Automatic operation shall be provided by the hospital BMS system).

h. Furnish and install time delay relay circuit (connected to the input – output contactor switching circuit) to provide a 10 to 30 second delay when switching from Lead to Lag VFD operations.

i. Motor disconnect switch with isolation contactors for each motor.

j. Motor isolation contactor shall provide overload (each motor leg) protection for the connected motor.

k. Each contactor shall be provided with 120 volt coils for control operation.

l. Each contactor shall be provided with two (2) isolated low voltage contacts.

m. Contacts (No & NC) shall be used to indicate position of contactor at the hospital BMS system.

n. Pilot lights on the panel face indicating motor contactor “ON” – “OFF”.

o. Pilot light on the panel face indicating Lead – Lag contactor drive operation.

p. Panel shall be wired to accept two (2) separate power feeds (1 per VFD drive).

q. Panel size shall fit a space of 36” wide x 20” deep.

r. Panel height cannot exceed 84”.

s. Panel heat rejection shall be approximately 12,000 BTU per panel.

t. Panels shall be shipped to the rooftop supplier for factory installation.

u. Rooftop manufacturer shall be responsible for any damage that may be incurred in shipment of the rooftop units to the jobsite.

H. Execution

1. Installation

a. The Drive manufacturer shall provide adequate drawings and instruction material to facilitate installation of the Drive by electrical and mechanical trade’s people employed by others.

2. Start-Up

a. Certified factory start-up shall be provided for each drive by a factory authorized service center. A certified start-up form shall be filled out for each drive with a copy provided to the Client Agency, and a copy kept on file at the manufacturer.

b. The factory will extend the normal warranty for the Drive with a certified factory start-up.

3. Product Support

a. Factory trained application engineering and service personnel that are thoroughly familiar with the Drive products offered shall be locally available at both the specifying and installation locations.

4. Warranty

a. With a certified start-up, warranty shall be 36 months from the date of start-up, not to exceed 42 months from the date of shipment. The warranty shall include all parts, labor, travel time, and expenses.

5. Optional Features

a. Optional features to be furnished and mounted by the drive manufacturer. All optional features shall be UL Listed and/or CSA listed by the drive manufacturer as a complete assembly.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install drive per manufacturers recommendations.

END OF SECTION

SECTION 232113

HVAC PIPING

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The pipe and fittings for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 CIRCULATING WATER PIPING

A. Circulating Water Piping shall include the following:

1. Hot Water Supply and Return (HWS & R)
2. Chilled Water Supply and Return (CWS & R)
3. Drain piping
4. Relief valve piping
5. Vent Piping

B. All new circulating water piping shall be Schedule 40, welded black steel pipe, conforming to ASTM Specifications A53. Weight and dimensions shall conform to ANSI Standard B36.10.

C. In lieu of using Schedule 40 black steel pipe and fittings for circulating water piping, the Contractor shall have the option of using Type L hard temper copper tubing assembled with wrought copper solder end fittings. Solder shall be 95-5 tin-antimony.

D. Circulating water piping systems shall be two-pipe forced circulation. Supply and return mains shall be run level. For up-feed connections and risers, branches shall be taken from main with 90 degree top connections and down-feed branches and risers shall be taken from the main with 90 degree bottom connections.

E. High points and drops of the piping system shall be provided with air vents of type specified in Section 230523.

F. Furnish and install inverted eccentric reducers in horizontal lines where reduction or increase in main size is shown. Top of pipe shall be level.

G. Ample provision for expansion and contraction of piping on all branch connections from mains and risers shall be provided.

H. Piping concealed in walls, partitions, above ceilings and other locations shall be tested with air or nitrogen with pressure held at 150 PSIG for two hours. Correction shall be made for changes in ambient temperatures.

I. Piping connections at the boilers, up to and including the first valve, shall be code welded in accordance with ASME regulations and as required by the State Department of Labor and Industry. Screwed and flanged connections may be made at the boilers where permitted by the State Department of Labor and Industry.

2.02 CHEMICAL FEED PIPING

A. Chemical feed piping shall be Schedule 80 black steel pipe. PVC or polyethylene rigid pipe and fittings may be used where recommended or required by the chemical treatment equipment manufacturer; however, piping must not be subject to high temperatures beyond the capability of the pipe.

2.03 COLD WATER MAKE-UP PIPING

A. From outlets on cold water mains provided by the Plumbing Contractor, furnish and install all cold water makeup piping to the following:

1. Circulating Water Piping
2. Steam Systems

B. Makeup piping shall be complete with all valves, strainers, backflow preventers, pressure-reducing valves, fittings and insulation for complete installations. Flexible connectors on makeup water piping shall be installed as shown on the drawings..

C. Cold water make-up lines shall be Type L hard temper copper tubing assembled with wrought copper solder end fittings.

2.04 NATURAL GAS PIPING

A. Natural gas piping will be extended by the Plumbing Contractor and terminated at locations near the burners. The Heating Contractor shall properly connect to gas outlets, furnish and install lubricated gas cocks, and shall furnish and install gas line to each gas burner. A full line size gas cock shall be provided on gas line to each burner. Automatic controls for each burner, gas pressure regulator, and pilot line shall be installed to perform all function herein specified and to meet the requirements of Industrial Risk Insurers' (IRI). Gas vent piping shall be extended to the exterior of the Building in accordance with applicable codes and regulations. The gas vent piping vent shall be extended through the roof with a pipe portal.

B. All gas piping shall be Schedule 40, black steel pipe, conforming to ASTM Specifications A53 and ANSI Standard B36.10. Gas piping 2-1/2" and larger shall be seamless and assembled with seamless forged steel welded fittings. Gas piping 2" and smaller shall be assembled with malleable iron screwed fittings. Galvanized pipe or fittings are not permitted. Gas piping shall be furnished and installed in strict accordance with the requirements of the local gas company.

2.05 JOINTS AND CONNECTIONS

A. Screwed Connections:

1. All joints in screwed pipe shall be made up with pipe joint compound applied to male threads only. Taping of joints will not be permitted. Threads shall be cut straight and true with all sections reamed and cleaned before installation.
2. All black steel pipe 2" and smaller shall be assembled with heavy boss, cast iron or malleable screwed fittings.

B. Welded Connections:

1. All joints in welded piping shall be assembled by fusion welding using factory-made welding fittings. Pipe shall be reamed and cleaned before erection. Weld-O-Lets or Thread-O-Lets may be used where the branch line is at least two sizes smaller than the main line as hereinbefore specified.
2. All welding shall be done by competent welders in a first-class, workmanlike manner. No welding operator shall be permitted to weld unless he has proved satisfactory experience and/or certified as having fully complied with acceptable qualification tests. When a welder has been approved, he shall not be removed without permission of Architect.
3. Certification shall indicate that each welder has passed a qualification test as prescribed by National Certified Pipe Welding Bureau, or by other reputable testing laboratories or agencies, using procedures approved by the American Society of Mechanical Engineers or the American Welding Society.

4. The abutting ends of all pipe and welding fittings shall be accurately beveled at an angle of 45° to within 1/16" plus or minus 1/32" of inside pipe wall. All surfaces beveled by the cutting torch shall be properly cleaned of all oxide and unnecessary roughness by grinding, filing or other suitable means.
5. Low carbon steel welding rods shall develop a tensile strength of not less than 45,000 PSI cross-section of the metal deposited in the weld. Special and eutectic steel welding rods of good weldability and having a tensile strength greater than 45,000 psi may be used.
6. All circumferential welds shall have a width to 2-1/2 times pipe wall thickness and shall be reinforced approximately 1/16" above outside of pipe wall. Fusion shall extend through entire pipe wall to the outside. Projection of fused metal on inside of pipe must be avoided. There shall be no valley, either at edge or at center of the joint, and weld shall be built up with multiple passes so that weld metal will present a gradual increase in thickness from outside surface of pipe to the center of the weld.
7. Weld neck flanges shall be employed where welded pipe is joined to flanged valves and equipment.
8. Welding procedure shall conform to recommendations of the ANSI Code for Pressure Piping. Gas welding will be acceptable.

C. Flanged Connections:
1. Flanged joints at valves, unions, equipment, etc., shall be made up with machine bolts and factory-made ring gaskets similar to Garlock, and of materials recommended for the various services. Flanges shall conform to ANSI B16.5.

D. Solder Connections:
1. All joints in copper tubing shall be made up with 95-5 tin-antimony solder. Ends of pipe and fittings shall be cleaned and burnished before solder is applied.

E. Mechanical Crimping Connections:
1. For copper circulating water piping and cold water make-up piping of all sizes, the Viega ProPress System of mechanical joint copper tubing assembly shall be acceptable. The ProPress System shall consist of an electro-hydraulic pressure crimping tool, with sets of interchangeable crimping jaws, and ProPress special copper fittings. The fittings shall include an O-sealing ring, and shall require no torches, solders, flux, or special pipe burnishings or preparation. A permanent, watertight seal is made by crimping the fittings. Rated at 200 PSI; tested to 600 PSI. The systems shall be installed in accordance with manufacturer’s installation instructions and governing code requirements. Pipe supports shall be installed so that interior horizontal piping is in uniform alignment.
2. The use of the ProPress System for tubing assembly is only acceptable when installed by tradespeople specifically trained in this type of assembly.

2.06 MECHANICAL GROOVED PIPE COUPLINGS

A. The HVAC Contractor shall be permitted to furnish and install mechanical grooved pipe couplings in lieu of welded fittings and flanges on the following steel piping systems:
1. Circulating Water Piping

B. Acceptable Manufacturers:
1. Victaulic (Basis of Design)
2. Tyco Grinnell
3. Anvil Gruvlok
4. As approved by Professional

C. All grooved couplings, and fittings, valves and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.

D. All castings used for coupling housings, fittings, valve bodies, etc., shall be date stamped for quality assurance and traceability.

E. Mechanical pipe couplings are not permitted in inaccessible spaces such as above plaster ceilings and piping and ductwork shafts unless approved by the Architect.

F. Pipe shall be of type herein specified, except pipe shall be square-cut or roll grooved to the coupling manufacturer's specifications. The pipe couplings shall be as manufactured by the Victaulic Company of America, or approved equal, and shall be suitable for the type of service intended. Couplings and gaskets shall have a temperature range of -30 degrees F. to +230 degrees F. The couplings shall be installed in a manner which will provide for expansion and contraction of the systems without leakage, in strict accordance with the coupling manufacturer's details, published literature and instruction.

G. Victaulic Installation-Ready Couplings Style 107H/107N (rigid) and 177 & 77 (flexible):

1. 2" through 12": Rigid type, coupling housings with offsetting, angle-pattern bolt pads to provide system rigidity and support and hanging in accordance with ANSI B3.1, B31.9. Couplings shall be installation ready, for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound with red color code designed for operating temperatures from -30 deg F to +250 deg F. Victaulic Style 107H/107N.

2. 2" through 8": Flexible type, for use in locations where vibration attenuation and stress relief are required. Couplings shall be installation ready, for direct stab installation without field disassembly. Gasket shall be Grade "EHP" EPDM compound with red color code designed for operating temperatures from -30 deg F to +250 deg F. Victaulic Style 177.

3. 10" through 12": Victaulic Style 77 standard flexible coupling with Grade "E" EPDM gasket with green color code for water services from -30 deg F to +230 deg F.

H. Victaulic AGS Series Fittings, Style W07 Rigid Coupling, and Style W77 Flexible Coupling:

1. AGS grooved ends, for use with Victaulic W07 or W77 couplings and W741 flange adapter. Fittings shall be manufactured of ductile iron conforming to ASTM A-536, factory-fabricated from carbon steel pipe conforming to ASTM A-53. Fittings shall be manufactured to the dimensional standards ASME B16.9. Orange enamel coated or galvanized.

2. AGS Couplings shall consist of two ASTM A-536 ductile iron housing segments, a wide-width elastomer pressure responsive FlushSeal® gasket, and zinc electroplated carbon steel track head bolts and nuts conforming to the physical and chemical requirements of ASTM A-449 and the physical requirements of ASTM A-183. Housings include lead-in chamfer on the housing key.

a. Victaulic W07 AGS Rigid Coupling: Coupling key shall be designed to fill the wedge shaped AGS groove to provide a rigid joint that corresponds with support spacings as defined by ASME B31.1 and B31.9. Systems incorporating rigid couplings require the calculated thermal growth/contraction of the piping system to be fully compensated for in the design of the piping system through use of adequate flexible components.

b. Victaulic W77 AGS Flexible Coupling: Coupling key shall be designed to fit into the wedge shaped AGS groove and allow for linear and angular movement, vibration attenuation, and stress relief

I. Flange adapters shall be suitable for direct connection to Class 125 or 150 flanged components, with ductile iron housings, and pressure responsive gaskets. Victaulic Style 741 / W741.

J. For use with copper tubing 2" and larger sizes, Victaulic Copper-Connection fittings conforming to ASME B16.22 and ASME B16.18, with Style 607H installation-ready coupling with offsetting angle-pattern bolt pads and grade EHP gasket for water service to +250 degrees F.

1. The system shall be manufactured to copper-tube dimensions. (Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.)

K. Gasket Elastomers shall have properties designated by ASTM D-2000. Gasket shall be of the mechanical grooved coupling design, pressure responsive so that internal water pressure serves to increase the seal's water tightness. Gasket supplied shall be EPDM-HP Grade EHP with red and green color code for water service to 250 degrees F and EPDM Grade "E" with green color code identification and conform with ASTM D-2000 designation 2CA615 A25B442 with maximum tensile change as published by the manufacturer for water service to 230 degrees F.

L. Bolts and nuts shall be heat-treated carbon steel conforming to physical properties of ASTM A183 and A449, minimum tensile 110,000 psi. The coupling segments shall be assembled with two or more oval neck track bolts. The nuts shall be tightened to assure firm metal-to-metal contact of the coupling bolt pads.

M. Grooved joints shall be installed in accordance with the manufacturer's latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks. Gaskets shall be molded and produced by the coupling manufacturer, and shall be verified as suitable for the intended service.

N. The Contractor shall obtain the services of the coupling manufacturer's qualified representative as required to obtain all instructions and details for a complete supervised installation.

O. The representative (direct employee) of the mechanical joint manufacture shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping products. The factory-trained representative shall periodically review the product installation and ensure best practices are being followed.

P. Contractor shall remove and replace any improperly installed products.

Q. A distributor's representative is not considered qualified to conduct the training.

R. The Heating Contractor will be responsible for the installation complete in every detail.

S. All insulation installations and other installation revisions will be the responsibility of the Heating Contractor. All mechanical pipe couplings shall be insulated with Zeston, Knauf, or approved equal, prefabricated fitting covers designed specifically for mechanical couplings. Valves, cocks, and other piping system accessories shall be revised as required to accommodate the coupling installation. The installation must conform with all applicable codes.

T. Sufficient hangers must be installed as required for complete substantial installations.

U. The entire installation shall be free of stress. For water systems, Victaulic flexible couplings may be used to accommodate thermal growth, contraction, and for the elimination of expansion loops. (In accordance with the manufacturer's written recommendations.) Where loops are required, use flexible couplings on the loop.

V. Three Victaulic flexible couplings may be used in lieu of flexible connectors for vibration attenuation. The couplings shall be placed in close proximity to the source of the vibration.

2.07 REFRIGERATION PIPING

A. Furnish and install a complete refrigeration piping system from the air-cooled condensing unit to the DX coil in all split system air conditioning units.

B. All refrigeration piping and accessories shall be installed in accordance with the refrigeration equipment manufacturer's recommendations and in accordance with the best standard practice.

C. System shall be complete with necessary shutoff valves, purge valves, charging valves, liquid line solenoid valve, sight glasses, dryers, vents, traps, fittings and other accessories required for a complete installation.

D. System shall be fully charged with refrigerant in accordance with the manufacturer's recommendations and requirements.

E. Refrigerant piping shall be sized as recommended by the equipment manufacturer, and based on total friction loss equivalent to not more 2 degrees F for hot gas line, and 1 degree F for liquid line.

F. Refrigeration piping shall be hard temper, or soft annealed, Type L, or ACR copper tubing assembled with long radius wrought copper solder end fittings or SAE fittings.

G. The contractor shall properly clean the piping, eliminating all moisture and contaminants, which could harm refrigeration or air conditioning equipment, before charging with refrigerant.

H. Refrigeration lines shall be properly supported.

I. Refrigeration valves shall be back-seating globe valves of the diaphragm packless type, as manufactured by Alco, Superior or approved equivalent. Shutoff valves shall be furnished and installed on all lines at the condensing unit and at the air-handling unit.

J. The Contractor shall include initial startup of the system, final checkout and instruction to the Client Agency's operating personnel.

K. Maintenance service for the refrigerant piping system shall also be included in the Contractor's bid for the first year from date of final acceptance by the Client Agency.

L. The approximate refrigerant piping arrangement, sizes, etc., are shown on the Drawings. The exact arrangement, sizes and other details shall be in strict accordance with the equipment manufacturer's diagrams, which shall be submitted for approval.

M. Installation of refrigeration systems shall be by technicians certified to purchase and handle refrigerants. Technicians are required to pass an EPA-approved test given by an EPA-approved certifying organization to become certified.

N. Apprentices are exempt from certification requirements provided the apprentice is closely and continually supervised by a certified technician.

2.08 CONDENSATE DRAIN SYSTEM

A. All condensate drain piping from HVAC equipment not in return, relief or conditioned air plenum spaces shall be polyvinyl chloride (PVC) Schedule 40 plastic pipe (DWV) ASTM 2665. All condensate drain piping in return, relief, or conditioned air plenum spaces shall be Type “L”, hard temper, copper tubing, assembled with cast bronze or wrought copper solder end drainage fittings. PVC fire rated insulated piping systems shall be acceptable, as herein specified.

B. Direct connection to the sanitary drainage system is prohibited. Provide air gaps in accordance with local prevailing code requirements.

C. Unless noted otherwise, drain lines shall be sloped at 1%. Minimum drain line size shall be 1-1/4”, except as otherwise specifically noted.

D. Provide a trap in gravity drain line at each piece of equipment. Coordinate depth of trap with equipment manufacturer. Refer to connection details shown on drawings. Traps will not be required on pumped condensate drain lines.

E. No PVC or plastic piping shall be used in return, relief or conditioned air plenum spaces. Use metallic piping and tubing systems as specified. In lieu of metallic piping, tubing, and fittings, the Contractor may use standard PVC piping and fittings with the addition of flame – attenuated fiberglass pipe insulation and fittings or non-combustible ceramic fiber pipe wrap and fittings in these areas, conforming to local fire codes and building codes. Flame-attentuated fiberglass pipe insulation shall be as manufactured by Owens-Corning Company, or approved equivalent; fire retardant fittings by Zeston, Proto, Speedline, or approved equivalent. Ceramic fiber pipe wrap and fittings shall be 3M FireMaster ceramic fiber Plenum Wrap, or approved equivalent. All insulation installations shall be completed by an Insulation Subcontractor responsible to the HVAC Contractor.

F. Joints in PVC pipe shall be accomplished with socket type fittings and solvent-cement welding for the DWV System.

G. All joints shall be made permanently gas and water tight.

H. The use of any of the above joints and connections shall be subject to their acceptability with the prevailing local plumbing codes.

I. Where condensate drain lines are extended to rain conductors, use bronze ball check valves in the condensate drain lines, the Apollo 61-12X, with light spring, or approved equivalent.

PART 3 – EXECUTION

3.01 PIPING SYSTEM INSTALLATIONS

A. All piping installations shall be in accordance with American Code for Pressure Piping No. ANSI B31.1. All piping not specifically mentioned herein shall be installed per the manufacturer's recommendations and applicable recognized codes.

B. All piping and system accessories shall be stored with ends closed tight.

C. Before installation, each length of pipe, each fitting and each accessory (such as a valve) shall be "bore-sighted", inspected and cleaned if debris or dirt is found.

D. After installation of piping, but before valves and accessories are installed, a heavy wad of swabbing cloth shall be pulled through the piping and fittings. All loose scale or debris shall be blown or worked free and removed.

E. After closure, each system shall be flushed clean as herein specified under "Cleaning." Connections shall be installed for this purpose, and all necessary temporary piping shall be furnished, installed and removed after system is approved. The Contractor shall double-check to see that items such as rocks, stones, mud, wood and other debris are not left in the system.

F. Equipment such as tanks shall be cleaned in the same manner but the procedure shall be varied to suit the specific item being cleaned. Coils shall be absolutely clean inside and outside before closure and after use for temporary heat, etc.

G. All pipes shall be cut accurately to measurements established at the Building and shall be worked into place without springing or forcing, properly clearing all Building openings. Excessive cutting or other weakening of the Building structure to facilitate piping installation will not be permitted. Threaded pipe shall have full, clean-cut threads. All pipes shall have burrs removed by reaming. All pipes shall be so installed as to provide proper drainage and to permit free expansion and contraction without causing damage. All changes in directions shall be made with fittings.

H. The ends of piping and associated equipment shall be capped or plugged as construction proceeds to prevent the entrance of dust, dirt, and other foreign matter.

I. Valves shall be so placed that automatic valves, check valves and equipment may be entirely isolated for repairs while the system is in operation.

J. All piping run within the Building shall be run concealed in the finished portions of the Building, in pipe spaces, furred ceilings or furred chases and exposed only in unfinished areas, Mechanical Rooms, or specifically where shown on the Drawings. The Heating Contractor shall locate all necessary chases or openings in new construction that are to be provided by the General Contractor. No piping shall be run exposed in finished areas of the Building without the consent and approval of the Architect for each specific installation.

K. All piping shall be hydrostatically or air tested to 150 PSIG, or 1.5 times the design pressure, whichever is higher, for a period of two hours. During this period all welds, joints, etc., shall be coated with soap emulsion to test for leaks, which shall be made tight and free from imperfections. Piping joints shall not be insulated until they have been pressure tested and are free of leaks.

L. All piping shall be cleaned, filled and vented of all air as herein specified.

M. Due to the small scale of the Drawings, it is not possible to indicate all offsets, fittings, valves or similar items which may be required to make a complete operating system. The Drawings are generally diagrammatic and indicative of the work to be installed. The Heating Contractor shall carefully investigate all conditions affecting his work and shall install his work in such a manner that interferences between pipes, conduit, ducts, equipment, architectural and structural features will be avoided, and shall furnish and install all such offsets or fittings as may be required to meet the conditions at the Building, so as to avoid such interferences without additional cost to the Project.

N. Each installation shall be made in a workmanlike manner, according to the best practice of the trade, properly installed and vented to eliminate air pockets or traps and to insure rapid and noiseless circulation throughout.

O. All pipe work shall run parallel with, or at right angles to Building walls and partitions, and all exposed connections, risers or other piping in such areas shall be erected plumb and straight so as to form parallel lines with walls and floors. These requirements refer to long and short runs alike. Piping shall not be run exposed in finished areas unless specifically shown and prior approval is obtained from the Architect.

P. Each section of pipe shall be reamed and cleaned before installation. All steel piping 2-1/2" and larger shall be assembled with welded connections. Seamless forged welding fittings of same material as pipe shall be used for all connections, except Weld-O-Lets or Thread-O-Lets may be used where branch line is at least two sizes smaller than main line.

END OF SECTION

SECTION 232123

HVAC PUMPS AND ACCESSORIES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The pumps for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS

A. Pumps shall be suitable for circulating water service which shall include the following systems:

1. Hot Water Supply and Return (HWS & R)

B. Furnish and install in strict accordance with the manufacturer's details and recommendations, new base mounted water circulating pumps, of cast iron, bronze fitted construction.

C. Each motor shall be standard drip proof, high efficiency type, rubber-mounted. Motors shall be wound for current characteristics, and operate at RPM as scheduled on the Drawings.

D. Motor for each pump shall be sized so that pump is non-overloading on any point on the pump characteristic curve.

E. The pumps shall be factory tested at operating conditions, thoroughly cleaned, and finished with machinery grade enamel paint.

F. Each pump shall be furnished with one spare set of bearings and a spare coupling, which shall be delivered to the Client Agency.

G. Verification of delivery, in writing, shall be obtained from the Client Agency, with a copy delivered to the Professional.

2.02 BASE MOUNTED CIRCULATING PUMPS

A. Acceptable Manufacturers:

1. Bell & Gossett Series – e-1510 End Suction (Basis of Design)
2. Armstrong Pumps, Inc.
3. Taco
4. Patterson
5. As approved by the Professional

B. Pumps shall be single-inlet, single-stage, and provided with mechanical seals, carbon seal ring and remote seat.

C. The impeller shall be of the enclosed type, dynamically balanced and keyed to the shaft and secured with a suitable locknut.

D. Pumps shall each be provided with a coupler guard conforming to ANSI B15.1.

E. The pump internals shall be capable of being serviced without disturbing piping connections or motor.

F. Solid type volute with support foot shall provide ease of servicing bearing frame.

G. Pump and motor shall be mounted on a common-welded steel fully enclosed base plate having

a sufficient grout volume and adequately sized grout holes.

2.03 INLINE PUMPS

A. Acceptable Manufacturers:
   1. Bell & Gossett Series 60 (Basis of Design)
   2. Bell & Gossett Series e-80 (Basis of Design)
   3. Bell & Gossett Series e-90 (Basis of Design)
   4. Armstrong Pumps, Inc.
   5. Taco
   6. Patterson
   7. Equal as approved by the Professional

B. Furnish and install in-the-line, direct-connected centrifugal pumps. Pumps shall be quiet operating and shall have capacity and motor characteristics indicated on the Drawings.

C. Pumps shall have 175 PSI WWP and shall be complete with cast iron housing, companion flanges, bronze trim, mechanical seal, center dropout coupler, lubricated bearings, bronze impeller and dynamically balanced shaft.

2.04 SUCTION DIFFUSERS

A. Suction diffusers shall be installed at each end suction pump where piping arrangement so dictates as recommended by the pump manufacturer.

B. Each unit shall consist of angle type body with inlet vanes and combination diffuser-strainer orifice plate with 3/16" diameter openings for pump protection.

C. Unit shall be equipped with disposable fine mesh startup strainer, which shall be removed after 30 days of operation.

D. Velocity through strainer free area shall not exceed 2 fps and pressure drop shall not exceed 1 psi at specified flow. Body shall fit pump and connecting pipe size.

E. Unit shall be provided with adjustable support foot to carry weight of suction piping.

F. Provide inlet pressure gauge and outlet compound gauge to indicate when cleaning is necessary.

G. Suction diffuser shall be as manufactured by the pump manufacturer.

H. Where mechanical pipe grooved couplings are used, the following suction diffuser shall be permitted:
   1. Suction Diffuser – Flanged outlet with grooved inlet connections, rated to 300 psi (2065 kPa). Ductile iron (ASTM A-536) body, 304 stainless steel frame and perforated sheet diffuser with 5/32" (4,0mm) diameter holes. Removable 20 mesh 304 stainless steel start-up pre-filter, outlets for pressure/temperature drain connections, and base support boss. Victaulic Series 731-G and W731-G.

2.05 TRIPLE DUTY VALVES

A. Acceptable Manufacturers:
   1. Bell & Gossett (Basis of Design)
   2. Armstrong Pumps, Inc.
   3. Taco
   4. Patterson

B. Furnish and install as shown on the plans, a triple duty valve designed to perform the functions of a non-slam check valve, throttling valve, shut-off valve, calibrated balancing valve and system flowmeter.

C. The valve shall be of heavy-duty cast iron construction with standard 125 psig ANSI flanged

connections, and rated for a maximum working pressure of 175 psig at 250 deg. F.

D. The valve shall be fitted with an EPDM soft seat, replaceable bronze disc, stainless steel stem and chatter preventing spring.

E. The valve design shall permit repacking under full system pressure.

F. Each valve shall be equipped with brass readout valves (with integral check valve) for taking differential pressure readings across the orifice to accurately balance the system to specified design conditions.

G. Check the operation of the valve and the pressure drop across the valve, and regulate the flow as required for the system.

H. Read the pressure drop carefully and determine the system flow from the Manufacturer's pressure drop charts.

I. Report the pressure drop and flow as required in Section 230593 - TESTING ADJUSTING & BALANCING OF SYSTEMS.

2.06 FLEXIBLE CONNECTORS

A. Provide a stainless steel braided type flexible connector in every pump suction and discharge, as close to the pump as possible to absorb vibration and prevent noise transmission.

B. Flex connectors shall be as manufactured by Keflex, or Metraflex for the temperatures and working pressures of the systems being installed.

C. Bellows style expansion joints are unacceptable and shall not be permitted as a substitute for stainless steel braided flexible connectors.

D. Where mechanical pipe grooved couplings are used, the following shall be permitted:

1. Three flexible type grooved joint couplings may be used in lieu of flexible connectors at equipment connections in applicable piping systems. The couplings shall be placed in close proximity to the vibration source. Basis of Design: Victaulic Company.

2. Around Pump Applications Victaulic 380/381/382 Series Vibration Isolation Drops may be used.

PART 3 – EXECUTION

3.01 PUMP INSTALLATION

A. Install base mounted pumps on 4” high concrete housekeeping pad and grout base full. Balance per manufacturers recommendations.

B. Base mounted pumps shall be leveled in accordance with the pump manufacturer's instructions.

C. Pump and motor shaft alignment shall be made before and after grout is poured and again after final pipe connections are made.

D. Mount and support inline pumps per manufacturer’s recommendations.

3.02 TRIPLE DUTY VALVE INSTALLATION

A. Install the triple duty valve as recommended by the Manufacturer. Provide access to remove the internal parts for service.

3.03 FLEXIBLE CONNECTOR INSTALLATION

A. Mount the flex connectors in the suction and discharge piping as recommended by the manufacturer. Prevent any tension, torsion, or compression on the connectors from the pipe system.

B. Tighten the connecting bolts with a torsion wrench as recommended by the manufacturer.

C. Check the installation for leaks and remake any leaking joints.

END OF SECTION

SECTION 23 2510

CLOSED LOOP WATER TREATMENT

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The contractor shall provide chemicals and labor for the pre-operational cleaning of all chilled, glycol or hot water loops and related equipment piping systems. This cleaning method is not intended for potable water systems. Contractor shall furnish and install all equipment, chemicals and service necessary for a complete water treatment program. A single water treatment company shall provide all products and services for undivided responsibility throughout the contract period. This company shall have an accredited laboratory. The water treatment products and services shall be provided by State Industrial Products, or approved equal.

1.04 ACCEPTABLE MANUFACTURERS

A. State Industrial Products - Water treatment products and services (Basis of Design)

B. Culligan

C. Equal as approved by the Professional

1.05 SUBMITTALS

A. The Contractor shall provide submittals for the following products required by this specification:

1. Nitrite Test Kit
2. 2-1/2 Gallon Filter Feeder
3. Cleaning Solution
4. Closed Loop Inhibitor

PART 2 – PRODUCTS

2.01 PRE-OPERATIONAL CLEANING

A. Preparation For Clean-Out

1. All systems must be prepared prior to the introduction of the chemical cleaner.
2. Contractor shall flush all systems, including mud from drop legs. Remove, clean and replace all strainers. All systems shall contain the highest quality of water available.
3. Complete circulation must be achieved during the cleaning procedure. A minimum flow rate of 2 feet per second shall be maintained to ensure the cleaning chemicals will work properly. All electric, air, and thermostatic operated valves shall be open. All dead end runs shall be looped together with piping not less than 1/3 the size of the run. This piping is to remain in place until the cleaning is complete.
4. A minimum of 1 ½” ball or gate valve is to be permanently installed in the low point of each system for the purpose of draining the system.

B. Cleaning Chemicals

1. A pre-operational cleaner shall be used to remove light grease, cutting oils, loose mill scale, organics and extraneous construction debris. The cleaner shall contain an organic phosphate, an organic corrosion inhibitor, a dispersant and an oil emulsifier, such as **Tempest**, or approved equal. Sufficient cleaner shall be used to treat all piping to remove oil and grease and to permit a uniform passivating film to form. This film aids in the prevention of flash corrosion when the system is most vulnerable to attack.

C. Pre-Operational Cleaning Procedure

1. Add recommended quantity of cleaning chemical directly into the closed loop before the recirculating pumps to ensure rapid mixing and distribution throughout the system. A small amount of antifoam may be added to prevent excessive foaming. Refer to MSDS for safety information.
2. Recirculate the system for 16-24 hours.
3. Open and drain mud legs and low points periodically during the cleaning process. Drain system completely paying particular attention to mud from drop legs and all low points.
4. Refill the system with clean potable water. Clean all strainers. Re-circulate for 8-12 hours and completely drain the system.
5. Refill the system. The length of time between the completion of the cleaning procedure and the addition of the corrosion inhibitor shall not exceed 24 hours.
6. Add the recommended level of closed loop inhibitor. The system is now ready for operation.
7. A service report shall be generated on-site by the water treatment representative certifying that the system has been cleaned in accordance with the above procedure and shall be copied to the mechanical contractor.

2.02 WATER TREATMENT PROGRAM

A. Chemical Feed and Control Equipment

1. A 2 ½ gal Chemical Filter-Feeder shall be used. This filter-feeder shall be floor mounted only and consist of the filter-feeder body, internal stainless steel retaining screen, and 3 ½" fill cap. A minimum of 4 filter bags will be provided with the filter-feeder for use. Filter-Feeder shall be supplied by **State Chemical, #102456.**
2. Chemical feeder shall be mounted on the floor, or on an interior wall. If wall mounted, the feeder opening shall not exceed 3' (three feet) from the operating floor.
3. Isolation valves, for purposes of feeder operation will be at a level approximately equal to, or slightly below the top of the feeder cap and a close as practical to the chemical feeder, as a means of limiting excessive air addition when feeding chemicals. A flow indicating device will be installed on the water inlet to the chemical filter feeder to ascertain flow.
4. A drain line from the chemical feeder shall be installed and run to a sanitary drain.
5. A properly sized water meter shall be installed on the closed loop make-up water line to provide measurements of make-up water to the system.

B. Water Treatment Chemicals

1. Furnish a one year supply of a liquid closed loop inhibitor for control of scale and corrosion in a closed recirculating system. Formulations shall not contain any ingredient which may be harmful to system materials of construction. The corrosion inhibitor shall contain a multi-functional blend of nitrite, molybdate, tolyltriazole, anionic polymer and buffering agents. Inhibitor shall be **HWS-135**, or approved equal. A MSDS shall be provided for all chemical products. No system shall be operated without the benefits of chemical protection.

C. Test Equipment

1. Furnish water test equipment, including storage case and spare reagents for maintaining control of the program standards in the closed loop system. Test kits shall include reagents and apparatus for the determination of nitrite level in the closed loop system.

D. Water Treatment Service Program

1. Provide start-up service and regular service visits to include:
    a. Recommendations for installation and system start-up.
    b. Initial treatment dosages.
    c. Training of operating personnel on proper feed and control techniques.
    d. Service visits and consultation meetings as required.
    e. Provide necessary log sheets and record forms.
    f. Provide laboratory and technical assistance as required.
    g. All services shall be provided by a qualified full time representative of the approved chemical company.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install all equipment per manufacturers recommendation and Best Industry Standards.

END OF SECTION

SECTION 233113

DUCTWORK

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The ductwork for the various HVAC systems shall be as hereinafter described in this section.

1.04 SUBMITTALS

A. Submit shop drawings depicting dimensioned ductwork layouts.

B. Submit duct construction standards for each ductwork pressure class required for this project.

C. Shop drawings shall indicate assembly, duct dimensions, sheetmetal gauge or thickness, required clearances, construction details, and field connection details.

D. Shop drawings shall define flange spacing dimensions and any additional reinforcement spacing dimensions.

1.05 GENERAL REQUIREMENTS

A. The Contractor shall furnish and install all sheet metal work as required for proper operation of the heating, ventilating and air conditioning system, supply air, return air, and exhaust ventilating systems.

B. The Contractor shall be held responsible to construct the air handling systems in accordance with UL requirements for the particular combinations on the Project. Fire dampers must be UL listed and approved for each particular type of installation in accordance with the UL regulations and NFPA requirements including NFPA 90A.

C. Ductwork shall include low velocity and medium heating and air conditioning supply, outdoor air, return, relief, transfer, and exhaust ventilation, mains, branches, access doors, dampers, wall sleeves, canvas connections, accessories, as hereinafter specified, and all necessary supports, bracing, stiffeners and hangers to provide neat vibration-proof air distribution systems. All supply ductwork shall be insulated as air conditioning ductwork.

D. The .2 Contractor shall be responsible for notifying the .1 Contractor where ductwork or other equipment will be extended through the roof and exterior walls. It will be necessary to coordinate the exact location of structural members to provide clearance for the ductwork.

E. The duct systems shall be arranged to provide all possible clearance for access to various dampers and other accessories. An access door shall be provided to service each damper. Shape and location of ducts may be changed to suit building conditions but area must be maintained. Attention is called to the limited space available for ductwork and close cooperation will be required between this Contractor and contractors for other trades.

F. All sheet metal work shall be fabricated and installed in a neat and workmanlike manner and by men experienced in this type of work.

G. Backdraft dampers shall be provided in exhaust duct discharges and at all exhaust fans to keep tramp air from entering ductwork or rooms. Motor operated dampers shall be provided as shown on Drawings in lieu of backdraft dampers.

H. Where vertical sheet metal ducts pass through floors or masonry construction, supporting angles shall be rigidly bolted to the floor. The horizontal leg of the angle shall be of sufficient

width to provide adequate bearing surface for the support of the respective duct. In all possible cases, the supporting angle shall be placed on all four sides of the duct. Where ductwork is exposed (not enclosed in masonry), a 2" high concrete curb shall be formed around all four sides of opening in floor to prevent water drippage to the ceiling below. Space between ductwork and wall or floor opening shall be filled with Dow Corning 3-6548 RTV sealant, or approved equal, to prevent the passage of flame and smoke. Where horizontal ducts pass through masonry wall construction, additionally provide sheet metal angles or flanges on each side of wall to completely close opening.

I. Furnish and install all structural steel members for the support of the ductwork and equipment to suit the structural and vibration isolation conditions.

PART 2 - PRODUCTS

2.01 LOW VELOCITY DUCTWORK

A. All low velocity ductwork shall be constructed and installed in strict accordance with the recommendations and details of SMACNA (Sheet Metal and Air Conditioning Contractors' National Association, Inc., 8224 Old Courthouse Road, Tysons Corner, Vienna, Virginia 22180), **except where these Specifications exceed SMACNA requirements**. Low velocity ductwork shall consist of outdoor intake ducts, supply ducts, exhaust ducts, transfer ducts, relief air ducts, and return ducts.

B. Metal used in ducts except as otherwise specified shall be galvanized sheet steel conforming to ASTM A527 or aluminum conforming to Aluminum Association Standards Designation #3003-H14.

C. All miscellaneous transitions, shapes and accessories have not been indicated due to the scale of the Drawings; however, the Contractor shall install all sheet metal accessories to complete the systems. Special care shall be exercised to provide tight fitting, well-fabricated well-braced ductwork systems. Adjustment mechanisms, controls and dampers of all kinds must be accessible.

D. Drive slip joints shall not be used for joint connections unless the Contractor thoroughly tapes each joint with 3M or approved equal 4" wide vinyl impregnated cloth duct tape with adhesive back. Two 2" wide overlapped tapes may be used in lieu of 4" wide tape. Taped drive slip joints may be used on ducts up to and including 18" only.

E. All new low velocity ductwork shall be constructed to SMACNA 2" w.g. pressure class standards and shall be neatly built, rigidly braced with structural shapes to prevent vibration.

F. Rectangular low velocity ductwork and shall be constructed with the sheetmetal thickness, joints, and bracing as indicated in the following table:

Steel Gauge	**Aluminum Thickness**	**Maximum Size, Inches**	**Type of Transverse Joint Connections**	**Bracing**
24	.020"	Up to 12	Plain S Slip, Pocket Lock or Bar Slips on 8'-0" Centers	None
24	.025"	13 to 18	Plain S Slip, Pocket Lock or Bar Slips on 8'-0" Centers	None

Steel Gauge	Aluminum Thickness	Maximum Size, Inches	Type of Transverse Joint Connections	Bracing
24	.025"	19 to 30	Hemmed S Slip, 1" Pocket Lock or 1" Bar Slips on 10'-0" Centers	1" x 1" x 1/8" angles 5'-0" OC max.
22	.032"	31 to 42	1" Pocket Lock or 1" Bar Slips, on 5'-0" Centers	1" x 1" x 1/8" angles 5'-0" OC max.
22	.032"	43 to 54	1-1/2" Angle Connections or 1-1/2" Pocket or 1-1/2" Bar Slips on 5'-0" Max. Centers	1-1/2" x 1-1/2" x 1/8" angles 5'-0" OC max.
20	.040"	55 to 60	1-1/2" Angle Connections or 1-1/2" Pocket or 1-1/2" Bar Slips on 5'-0" Max. Centers with 1-3/8" x 1/8" Bar Reinforcing	1-1/2"x 1-1/2" x 1/8" angles 5'-0" OC max.
20	.040"	61 to 84	1-1/2" Angle Connections or 1-1/2" Bar Slips on 5'-0" Max. Centers with 1-3/8" x 1/8" Bar Reinforcing	1-1/2"x 1-1/2" x 1/8" angles 4'-0" OC max.

Steel Gauge	Aluminum Thickness	Maximum Size, Inches	Type of Transverse Joint Connections	Bracing
18	.051"	85 to 96	1-1/2" Angle Pocket Connections or 1-1/2" Angle Slips or 1-1/2" Bar Slips 5'-0" Max. Centers with 1-3/8" x 3/16" Bar Reinforcing	1-1/2" x 1-1/2" x 3/16" angles 3'-0" OC max.
18	.051	Over 96	2" Angle Pocket Connections or 2" Angle Slips 5'-0" Maximum Centers with 2" x 1/4" Bar Reinforcing	2" x 2" x 1/4" angles 2'-6" OC max.

G. The thickness of low velocity rectangular ductwork shall be no less than 24 gauge.

H. Exposed ductwork shall be one (1) gauge heavier than that listed in the table above or as called out on the drawings.

I. For exhaust systems, where ducts enter the shafts, including the smoke/fire damper, and extending to the exhaust fan, duct static pressure rating shall be 4” W.G. from the exhaust registers to the shaft, duct static pressures ratings shall be 2” W.G.

J. Round low velocity ductwork shall be fabricated of galvanized steel with lock-type spiral seams in accordance with SMACNA details and steel gauge thickness as listed in the SMACNA Manual, but not less than 26 gauge thickness. Duct system shall be as manufactured by United Sheet Metal, Semco, Hranec SMI, or approved equal.

K. Longitudinal seam round ductwork will not be accepted. “Snap Lock” round ductwork will not be accepted.

L. All round ductwork fittings shall be pressed or welded. Adjustable elbows or fittings will not be accepted.

M. All joints in ductwork shall be airtight and shall be constructed in accordance with SMACNA recommendations, except where SMACNA recommendations are exceeded by these Specifications.

N. All connections between motor-operated equipment and ductwork shall be made through 20 oz. fire-resistant canvas throats, "Ventfab," "Durodyne," or approved equal.

O. All ductwork shall be supported by hanger straps, angles, rods, or bands, attached, sized and spaced in accordance with the SMACNA duct construction standards. Standard sheet metal practices listed and shown in the SMACNA "Duct Manual" shall apply to work to be performed.

P. Kitchen Hood Exhaust System Ductwork (where indicated on drawings)

1. Acceptable Manufacturers:
    a. Metal-Fab Grease Duct Model No Chase™, Series 4G (Basis of Design)

       Local Representative - Pittsburgh Air Systems, Inc. 412-741-3070.
    b. AMPCO Grease duct Model IVSI Zero Clearance, local representative – Deckman Company, 412-257-3333
    c. Metalbestos
    d. Heat-Fab
    e. Equal as approved by the Professional
2. The Grease Duct shall be factory prefabricated, double wall type, listed by UL for the venting of grease laden air from kitchen hoods requiring grease duct as described in NFPA 96. The Grease Duct shall be rated for continuous operation at 500º F (260º C) and intermittent operation at 2000º F (1093º C).
3. The Grease Duct shall be listed and labeled UL/ULc 1978 “Standard for Grease Ducts – 0” Clearance”, listed as “UL Classification: Grease Duct Assemblies Sub Category (HNOB) G-1, UL Fire Resistance Directory Alternate to 3 hr. Shaft Enclosure” and approved NMC: National Mechanical Code (BOCA) Research Report No. 96-37. The grease duct shall be listed and labeled as a fire rated system which can be installed at zero (0.0") inch clearance to combustible surfaces. The Grease Duct shall be listed to penetrate interior walls or partitions rated up to 2 hours. Products not rated by BOCA and listed by UL for zero clearance to combustibles and as a 2-hour fire stop will not be approved.
4. The inner wall shall be constructed of Type 304 Stainless Steel. The outer wall shall be constructed of Aluminized Steel.
5. The Grease Duct shall have a 4" wide annular space between the inner and outer walls, which is filled with 4" of high temperature ceramic fiber insulation.
6. The Grease Duct shall be sealed liquid tight by means of a mechanical joint consisting of integral flanges on adjoining sections of pipe, held together with a stainless steel flange band and sealed with Type P080 Sealant.
7. The Grease Duct shall include hood and fan transitions, pipe supports and guides, fittings, cleanout ports, ports for the introduction of fire suppression or wash down nozzles, expansion joints and thimbles for penetration of non-fire rated building members, all as shown on plans or as required to meet local building code requirements. All components of the Grease Duct system shall be provided by the Grease duct manufacturer to ensure that the system meets the requirements of the listing.
8. All Grease Duct supports or guides shall be anchored with FM Stainless Fasteners FIX Epoxy Anchoring System or equal, approved by the building code official. Anchors shall be a minimum of 5/8" diameter. Penetrations through partitions rated for up to 2 hours must be fire stopped in accordance with the manufacturer's instructions using the Model PICPPK fire stop kit.
9. The Grease Duct shall be installed in complete compliance with the manufacturer's listed installation instructions.

Q. Exhaust ductwork installed in conjunction with the kitchen hood exhaust system, where wrapped insulation is required, shall conform with the latest requirements of NFPA No. 96. Concealed ductwork shall be constructed of not less than .054 in. (No. 16 MSG) steel and shall be supported by not less than 16 gauge carbon steel.

1. No. 18 gauge Type 304 stainless steel may be used in lieu of No. 16 MSG carbon steel for concealed ductwork. Exposed ductwork shall be No. 18 gauge Type 304 stainless steel polished and finished as hereinafter specified. All exhaust ductwork installed in conjunction with the kitchen hood shall have all seams and joints externally welded to form

a liquid tight continuous external weld. Refer to NFPA No. 96 for additional requirements. Maintain all clearances and furnish and install fireproofing materials as required by NFPA. Cleanout openings shall be provided in kitchen hood ductwork as required for inspection and cleanout purposes. Exposed ductwork in kitchen shall be fabricated from Type 304 stainless steel with exposed surfaces polished to a No. 4 satin finish. All joints shall be made liquid tight or watertight as specified above. Fume hood exhaust ductwork shall be Type 304 stainless steel.

2.02 SPECIAL DUCT MATERIALS

A. The following duct systems shall be constructed of aluminum:

1. Exhaust associated with dishwashers and other wet area

2.03 MEDIUM VELOCITY RECTANGULAR CIRCULAR AND OVAL DUCTWORK (ALL DUCTWORK FROM AIR HANDLING UNITS UP TO VAV OR CV BOXES)

A. The contractor can use rectangular round, oval or rectangular medium velocity ductwork. The contractor must use rectangular duct at all beam penetrations to properly fit in the hole of beam that has been precut.

B. All applicable portions of "Low Velocity Ductwork" shall apply to this section of the Specification.

C. The Contractor shall provide volume control dampers as indicated.

D. Medium velocity ductwork shall be standard rectangular circular or oval spiral rigid galvanized ductwork with standard fittings, conical takeoffs and ductwork field-insulated with blanket insulation with sealed vapor barrier as specified under "Insulation" or internal lining in areas specified.

E. All medium velocity ductwork shall be constructed and installed in strict accordance with SMACNA and with the latest edition of the ASHRAE Guide, except where these Specifications exceed the above construction requirements. All ducts shall be of sizes indicated, properly supported and hung from Building structure by galvanized steel band hangers or isolation hangers as required. Perforated steel strip will not be acceptable for hangers. Each hanger strap shall be provided with inserts in concrete, or supported from steel using beam clamps. All support members shall be furnished and installed in strict accordance with the SMACNA duct manual and the ASHRAE Guide as specified above.

F. Flexible medium velocity ducts shall be used where specifically indicated on the Drawings or where required to pass ducts around conflicting construction and for connection to air terminals. Use of flexible ductwork shall be kept to a minimum, but do not exceed 3 feet, refer to NFPA 90A. Flexible medium velocity ducts shall be factory insulated and covered with a fiberglass reinforced metalized film vapor barrier, and shall be Thermaflex Type M-KC, as manufactured by Automation Industries, Wiremold Type WK, or approved equivalent.

G. All circular and oval ductwork shall be United Sheet Metal Company spiral duct, Norlock, Semco, or approved equivalent. Eight inch diameter and under shall be No. 26 gauge; 9" to 24" diameter shall be No. 24 gauge; 26" through 36" diameter shall be No. 22 gauge, and ducts 36" through 50" diameter shall be No. 20 gauge size, zinc-coated steel of 4-ply, spiral lock seam construction, furnished in 12' or 20'-0" lengths, or the manufacturer's standard lengths. Ducts shall be cut to specific lengths on the job by the Contractor to meet field conditions and assembled with slip fittings as manufactured by the duct manufacturer. Reinforcing spiral seams shall be on maximum center dimensions, 4" on small sizes, and 8" on larger sizes. Ribbon width shall not exceed 4" up to and including 8" diameter. Ribbon width shall not exceed 8" on other larger sizes.

H. All fittings in circular or oval ductwork shall be factory-fabricated and shall be designed and manufactured by the duct manufacturer. All elbows and angles shall have a centerline radius of at least 1-1/2 times the diameter. All fittings shall be fabricated by means of the continuous carbon arc Evr-Dur welding method, or equivalent. Fittings up to and including 36" in diameter shall be 20 gauge, zinc-coated steel. Fittings 36" through 50" diameter shall be 18 gauge, and over 50" diameter shall be 16 gauge. All field offsets shall be made by using 45 degree elbows

or offset fittings. All tee fittings shall be of the "conical" type. All 45 degree and 90 degree ells 3" through 8" diameter shall be die formed ells for laminar airflow. Elbows over 8" diameter shall be the 5-section mitered type. Oval ducts and transitions or transitions to rectangular shape, shall be furnished and installed where necessary to clear Building steel or other ducts.

I. Where a change in shape from round to rectangular or oval, and vice versa, is required, a transformation joint with a taper of not more than 1" in 7" shall be used and construction shall be as hereinafter specified.

J. Fire dampers suitable for medium velocity service shall be furnished and installed where required by NFPA, in each duct that extends through fire rated construction. Damper sleeves shall be No. 10 gauge in 8" to 18" diameter, and No. 12 gauge over 18" diameter, or United Sheet Metal No. 18-12 or 14, Prefco Model 5500 CR/CO, Ruskin, or approved equivalent. Damper assemblies shall be provided with access doors, fusible links, bronze spring-holding catches and oil-impregnated bronze bearings. Access doors in general construction shall be furnished and installed by this Contractor. All applicable portions of low velocity duct fire dampers shall be considered a part of this Specification. Metal wall sleeves and steel angle frames shall be furnished and installed at dampers in accordance with the manufacturer's details and as required by Underwriters.

K. All ducts shall be supported in accordance with the duct manufacturer's recommendations, ASHRAE Guide, SMACNA Medium velocity Manual as specified for vibration isolation and good practices. All flexible connections shall be made with Ventglas, or approved equivalent, 30 oz. UL approved and coated canvas fabric and joints shall be additionally band clamped and sealed completely airtight.

L. All field connections in circular or oval ductwork shall be of the slip type. The only type of joint permitted on circular and oval ducts shall be of the heat-shrink-on type as manufactured by Raychem, or approved equivalent; however, special duct tape and sealer such as manufactured by Hardcast may be submitted for review and approval by the Professional. Tape and sealer shall meet the requirements of NFPA for flame and smoke spread requirements and the joints when completed shall be capable of air tests up to 30" WG. Ductwork testing shall be as hereinafter specified. Should Hardcast duct tape be considered for installation, the Contractor shall submit a sample of the wrapped duct joint which shall be taped and sealed in place. The tape shall be coated on both sides and at least two overlapped layers of 3" wide tape shall be applied to each joint. The submitted sample, if approved, will be used as a basis for the application and approval of all joints made throughout the installation.

M. The Contractor shall submit complete catalog data and application methods for all joint materials used on this Project. The manufacturer's details and methods of installation shall be adhered to.

N. All medium velocity oval shaped ductwork shall conform with the specifications for medium velocity circular ductwork. Oval medium velocity ductwork shall be reinforced, braced and supported as required to avoid excessive deformation. Bracing and reinforcement shall conform with the oval duct manufacturer's published tables, details, and instructions. In absence thereof, bracing, supports, and reinforcing shall conform with United Sheet Metal's published engineering bulletins.

O. All medium velocity ductwork shall have a pressure classification of 6" water column. Medium velocity ductwork shall be insulated as supply ductwork.

2.04 MEDIUM VELOCITY RECTANGULAR TRANSITION DUCTWORK (ALL DUCTWORK FROM AIR HANDLING UNITS UP TO VAV OR CV BOXES)

A. Furnish and install rectangular medium velocity galvanized steel ductwork at transitions and other locations as indicated on the Drawings or as required to meet job conditions. Ductwork shall have a pressure classification of 6” water column.

B. All applicable sections of low velocity and rectangular, round and oval medium velocity ductwork systems shall apply to the installation of rectangular medium velocity ductwork. In addition, the rectangular ducts shall be assembled with medium velocity airtight slip joints or

standing seams, pocket lock joints or welded flange joints in accordance with the recommendations of the SMACNA Duct Manual for medium velocity systems. Sealing mastic shall be flooded into all joints and connections as illustrated in the manual. Care shall be exercised to assure that inside lips of joints are not bent into the airstream during the assembly of the joints as hereinbefore specified for circular medium velocity ductwork. In lieu of the above, the Contractor will have the option of using a prefabricated duct connection system similar to the "Nexus" 4-bolt system as manufactured by Exanno Corporation, the Ductmate system, or approved equivalent. The system shall be installed in strict accordance with the manufacturer's requirements and with the requirements of SMACNA.

C. All medium velocity rectangular ductwork shall be constructed of galvanized steel and gauges shall conform with Figure 3-1 of the SMACNA Duct Manual for Medium velocity Systems, generally as follows:

24 gauge to 18" size

22 gauge 19" to 48" size

20 gauge 49" to 72" size

18 gauge over 72" size

D. All supporting angles shall be tied together with tie rod construction. Hangers and supports shall conform with the details and recommendations of the manual. Ductwork of all systems shall be specially supported with rod and strap hangers prior to the placement of concrete.

E. All rectangular medium velocity ductwork shall be tested for leakage as herein specified for circular medium velocity ductwork, as described in the manual, and shall be structurally tested as outlined by SMACNA.

F. Medium velocity rectangular ductwork shall be insulated as specified under "Insulation" for medium velocity systems with special care being taken on sealing and taping.

G. Equivalent rectangular ductwork can be used for medium velocity systems as long as all SMACNA standards are complied with.

H. The thickness of medium velocity rectangular ductwork shall be no less than 24 gauge.

2.05 INSERTS

A. The Contractor shall place all hanger and support inserts in concrete. Special studs "shot" into concrete will not be permitted.

B. All expansion shells shall be of the self-drilling types as manufactured by the Phillips Drill Company, Ramset, Rawlplug, or approved equal. Shells shall be the hammer installed, special flush or hanger rod types. Shells shall be installed with a drill-hammer.

C. Lead expansion shields or lead wedge type shields are not permitted.

D. Epoxy adhesive anchors, Hilti or equal, shall be used where specified on the design drawings.

2.06 PENETRATIONS

A. Seal all openings through walls of air plenum spaces and relief air shafts, where ducts, are installed under this Contract to assure airtight plenum spaces. Coordinate all work with contractors of other trades.

PART 3 - EXECUTION

3.01 DUCTWORK TESTING

A. The Contractor shall, at the beginning of the work, construct, erect and leak test a representative sample of the duct construction to be used at the 4-inch w.g. pressure class. The sample specimen shall include at least five transverse joints, typical seams, an access door and at least two typical branch connections plus an elbow. The specimen shall be a portion of a main duct or main branch as submitted by the Contractor and accepted by the Professional.

B. The leakage shall not exceed the allotted amount for the pressure class, or the allotted amount for that portion of the system whichever is applicable.

Duct Class	2” w.g.	4” w.g.
Seal Class	A	A
Sealing Applicable	Joints, Seams and All Duct Wall Penetrations	Joints, Seams and All Duct Wall Penetrations
Leakage Class		
Rectangular Metal	4	2
Round Metal	4	2

C. Leakage tests are not required for the 2-inch w.g. duct pressure class.

D. Concentrated leakage at any one point, on any duct, will not be permitted and shall be corrected to the satisfaction of the Professional.

E. Leak test procedures shall follow the outlines and classifications in the SMACNA *HVAC Duct Leakage Test Manual – Second Edition 2012.*

F. If the specimen fails to meet the allotted leakage level, the Contractor shall modify the ductwork to bring it into compliance and shall retest it until acceptable leakage is demonstrated.

G. Tests and necessary repairs shall be completed prior to concealment of ducts.

3.02 INSTALLATION

A. Install all ductwork per SMACNA Standards.

B. The ends of all ductwork and associated equipment shall be capped plugged, or adequately sealed at fabrication, during shipping, during storage at the site and as construction proceeds to prevent the entrance of dust, dirt, and other foreign matter. All open ends on installed duct work shall be capped, plugged or adequately sealed to prevent the entrance of dust, dirt, and other foreign matter.

C. All ductwork regardless of function or pressure class shall be sealed air tight from fan or unit connections up to and including the register, grille, or diffuser collar. All ductwork joints shall be sealed in their entirety.

3.03 UNACCEPTABLE HANGER AND SUPPORT INSTALLATIONS

A. It is unacceptable to support any pipe(s) or duct(s) from other pipe(s) or duct(s).

B. It is unacceptable for this Contractor to support his work from the hangers of other trades. All trades must install their own hangers.

C. Unacceptable hanger and support installations shall be corrected as directed by the Professional at no cost to the Client Agency.

D. It is unacceptable to attach supports to the building structure or concrete slabs using nails or a nail gun.

E. Perforated steel strap and perforated steel angle are unacceptable supports for ductwork.

END OF SECTION

SECTION 233114

EXTERIOR DUCTWORK – MANUFACTURED PRE-INSULATED

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. Section includes:

1. Exterior ductwork, designed, manufactured, and pre-insulated for thermal efficiency, low leakage, and weather resistance.
2. Pressure Class: 6" w.g. positive and 6” w.g. negative.

B. This section does not include:

1. Air passages rated over a continuous internal static pressure of 6" w.g. positive, 6” w.g. negative, or with test pressure rating over: 10" w.g. startup and 10" w.g. negative (as documented on product labeling).

1.03 SUBMITTALS

A. Product data: For each type of product indicated.

B. Shop drawings: Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work including.

1. Duct layout indicating sizes and pressure classes.
2. Elevation of top of ducts.
3. Dimensions of main duct runs from building grid lines.
4. Fittings.
5. Penetrations through fire-rated and other partitions.

C. Coordination Drawings: Plans, drawn to scale, showing coordination general construction, building components, and other building services.

1.04 QUALITY ASSURANCE

A. Installer Qualifications:

1. Exterior ductwork can be installed by competent trained field mechanics who demonstrate competence in the HVAC industry.

1.05 SPECIFICATION COMPLIANCE

A. Duct Leakage Class, follow SMACNA Leakage Class 3 or less.

B. Exterior ductwork shall incorporate a Kingspan KoolDuct fortified inner liner compliant to UL (C-UL) 181 Standard for Safety Listed, Class 1 system, with included testing and passing the following:

1. Test for Surface Burning Characteristics
2. Flame Penetration Test
3. Burning Test
4. Mold Growth and Humidity Test
5. Low Temperature Test and High Temperature Test
6. Puncture Test
7. Static Load Test

8. Impact Test
9. Pressure Test and Collapse (negative pressure) Test
10. High Temperature and Humidity for 90 days
11. Cone Calorimeter
12. ASTM E2257 Standard Test Method for Room Fire Test of Wall and Ceiling Materials and Assemblies
13. ASTM E 84 tested, Tunnel Test, Does not exceed 25 flame spread, 50 smoke developed.
14. DW144, Class B
15. NRTL product approval, (Subpart S of 29 CFR Part 1910, OSHA)
16. ASTM C 423 noise reduction
17. ASTM E 96/E 96M Procedure A for permeability
18. ASTM C 1071 for erosion
19. ASTM C 518: 2004, Standard Test Method for Steady–State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
20. UL 723, Test for Surface Burning Characteristics of Building Materials
21. NFPA Compliance:
    a. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems"
    b. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems"
    c. NFPA 255, “Standard Method of Test of Surface Burning Characteristics of Building Materials

C. Exterior ductwork outer shell shall be a UV stable 1000 micron high impact resistant titanium infused vinyl with included testing as following;
1. UL-94 Flammability V-0
2. ASTM D-638 Tensile Strength of 6250 psi
3. ASTM D-790 Flexible Strength of 11,000 psi
4. ASTM D-4226 Drop Impact Resistance
5. ASTM D-4216 Cell Classification

1.06 PRODUCT DELIVERY AND STORAGE

A. Prevent objectionable aesthetic damage to the outer surface of duct segments during transport and storage.

B. Store duct segments under cover and protect from excessive moisture prior to installation.

PART 2 – PRODUCTS

2.01 EXTERIOR RECTANGULAR DUCT AND FITTINGS

A. Acceptable Manufacturers:
1. Thermaduct with Kingspan Kooltherm thermoset resin insulated core (Basis of Design)
2. Dual-Tech by PTM Manufacturing, LLC
3. Pro-R by Duct & Cleats
4. Tuff Duct
5. Equal as approved by the Professional

B. The panel shall be manufactured of CFC-free closed cell rigid thermoset resin thermally bonded on both sides to a factory applied .001" (25 micron) aluminum foil facing reinforced with a fiberglass scrim. An added UV stable, 1000 micron high impact resistant titanium infused vinyl is factory bonded to the outer surfaces to provide a zero permeability water tight barrier.

C. The thermal conductivity shall be no greater than 0.13BTU • in/Hr •ft2•°F, the thermal conductivity shall be no greater than 0.13BTU • in/Hr •ft2•°F

D. The density of the Kooltherm foam shall not be less than 3.5 PCF with a minimum compressive strength of 28 psi (.2 MPa).

E. The panel thickness, R-value, and other characteristics shall be as follows:

1. Maximum Temperature: Continuous rating of 185 °F inside ducts or ambient temperature surrounding ducts.
2. Maximum Thermal Conductivity: 0.13 Btu x in./h x sq. ft. x deg F at 75 °F mean temperature.
3. Permeability: 0.00 perms maximum when tested according to ASTM E 96/E 96M, Procedure A.
4. Antimicrobial Agent: Additive for antimicrobial shall not be used but instead, raw product must pass UL bacteria growth testing.
5. Noise-Reduction Coefficient: 0.05 minimum when tested according to ASTM C 423, Mounting A.
6. Required Markings: All interior duct liner shall bear UL label and other markings required by UL 181 on each full sheet of duct panel; UL ratings for internal closure materials.
7. All insulation materials shall be closed cell with a closed cell content of >90%.
8. R-value: 1 ¾" Thick Panel: 12 R

F. Closure Materials:

1. V-Groove Adhesive: Silicone (interior only).
2. UV stable 39 mil high impact resistant titanium infused vinyl (exterior).
    a. Factory manufactured seamless corners for zero perms.
    b. Cohesive bonded over-lap at corner seam covers for zero perms.
    c. Water resistant titanium infused welded vinyl seams.
    d. Mold and mildew resistant.
3. Polymeric Sealing System:
    a. Structural Membrane: Aluminum scrim with woven glass fiber with UV stable vinyl clad applied
    b. Minimum Seam Cover Width: 2 7/8" inches
    c. Sealant: Low VOC.
    d. Color: As selected by the Professional with White being the standard color.
    e. Water resistant.
    f. Mold and mildew resistant.
4. Duct Connectors.
    a. Factory manufactured cohesive bonded strips (low pressure only).
    b. Factory manufactured all aluminum grip flange.
        1) Grip flange
        2) F-flange
        3) H-flange
        4) U-flange
    c. Factory manufactured galvanized 4-bolt flange.

G. Outdoor Cladding

1. Duct segments shall incorporate UV stable 39 mil high impact resistant titanium infused vinyl which is introduced during the manufacturing process.

H. Flange coverings

1. Flanges are field sealed airtight before flange covers are installed. Flange covering consists of the following:

a. Foam tape insulation with molded 39 mil covers.

b. Air gap (heating only application) with molded 39 mil covers.

I. Weight

1. Exterior ductwork shall provide low weight stresses on the building framing and support members. Assembled exterior ductwork shall have a weight of 0.86 lbs. per square foot to maximum weight of 2.7 lbs. per square foot (depending on R-value). Hangers and tie-downs are to be detailed on the manufacturer's installing contractors detail drawings prior to installation but not exceeding 13' for duct girth <84" and 8' for duct girth >85" between hangers and designed to carry the weight and wind load of the ductwork.

J. Interior Surface

1. Galvanized steel interior liner.

K. Access Panels

1. Duct access panels or doors shall be spaced a maximum of 20 Feet and shall be provided at either side of turning vanes or dampers for duct cleaning.

PART 3 – EXECUTION

3.01 SHOP FABRICATION

A. Certification:

1. Ducts shall be detailed and fully factory manufactured by an authorized manufacturer's facility system. All fabrication labor will be certified "yellow label" building trade professionals, compliant to SMWIA and SMACNA labor guidelines (work preservation observed).

B. Fabrication:

1. Fabricated joints, seams, transitions, reinforcement, elbows, branch connections, access doors and panels, and damage repairs according to manufacturer's written and detailed instructions.

2. Fabricated 90-degree mitered elbows to include turning vanes.

3. Fabricated duct segments in accordance with manufacturer's written details.

4. Duct Fittings shall include 6 inches of connecting material, as measured, from last bend line to the end of the duct. Connections on machine manufactured duct may be 4 inches.

5. Fabricated duct segments utilizing v-groove method of fabrication. Factory welded or cohesively bonded seams will apply to fully manufactured ductwork and fittings. Internal seams will be supplied with an unbroken layer of low VOC silicone or bonding (for paint shop applications). Each duct segment will be factory supplied with either aluminum grip pro-file or pre-insulated duct connectors in accordance with manufacturer's detailed submittal guide. Applied duct reinforcement to protect against side deformation from both positive and negative pressure per manufacturer's design guide based on specified ductwork size and system pressure.

6. Designed and fabricated duct segments and fittings will be in accordance with "SMACNA Duct Construction Standards" latest edition.

7. Both positive and negative ductwork and fittings shall be constructed to incorporate a UL Listed as a Class 1 air duct to Standard for Safety UL 181 liner with an exterior clad for permanent protection against water intrusion.

8. Duct shall be constructed to exceed requirements for snow and wind loads.

3.02 DUCT INSTALLATION

A. Duct segments shall be installed be competent HVAC installers.

B. Install ducts and fittings to comply with manufacturer’s installation instructions and as follows:

1. Install ducts with fewest possible joints.
2. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
3. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
4. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."
5. Use prescribed duct support spacing as described in this specification and manufacturer’s recommendations.
6. Air Leakage: Duct air leakage rates shall comply with “SMACNA HVAC Duct Construction Standards” latest version per applicable leakage class based on pressure.

3.03 HANGER AND SUPPORT INSTALLATION

A. .2 Contractor to ensure that the ductwork system is properly and adequately supported.

1. Ensure that the chosen method is compatible with the specific ductwork system requirements per manufacturer’s installation detail drawings. The .2 Contractor shall submit shop drawings for approval prior to work commencement.
2. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Supports of straight runs of ductwork:

1. Spacing shall not exceed 13 feet (3.96 m) for duct sections when fabricated in 13-foot (3.96 m) lengths with duct girth less than or equal to 84 inches.
2. Spacing shall not exceed 8 feet for duct sizes and short segments with duct girth equal to or greater than 85 inches.
3. Spacing shall not exceed 6 feet for duct sizes and short segments with duct girth equal to or greater than 232 inches.
4. For ducts of girth equal to or greater than 300 inches, consult the factory.
5. Girth shall be calculated as the sum of the internal dimensions of the duct. i.e., for a 20” x 10” duct the girth is 20” + 20” + 10” + 10” = 60”
6. Ductwork shall be supported in accordance with the manufacturer’s installation details provided prior to work commencement.

C. Ductwork shall be supported at changes of direction, at branch duct connections, tee fittings, parallel under turning vanes and all duct accessories such as dampers, etc.

D. The load of such accessories to the ductwork shall be neutralized by the accessory support.

3.04 FIELD QUALITY CONTROL

A. Inspection: Arrange for manufacturer's representative to inspect completed installation and provide written report that installation complies with manufacturer's written instructions.

1. Remove and replace duct system where inspection indicates that it does not comply with specified requirements.

B. Perform additional testing and inspecting, at the .2 Contractor's expense, to determine compliance of replaced or additional work with specified requirements.

3.05 DUCT SCHEDULE

A. Outdoor Ducts and Fittings:
   1. Exterior Rectangular Ducts and Fittings:
      a. Minimum Panel Thickness: 1 ¾ in.
      b. Cladding: minimum 0.038 inch

END OF SECTION

SECTION 233115

EXISTING DUCTWORK CLEANING

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 – PRODUCTS

2.01 GENERAL

A. All supply and return ductwork shown to be reused shall be cleaned as hereinafter described in this Section.

B. Furnish and install new access openings as required to perform the direct contact interior cleaning. Access openings shall be fitted with air-tight cover as specified in Section 233300.

C. Rust, deterioration, or other special conditions encountered during performance of cleaning shall be reported to the Professional.

D. All cleaning compounds used for the interior cleaning of the ductwork shall be non-toxic.

E. The .2 Contractor shall completely remove by pneumatic process (Industrial Vacuum Cleaning), or other processes, all dirt, lint, dust, grease, oily residue or other accumulation from the interior of duct systems.

1. All grease, lint, dirt, soot, oily residue and other accumulations, removed from all areas shall be gathered, contained and removed from each site by the .2 Contractor and disposed of in accordance with local regulations governing such removal and disposal.
2. The use of outdoor truck mounted vacuum equipment will not be allowed.
3. HEPA vacuum equipment shall be used where advisable and in critical areas.

F. The .2 Contractor shall install access doors as required to perform work under this Contract.

G. Install and/or repair insulation removed or damaged during work performed under this Contract.

H. Safety Requirements:

1. The .2 Contractor will perform his work in strict accord with accredited standards and codes in order to alleviate possibility of damage to installed District machinery and equipment. Every effort will be made to safeguard human life and property.
2. In all explosion hazard areas, the .2 Contractor shall use only explosion proof electrical equipment and appliances conforming to the National Code. All Industrial Vacuum Machines, Pneumatic Exhausters and Blower Compressors, and other Equipment will be of sufficient capacity to ensure maximum results and safety.

I. Protection of Equipment

1. While on or near installed equipment, the .2 Contractor will use drop cloths, shields and other protective devices to prevent damage to mechanical equipment and/or areas adjacent to units being cleaned and decontaminated.
2. The .2 Contractor shall move all furniture and fixtures that may interfere with performance of the work specified and shall reposition same upon completion of the work in each area and clean the area in which the work has been performed. All bracings, rafters and adjacent

structural members and equipment shall be kept clean or cleaned after operations are completed.

J. The cleaned ductwork shall be sealed with a water based resin sealer to control insulation peeling. The resin sealer shall be non-toxic, designed for this duct insulation sealing application and pre-approved by the Professional and Department. Sealer shall be Type 40-23 as manufactured by Foster Products or approved equivalent.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install as per manufacturers recommendations.

END OF SECTION

SECTION 233300
DUCT ACCESSORIES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 SUMMARY

A. This Section includes the following:
   1. Backdraft dampers.
   2. Manual-volume dampers.
   3. Fire and smoke dampers.
   4. Motor operated dampers.
   5. Turning vanes.
   6. Duct-mounted access doors and panels.
   7. Flexible ducts.
   8. Flexible connectors.
   9. Duct accessory hardware.
   10. Cable control system for volume control dampers

B. Related Sections include the following:
   1. Division 23 Section "Air Terminals" for air terminal boxes.
   2. Division 23 Section "Diffusers, Registers, and Grilles."

1.04 SUBMITTALS

A. Provide product data for the following:
   1. Backdraft dampers.
   2. Manual-volume dampers.
   3. Fire and smoke dampers.
   4. Motor operated dampers.
   5. Turning vanes
   6. Duct-mounted access doors and panels.
   7. Flexible ducts.
   8. Flexible connectors.
   9. Duct accessory hardware.
   10. Cable control system for volume control dampers

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loadings, required clearances, method of field assembly, components, location, and size of each field connection. Detail the following:
   1. Special fittings and manual-volume-damper installations.
   2. Fire-damper installations, including sleeves and duct-mounted access doors and panels.

C. Product Certificates: Submit certified test data on dynamic insertion loss; self-noise power levels; and airflow performance data, static-pressure loss, dimensions, and weights.

1.05 QUALITY ASSURANCE

A. NFPA Compliance: Comply with the following NFPA standards:

1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."

1.06 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

3.01 DAMPERS

A. Backdraft Dampers: Backdraft dampers shall be factory made of minimum .050" extruded aluminum blades supported on aluminum or zinc plated steel rods, in nylon bearings, set in minimum .063" extruded aluminum frame. Blades shall be fitted with vinyl inserts on contact edges to prevent noise. Blades shall be 40" maximum length and 6" maximum individual width. Damper assembly shall be provided with an adjustable counter-balance device. Channel frame shall be fitted to duct, vent or wall opening and edges sealed airtight. Inside dimensions of channel frame shall not be less than the daylight opening of the grille so that frame is not visible with grille in place. Exhaust fans equipped with backdraft dampers shall be furnished with dampers conforming to the requirements of this specification, and shall be furnished with dampers full size of connecting collar.

B. Rectangular Volume Control Dampers: Volume control dampers shall be of the factory fabricated opposed blade, multi-louver type, controlled from a single point with an adjusting device. Install end bearings with a rubber gasket on the outside of ducts or frames to prevent air leakage around the damper shaft and for smooth operation. Dampers shall be mounted in heavy galvanized steel channel frames and shall have smooth acting linkage. Blades shall be not less than 18 gauge galvanized, die-formed steel. Adjusting devices shall have locking mechanisms and shall be accessible.

C. Round Volume Control Dampers: Factory fabricated, single blade, center pivoted, constructed of galvanized sheet steel, controlled from a single point with an accessible adjusting device with locking mechanism.

D. Motor Operated Dampers – Refer to Section 230900.

E. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products which may be incorporated in the work include, but are not limited to, the following:

1. Backdraft Dampers:
    a. Arrow United Industries, Inc. (Type 655)
    b. Air Balance Inc. (Model BS 55)
    c. Greenheck Fan Corp. (Series VBD-360)
    d. National Controlled Air (Series BD2/A2)
    e. Ruskin Manufacturing Co. (Series CBD6)
    f. Nailor
    g. Pottorff
2. Volume Control Dampers:
    a. Air Balance Inc. (Rectangular Model AC-2, Round Model AC-112)
    b. Arrow United Industries Inc. (Model 1770)
    c. Louvers and Dampers, Inc. (Rectangular Model VCD-400, Round Model CD-600)

d. National Controlled Air (Rectangular Model SCD-57, Round Model SCD-RD-88)

e. United McGill Corp. (Round Dampers, Model SRSVL)

f. Nailor

g. Pottorff

3.02 FIRE AND SMOKE DAMPERS

A. Fire Dampers:

1. Provide fire dampers with fusible links, where required by NFPA and where indicated on the drawings. Fire dampers shall be rated for 1-1/2 hours or 3 hours as required by the fire rating of construction in which they are installed. Fire dampers must be UL listed and approved for each particular type of installation in accordance with UL and NFPA 90A requirements. Provide dampers and associated sheet metal construction in accordance with UL requirements for the particular combinations on the project and in accordance with SMACNA recommendations. Fire dampers shall be accessible, with suitable means provided for replacing fusible links. Access doors shall be provided in ductwork, walls or ceilings.

2. Fire dampers shall be constructed and installed in accordance with applicable requirements of the State and the National Fire Protection Association NFPA 90A. Dampers shall be dynamically tested, rated and labeled in accordance with the fourth edition of UL Standard 555. Dampers generally shall be of the roll form blade design and shall bear the Underwriters' label. Damper blades shall be fabricated of 21 gauge galvanized steel. Frames shall be one piece. Entire assembly shall be given a rustproof protective coating by the manufacturer. Stainless steel blades and accessories conforming with UL and NFPA requirements will be acceptable. Fusible links shall have temperature rating approximately 50 degrees F. above the maximum temperature that would normally be encountered with the system in operation or shutdown, but not less than 212 degrees F. unless specifically indicated otherwise. Fire dampers shall be suitable for installation in horizontal and vertical positions. Where fire dampers are installed in conjunction with grilles and registers in walls, it will be necessary for the Contractor to resize grilles and wall openings to accommodate additional area of damper assemblies where blades are stacked.

3. Fire dampers shall have a full opening equal to the duct size or of sizes noted. Blades, in the open position, shall be located and stacked out of the air stream to allow 100 percent free open area for air flow. Fire dampers installed in masonry walls or air shafts shall be installed and secured to structural steel angles and channels provided under this Contract.

4. Fire dampers suitable for high velocity service shall be furnished and installed where required by NFPA, in each duct that extends through fire rated construction. Damper sleeves shall be No. 10 gauge in 8" to 18" diameter and No. 12 gauge over 18" diameter. Damper assemblies shall be provided with access doors, fusible links, bronze spring-holding catches and oil-impregnated bronze bearings. Applicable portions of low velocity duct fire dampers shall be considered a part of this specification. Metal wall sleeves and steel angle frames shall be furnished and installed at dampers in accordance with the manufacturer's details and as required by Underwriters'. Conform to recommendations of SMACNA.

B. Smoke Dampers:

1. Provide smoke dampers at locations shown on the drawings and as required to meet NFPA requirements. Dampers shall be factory furnished with damper operators and the entire assembly shall be UL listed.

2. Smoke dampers shall be parallel blade type dampers suitable for high velocity service and shall be constructed for low leakage and low pressure drop. Smoke dampers shall be furnished with a UL 555S and NFPA 90A classified label. Damper assembly including operator shall be qualified under UL at 350 degrees F. elevated temperature. The damper leakage shall not exceed 4 CFM per sq. ft. at 1 inch w.g. (UL Leakage Class I). Damper frames shall be constructed of No. 16 gauge galvanized sheet steel and the blades shall be airfoil type constructed of double No. 22 gauge sheet steel. Damper blades shall not exceed 6" in width. Blades shall be suitable for high velocity performance (3500 fpm). Damper bearings shall be stainless steel sleeve type. Replaceable silicone rubber seals shall be installed along each blade edge in integral ribbed groove inserts in frames and blades. Compression type stainless steel seals shall be provided on top, bottom and sides of frame. Each smoke damper shall also be furnished with an SPST end switch package for remote position monitoring of damper blades in full open and full closed positions.

3. Smoke dampers shall be controlled as specified in, "Sequences of Operation." Smoke dampers shall be factory furnished complete with linkages, extended shaft and damper actuators. Duct mounted smoke detectors will be provided under Division 16, ELECTRICAL. Damper actuators shall be electric, suitable for elevated temperature service and shall be UL listed for smoke damper application.

C. Combination Fire/Smoke Dampers:

1. Provide combination fire/smoke dampers at locations shown on the drawings and as required to meet NFPA requirements. Dampers shall be factory furnished with damper operators and the entire assembly shall be UL listed.

2. Combination fire/smoke damper assemblies shall be furnished with a UL 555S and NFPA 90A classified label. Dampers shall utilize a parallel multi-blade type construction and bear a 1-1/2 hour UL label.

3. High velocity damper shall bear a UL 555S leakage Class 1 rating of 10 cfm per foot at one inch water gauge. Blade construction shall be of galvanized steel, one piece airfoil blade design. Damper shall be rated for a velocity of 3,500 feet per minute at a pressure drop of 0.1" water gauge maximum (30 x 36 nominal size). Air foil blades shall be center pivoted so they can be installed for air flow in either direction.

4. Low velocity dampers shall bear a UL 555S leakage rating Class 1 classified label. Blades shall be of galvanized steel construction, triple V groove design with center pivot design and be capable of handling velocities to 2,000 feet a minute at a pressure drop of 0.08 water gauge. Dampers shall be capable of providing modulation volume control and shall have been tested at no less than 5,000 cycles after salt spray and dust fouling against system pressure velocity.

5. Each fire/smoke damper shall be equipped with a UL classified firestat or electro-mechanical link resettable with remote command operation, 120 volt service with an SPST end switch package for remote position monitoring of damper blades in full open and full closed psitions.

6. Dampers with modulating actuators shall be coordinated with the ATC Contractor. Dampers shall be controlled as specified in “Sequences fo Operation” Combination fire/smoke dampers shall be factory furnished complete with linkages, extended shaft and damper actuators. Duct mounted smoke detectors will be provided under Division 16, ELECTRICAL. Damper actuators shall be electric, suitable for elevated temperature service and shall be UL listed for smoke damper application.

D. Available Manufacturers: Subject to compliance with requirements, manufacturers offering fire and smoke dampers which may be incorporated in the work include, but are not limited to, the following:

1. Fire Dampers:

a. Greenheck, Inc. (Model DFD-150-Type B, Model CRD, Model DFD-155 Type C/CO/CR).

b. National Controlled Air (Model DFD-B)

c. Ruskin Mfg. Co. (Model D1BD2-B, Model CFD-5A, Model D1BD2 and D1BD23 Style CR/CO)

d. Air Balance Model D19 Type B

e. Prefco Model 5500 DE4/DE6

f. Pottorff

g. Nailor

2. Smoke Dampers:

a. Greenheck, Inc. (Model SMD-43)

b. National Controlled Air (Model SSD-AF-59)

c. Ruskin Mfg. Co. (Model SD-60).

d. Air Balance (Model SA1, SA2)

e. Prefco (Model 5180)

f. Johnson Controls

g. Pottorff

h. Nailor

3. Combination Fire/Smoke Dampers:

a. Greenheck, Inc. (Model FSD-33 and Model FSD-21)

b. National Controlled Air (Model FSD-AF-58 and Model FSD-3V-57)

c. Ruskin Mfg. Co. (Model FSD-60 and Model FSD-35)

d. Air Balance (Model FA1, FA2)

e. Prefco (Model 5080)

f. Johnson Controls

g. Pottorff

h. Nailor

3.03 FLEXIBLE DUCTS

A. Flexible ducts may be used for connection to air terminals. Flexible ducts shall be used on straight runs only and individual lengths shall be a minimum of 5 feet and a maximum of 8 feet. Ducts shall be suspended with band hangers and wire spaced as recommended by the duct manufacturer and to prevent sagging and kinking. Flexible ducts shall be attached to ductwork and terminals with cinch-type nylon bands and duct tape.

B. Flexible Duct Construction:

1. Construct the duct of 3003-H14 alloy aluminum in accordance with ASTM B 209.

2. The duct wall shall be at least 0.005 inches thick, spiral wound into a tube and spiral corrugated to provide strength and flexibility.

3. Use a mechanical lock to form a continuous secure air tight joint without the use of adhesive.

4. The internal working pressure rating shall be at least as follows with a bursting pressure of at least 2-1/2 times the working pressure.

a. Positive: 10 inches W.C. thru 16”; 6” W.C. 18” and 20”

b. Negative: 10 inches W.C. thru 16”; 4” W.C. 18” and 20”

5. The duct shall be rated for a velocity of at least 5500 feet per minute.

6. Suitable for operating temperatures of at least 250 degrees F.

7. Factory insulate the flexible duct with flexible fiberglass insulation. The R value shall be at least 6.0 at a mean temperature of 75 degrees F.
8. Cover the insulation with a reinforced aluminum pigmented vapor barrier jacket having a permeance of not greater than 0.05 perms when tested in accordance with ASTM E 96, procedure A.
9. The ductwork shall be UL 181 or ETL listed, Class 1 Air Duct and comply with NFPA 90A and NFPA 90B.
10. Acceptable Manufacturers:
    a. Flexmaster Type TLM (Basis of Design)
    b. Thermaflex
    c. Wiremold Co.

3.04 TURNING VANES

A. Acceptable Manufacturers:
    1. Aero-Dyne Sound Control Company, High Efficiency Profile, HEP (Basis of Design). Contact: www.aero-dyne.net PH: 800-522-2423

B. Turning vanes shall be installed at each change in direction of square or rectangular, low and medium velocity supply air ductwork, particularly at mitered elbows where radius elbows are impractical, and shall be of sizes to suit ductwork.

C. Turning vanes shall be installed in outdoor air intake, return or exhaust ducts only where specifically shown or noted on the drawings.

D. Turning vanes shall be an engineered, true airfoil design with smoothly rounded entry nose and extended trailing edge for low-pressure drop, anti-dirt, and positive fastening.

E. Generated sound power level shall not exceed 54 decibels in band 4 at 2,000 FPM-duct 24 x 24.

F. Fabricate assemblies with the Aero-Dyne Side Rail support system. Install vanes on design centers of 2.4 inches across the full diagonal dimension of the elbow. Tabbed or slotted dimple fasteners are not acceptable.

G. Submittals are required; proposed substitution shall include independent performance test data for pressure loss and generated sound power levels.

3.05 ACCESS DOORS IN DUCTS

A. Furnish and install access doors and frames to permit inspection, operation and maintenance of devices concealed behind the sheetmetal work. Provide duct access doors of insulated double panel construction, not less than 20 gauge, galvanized steel. Provide access doors with sponge rubber gaskets around their entire perimeter. Where ducts are uninsulated or are not lined, insulation in access doors may be omitted.

B. Hang access doors in ductwork in separate frames on heavy flat hinges. Provide "Ventlok No. 100" cast zinc latches. Where space conditions preclude the use of hinges, provide a minimum of 4 heavy window type latches.

C. Provide duct access doors not smaller than 18" x 18". Provide ducts smaller than 18" in width with access doors two inches less in width than the width of the duct. Minimum dimension of one side to be 18".

3.06 ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments, and length to suit duct insulation thickness.

B. Splitter Damper Accessories:Zinc-plated damper blade bracket; 1/4-inch, zinc-plated operating rod; and a duct-mounted, ball-joint bracket with flat rubber gasket and square-head set screw.

C. Flexible Duct Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action, in sizes 3 to 18 inches to suit duct size.

D. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

3.07 FLEXIBLE CONNECTORS

A. General: Flame-retarded or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

B. Metal-Edged Connectors: Factory fabricated with a strip of fabric 3-1/2 inches wide attached to two strips of 2-3/4-inch-wide, 0.028-inch-thick, galvanized sheet steel.

C. Flexible Connector Fabric: Glass fabric double coated with polychloroprene.

1. Minimum Weight: 26 oz./sq. yd.

2. Tensile Strength: 480 lbf/inch in the warp, and 360 lbf/inch in the filling.

2.08 CABLE CONTROL SYSTEM FOR VOLUME CONTROL DAMPERS

A. Damper controller and cable shall be concealed above the ceiling. Cable to consist of Bowden cable .054” stainless steel control wire with a tensile strength of 260,000 lbs. that is encapsulated in 1/16” flexible galvanized spiral wire sheath. Control kit shall be designed for use with internally or externally controlled round or rectangular dampers and shall consist of 14 gauge steel rack and pinion gear drive capable of delivering 35 in. lbs. of push / pull torque that converts rotary motion to push-pull motion. Control shaft shall be D-style flatted 1/4” diameter with 265-degree rotation providing 1-1/2” linear travel capability. Control kit mounting bracket can be field mounted on ceiling framework, behind grilles, on or inside plenum slot diffusers and other various types of diffusers. Control kit shall be manually operated using Young Regulator Model 030 wrench. Control kit shall be Young Regulator Model 270-275 or prior approved equal.

B. Cable control systems for volume control dampers shall be installed where dampers are above hard ceilings to eliminate the need for access panels.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install duct accessories according to applicable details shown in SMACNA's "HVAC Duct Construction Standards--Metal and Flexible".

B. Install volume dampers in lined duct; avoid damage to and erosion of duct liner.

C. Provide test holes at fan inlet and outlet and elsewhere as indicated.

D. Install fire dampers according to manufacturer's UL-approved written instructions.

1. Install fusible links in fire dampers.

E. Install duct access panels downstream from volume dampers, fire dampers, turning vanes, and equipment.

1. Install duct access panels to allow access to interior of ducts for cleaning, inspecting, adjusting, and maintaining accessories and terminal units.

2. Install access panels on side of duct where adequate clearance is available.

F. Label access doors according to Division 23 Section "Mechanical Identification."

3.02 ADJUSTING

A. Adjust duct accessories for proper settings.

B. Adjust fire dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 23 Section "Testing, Adjusting, and Balancing."

END OF SECTION

SECTION 233423

SUPPLY AND EXHAUST FANS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The fans for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 POWER ROOF VENTILATORS - TYPE B

A. Acceptable Manufacturers:

1. Twin City Model BCRD (Basis of Design)
2. Greenheck
3. ACME
4. Carnes
5. Equal as approved by the Professional

B. Roof mounted exhaust fans shall be of the belt driven centrifugal type.

C. PERFORMANCE - Fans shall be tested in accordance with AMCA 211 and AMCA 311 test codes for air moving devices and shall be guaranteed by the manufacturer to deliver rated published performance levels. Fans shall be licensed to bear the AMCA certified ratings seal for both sound and air. Models shall be CULUS 705 listed.

D. CONSTRUCTION - BCRD fans housings shall be constructed of spun aluminum and shall offer finish durability and aesthetic appearance. Fan spinnings shall have a rolled bead edge for rigidity. All units have a deep venturi inlet to prevent snow and rain entry into the building. The curb cap shall include prepunched mounting holes for ease of installation. A conduit chase constructed of electrical metallic tubing shall be provided to the mo tor compartment. The curb base shall provide protection from weather. Lifting lugs shall be provided inside the motor compartment for ease of handling and installation. Fans shall bear a permanently attached nameplate displaying model and serial number of the unit for future identification.

E. MOTOR AND DRIVE ASSEMBLY - Motor and drive assembly shall be mounted on vibration isolators to eliminate vibration and noise transmission into the ductwork. Motors and drives shall be mounted out of the exhaust airstream.

F. WHEEL - Fan wheels shall be of the centrifugal backward inclined type, constructed of aluminum and containing a matching inlet venturi for optimum unit performance. Wheels shall be statically and dynamically balanced.

G. SHAFT - Fan shafts shall be precision-ground and polished. Shafts shall have a first critical speed of at least 125% of the fan's maximum operating speed.

H. BEARINGS - Bearings shall be of the one-piece, pillow block type with relubricable zerk fittings. Bearings shall be designed for air handling service with a minimum L-10 life in excess of 100,000 hours; L-50 500,000 hours at the maximum cataloged operating speed. Bearing mounting plate shall have self-aligning tabs for exact locating and alignment of bearings.

I. DRIVE - Drive assembly shall be constructed of heavy-gauge galvanized steel. Drives shall be sized for a minimum of 150% of driven horsepower. Machined, cast iron motor sheaves shall be adjustable for final system balance.

J. MOTOR - Motors shall be heavy-duty ball bearing type, closely matched to the fan load. All single-phase ODP motors shall contain thermal overload protection. All motors shall be UL and /or CSA recognized. Motor adjustment shall allow precise belt tensioning for optimum belt life and one-person adjustment and servicing.

K. DISCONNECT SWITCH - A NEMA 1 disconnect switch shall be supplied with wiring leading from the motor to the junction box (ODP and TEFC motors).

L. ACCESSORIES - When specified, accessories such as backdraft damper, roof curb, curb hinge, retaining chain, security hasp, NEMA-4 disconnect switch, 2-speed switch, firestat, aluminum bird screen, aluminum insect screen, and special coatings shall be provided to maintain one source responsibility.

M. FACTORY RUN TEST - All fans prior to shipment shall be completely assembled and test run as a unit at operating speed or maximum RPM allowed for the particular construction type. Each wheel shall be statically and dynamically balanced in accordance with ANSI/AMCA 204-96 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Balance readings shall be taken by electronic type equipment in the axial, vertical, and horizontal directions on each of the bearings. Records shall be maintained and a written copy shall be available upon request.

N. GUARANTEE - The manufacturer shall guarantee the workmanship and materials for its roof and wall mounted centrifugal exhaust fans for at least one (1) year from startup or eighteen (18) months from shipment, whichever occurs first.

2.02 INLINE FANS

A. Acceptable Manufacturers:

1. Twin City Model BSI (Basis of Design)
2. Greenheck Model BSQ
3. Equal as approved by the Professional

B. Duct mounted fans shall be of the centrifugal belt driven in-line type. Where indicated on the drawings, fans shall be furnished with integral filter.

C. The fan housing shall be of the square design constructed of heavy gauge galvanized steel and shall include square duct mounting collars.

D. Fan construction shall include two removable access panels located perpendicular to the motor mounting panel. The access panels must be of sufficient size to permit easy access to all interior components.

E. The fan wheel shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. Wheels shall be statically and dynamically balanced.

F. Motors shall be heavy duty ball bearing type, carefully matched to the fan load and furnished at the specified voltage, phase and enclosure. Motors and drives shall be mounted out of the air stream. Motors shall be readily accessible for maintenance.

G. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings.

H. Bearings shall be selected for a minimum (L50) life in excess of 200,000 hours at maximum cataloged operating speed.

I. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shafts. Motor pulleys shall be adjustable for final system balancing.

J. A NEMA 1 disconnect switch shall be provided as standard, except with explosion resistant motors, where disconnects are optional. Factory wiring shall be provided from motor to the handy box.

K. All fans shall bear the AMCA Certified Ratings Seal for both sound and air performance. Each fan shall bear a permanently affixed manufacturer's nameplate containing the model number and individual serial number for future identification.

L. Where indicated on plans, fan shall be furnished with a combined filter box to eliminate special remote filter box assemblies. Filter box shall accommodate the installation of 1" or 2" aluminum mesh or paper filters.

2.03 BELT DRIVE EXHAUST FANS

A. Acceptable Manufacturers:

1. Twin City Model BISW and Model BCVU2 for kitchen hood exhaust (Basis of Design)
2. Greenheck
3. ACME
4. Carnes
5. Equal as approved by the Professional

B. Exhaust fans shall be of the centrifugal type with backward inclined wheels as indicated on the plans and schedules.

C. The housings on fan sizes 54 and larger shall be of continuously welded heavy gauge steel. Fan housings on sizes 12 through 49 shall be of air-tight –Perma-Lock™ construction with the scroll panel material formed and embedded into the side panels. The housing and bearing support shall be constructed of welded structural steel members to prevent vibration and rigidly support the shaft and bearings.

D. The fan wheel shall be of the non-overloading backward inclined centrifugal type. Wheels shall be statically and dynamically balanced. The wheel cone and fan inlet cone shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency. Turned, precision ground and polished steel shafts shall be sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class. Close tolerances shall be maintained where the shaft passes through the bearing.

E. Bearings shall be heavy duty grease lubricated, self-aligning ball bearing or roller pillow block type. Bearings shall be selected for a minimum (L50) life of 200,000 hours at maximum operating speed for each pressure class. Fan performance shall be based on tests conducted in accordance with AMCA standard 210 test code for air moving devices and fans shall be licensed to bear the AMCA Certified Ratings Seal.

F. After assembly each fan shall be given an electronic vibration analysis while running at the specified operating RPM. Vibration amplitude and frequency shall be recorded in the horizontal, vertical and axial planes of each bearing to assure smooth vibration free operation. The analyzer print-out shall be filed and made available upon customer request.

G. Kitchen hood exhaust fans shall include V-belt drives, motor, UL weather cover, bolted access door, drain connection, backplate fins, UL 762 Labels, and name plate. Fans shall be installed per local codes and NFPA 96.

H. FINISH AND COATING -- The entire fan assembly, excluding the shaft, shall be thoroughly degreased and deburred before application of a rust-preventative primer. After the fan is completely assembled, a finish coat of paint shall be applied to the entire assembly. Fan finish and coatings shall be weather resistant. The fan shaft shall be coated with a petroleum-based rust protectant.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install per manufacturers recommendations.

END OF SECTION

SECTION 233424

ROOF MOUNTED EQUIPMENT ACCESSORIES

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The accessories for the various Roof Mounted HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 PREFABRICATED PIPE PORTALS

A. Acceptable Manufacturers:

1. RPS Accessories. (Basis of Design)
2. Thycurb
3. Pate Co.
4. Equal as approved by the Professional

B. The .2 Contractor shall furnish and install a prefabricated pipe portal system for all pipe lines extended through the roof. Bases, portal covers, counterflashing, and other accessories shall be furnished and installed by the .2 Contractor. Openings in the roof will be by the .1 Contractor. Setting of curbs, flashing, counterflashing, etc. shall be by the .2 Contractor.

C. Curbs shall be 18 gauge galvanized steel of monolithic construction with integral base plate, continuous welded corner seams, factory-installed treated wood nailers, 1-1/2" thick 3 lb. density fiberglass insulation adhered to inside of all curb walls, and 18 gauge galvanized steel counterflashing. Curb heights and lengths shall be as required by the Contractor for installation of the lines shown. Top of curb shall be located not less than 12" above finished roof surface.

D. The pipe portal for gas vent piping shall be furnished with a laminated acrylic coated ABS plastic curb cover with prepunched mounted holes and molded sealing ring on an 8" collared opening, and an EPDM compression molded rubber cap and necessary stainless steel clamps. Curb covers shall be resistant to ozone and ultra violet sun rays and shall have a serviceable temperature range of -40 degrees F. to +160 degrees F. The molded sealing ring on the collared opening and the groove in the rubber cap shall be installed to assure a weathertight pressure and mechanical lock. The protective rubber caps shall have a serviceable temperature range of -60 degrees F. to +250 degrees F. and shall also be resistant to ozone and ultra violet sun rays. The conical shaped steps of the nipple shall provide a taut waterproof seal around the pipe. The stainless steel clamps shall provide added protection to guarantee the seal.

2.02 ROOF CURBS

A. Acceptable Manufacturers:

1. RPS Accessories Model RC-A (Basis of Design)
2. Thycurb
3. Cambridgeport
4. Equal as approved by the Professional

B. Furnish and install roof products and systems roof curbs at all roof openings as specified on the Drawings. Prefabricated roof curbs shall be of box section design, constructed using minimum 18 gauge galvanized steel, with fully mitered and welded corners, 3" cant. Roof curbs shall be internally reinforced on any side longer than 3'-0" and shall have factory internal base plate. Roof curbs to be insulated with 1-1/2" thick 3 lb. density fiberglass insulation, and factory installed wood nailers fastened from underside with TEK screws. Height to be 8" above the finished roof or as detailed. Roof curbs shall be level at the top with pitch built-in when deck slopes 1/4 of an inch per foot or greater, or as detailed.

C. Prefabricated roof curbs shall be Model RC-A manufactured by Roof Products and Systems Corporation, Bensenville, IL, Thycurb or approved equivalent. Contractor fabricated roof curbs will not be accepted.

2.03 ROOFTOP EQUIPMENT SUPPORT SYSTEMS

A. The following listed equipment roof support systems are specified to provide the Contractor with acceptable options. Each system is an acceptable option within the limitations of its intended design. The Contractor shall install the roof equipment support option(s) he selects per the manufacturer's instructions and in full coordination with the new and/or existing building roof and structure. The equipment support systems are permitted for use with, but not limited to, piping, ductwork, mini-split condensing units, VFR condensing units, solar panels, and step-over walkways.

B. Equipment Rails

1. Acceptable Manufacturers:
    a. RPS Accessories Model ER-A (Basis of Design)
    b. Thycurb
    c. Cambridgeport
    d. Equal as approved by the Professional
2. Equipment rails shall be manufactured of 18 or 14 gauge galvanized steel as required. Fully mitered and welded corners, 3" cant (except style ER-2A). Equipment rails shall be internally reinforced with integral base plate and factory installed wood nailer. (Specify 2 x 4, 6, 8, 10, 12). Height to be 8" above finished roof or as detailed. Equipment rails shall span a minimum of two (2) joists and not cantilever more than 6". Equipment rails shall be level at the top with pitch built-in when deck slopes ¼" of an inch per foot or greater, or as detailed.
3. Contractor fabricated equipment rails will not be accepted.

C. Roof Top Piping And Duct Supports

1. Acceptable Manufacturers:
    a. Roof Top Blox by Dymotek Corporation (Basis of Design)
    b. C-Port Rooftop Support Solutions, http://www.c-port.net
    c. Ecofoot
    d. Miro Industries
    e. Equal as approved by the Professional
2. Piping, duct, and mechanical support blocks shall be constructed of a body molded from UV-resistant HDPE resin with a foam base platform of 1-inch thick, 25 LB density closed cell polystyrene.
3. Block and height extension accessory shall have multiple piping saddles to organize piping and internal heavy-duty screw thread gripping feature.
4. Block shall have provision to install ⅜" or ½" threaded rod with complete height adjustability from the top using engineered nut slots.

D. Freestanding Non-Penetrative Support Systems

1. Acceptable Manufacturers:
    a. Bigfoot Systems, www.bigfootsupport.com (Basis of Design)
    b. C-Port/Clearline, http://www.c-port.net/roof-walkways/
    c. Ecofoot
    d. Miro Industries
    e. Equal as approved by the Professional
2. Components:
    a. Plastic foot: Nylon, 30% glass fiber fill
    b. Anti-vibration mat: SBR-Recycled Rubber
    c. Metal framework: Hot dip galvanized steel
    d. Concrete ballast feet: Reinforced concrete
    e. Fix-It Foot: SBR-Recycled Rubber
3. Permitted for:
    a. Piping and ductwork step-over walkways and equipment access walkways.
    b. Photo voltaic and thermal solar panels.
    c. Piping, ductwork, mini-split condensing units, VFV and VRF units.

E. Pressure treated lumber for equipment support is unacceptable.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install per manufacturers recommendations.

END OF SECTION

SECTION 233600

VARIABLE AND CONSTANT VOLUME BOXES

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.01 VARIABLE AND CONSTANT VOLUME BOXES

A. Acceptable Manufacturers:

1. Johnson Controls Model TSS (Basis of Design)
2. Krueger Model LMHS
3. Titus ESV
4. Price
5. Equal as approved by the Professional

B. Furnish and install single duct (variable or constant volume) terminal units of the sizes shown in the plans.

C. Terminals shall be certified by use of the ARI Standard 880-98 Certification Program and carry the ARI seal.

D. Unit casing shall be constructed of not less than 22 gage, galvanized steel.

E. All round air inlet collars shall accommodate standard flex duct sizes. Unit discharge shall be slip and drive construction for field attachment to downstream ductwork.

F. Unit labels shall be adhered to each unit including model size, airflow (CFM), balancing chart, and tagged data.

G. The control air damper assembly shall be constructed of heavy gage galvanized steel with solid 1/2” shaft rotating in Delrin® bearings. Damper shaft shall be marked on the end to indicate damper position. Damper blade shall incorporate a flexible gasket for tight airflow shutoff and operate over a full 90° rotation.

H. Each unit shall be equipped with a factory installed, airflow sensing device. Provide a linear, multi-point, velocity-averaging sensor with an amplified signal.

I. Provide balancing taps to allow for easy airflow verification.

J. The radiated and discharge attenuation factors for the specified NC levels shall be based the attenuation factors from ARI Standard 885-98 Appendix E, which includes room absorption, environmental adjustment factor, duct insertion, end reflection and duct branching.

K. Sterilwall Insulation: Unit casing shall be lined with 1” thick, 1 1/2 lb. dual density fiberglass insulation, meeting UL 181 and NFPA 90A, enclosed between the unit casing and a non-perforated internal sheetmetal cover extending over the fiberglass insulation, as well as covering the liner cut edges.

L. Hot water coil casing shall be constructed with minimum 20 gage galvanized steel with slip and drive discharge for attachment to downstream ductwork. Coils shall be factory attached to the terminal unit. Fins shall be rippled and corrugated heavy gage aluminum, mechanically bonded to tubes. Tubes shall be copper with minimum wall thickness of 0.016" and with male solder header connections. Coils shall be leak tested to 400 PSI. Number of coil rows and circuits shall be selected to provide performance as required by the plans. Coil performance data shall be based on tests run in accordance with ARI Standard 410.

M. Provide factory mounted access door.

N. The ATC Contractor will furnish the controller/damper actuator for factory mounting.

O. The ATC Contractor will furnish the hot water control valve for field mounting by the .2 Contractor. The ATC Contractor will connect the valve actuator to the terminal unit controller.

P. The .2 Contractor shall coordinate all terminal unit control requirements with the ATC Contractor.

Q. Unit shall be furnished with no controls. Unit shall be equipped with a flow cross/ring averaging sensor that samples duct pressure and a control damper with a 1/2 in. extended shaft that requires rotary operation to open and close damper. The ATC Contractor shall furnish a DDC controller to the box manufacturer for factory installation by the box manufacturer. for each variable/constant volume box. DDC controller shall include an integral damper operator/differential pressure sensor. The box manufacturer shall install the DDC controller. The box manufacturer shall also connect the DDC controller to the airflow ring/cross furnished as part of the VAV/CV box. Box manufacturer shall include the cost for all factory mounting and connecting work in the variable volume box pricing given to the .2 Contractor. The ATC contractor shall furnish the reheat control valve for installation by the .2 Contractor.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install per manufacturers recommendations.

B. The ATC Contractor will connect tubing from the airflow measuring device to the differential pressure sensor.

C. The ATC Contractor will connect the terminal unit controller to the network communication bus.

D. The ATC Contractor will furnish and install the unit transformer adjacent to a 120V junction box, which will be furnished and installed by the .4 Contractor. The ATC Contractor will connect the 24V power from the unit transformer to the controllers of up to approximately five (5) terminal units.

E. The ends of the all variable and constant volume boxes shall be capped plugged, or adequately scaled at fabrication, during shipping, during storage at the site and as construction proceeds to prevent the entrance of dust, dirt, and other foreign matter. All open ends on installed Variable and Constant Volume Boxes shall be capped, plugged or adequately sealed to prevent the entrance of dust, dirt, and other foreign matter.

END OF SECTION

SECTION 233713

AIR OUTLETS AND INLETS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.01 GRILLES AND REGISTERS – EXHAUST, RELIEF, TRANSFER AND RETURN AIR

A. Acceptable Manufacturers:

1. Krueger Model S480 (Basis of Design)
2. Anemostat Model HP35H0
3. Price
4. Titus
5. Equal as approved by the Professional

B. Furnish and install grilles and registers at exhaust or vent openings. The installation of grilles and registers shall be coordinated with work being done by contractors of other trades. Grilles and registers shall be located symmetrically at centers of ceiling tiles in acoustical tile ceilings. All grilles and registers shall be installed and located subject to the approval of the Architect.

C. Ceiling mounted grilles and registers shall be suitable for installation in types of ceilings indicated on the architectural drawings.

D. All grilles and registers shall be securely attached and supported from associated ductwork or, where not duct connected, shall be attached and supported from the building structural system. Grilles and registers shall not be supported on ceilings of any type.

E. Grilles and register faces shall have a white factory painted finish and shall be provided with foam neoprene or rubber border gaskets.

F. The return and transfer grilles in any wall areas shall be heavy-duty type with extra reinforcing bars. Heavy-duty grilles shall be Model S480 as manufactured by Krueger, or Model HD35HO as manufactured by Anemostat.

G. Ceiling grilles shall be fabricated from aluminum and have fixed aluminum louvers, spaced 3/4" on centers and fixed at 35 degrees split deflection in ceilings and 35 degrees single deflection in sidewalls. Grilles shall be similar to Krueger Series S-580, with the style frame as required for the ceiling type.

H. Faces of registers shall be as described for the grilles above. The damper shall be opposed blade with key-operated mechanisms or setscrew locking device to hold the damper blades in any set position. The dampers shall be fabricated from steel with prime coat finish.

I. Factory painted finish shall be of color as selected by the Professional.

2.02 SUPPLY AIR REGISTERS

A. Acceptable Manufacturers:

1. Krueger Series 5880H (Basis of Design)
2. Anemostat
3. Price

4. Titus
5. Equal as approved by the Professional

B. Furnish and install in supply ductwork double deflection solid-bar adjustable vertical front louvers and solid-bar adjustable horizontal back louver grilles with frames. Supply registers shall be fabricated and finished as herein specified for exhaust grilles. Bars shall pass through supports as required to lock bars firmly in place.

C. Supply registers shall have supply grille faces and be provided with key-operated worm gear mechanism or setscrew locked adjustable opposed-blade dampers. Supply air registers shall be located in a symmetrical manner subject to the approval of the Professional.

D. Factory painted finish shall be of color as selected by the Professional.

2.03 PLAQUE STYLE DIFFUSERS – SUPPLY

A. Acceptable Manufacturers:
1. Krueger Model PLQ (Basis of Design)
2. Anemostat
3. Price
4. Titus
5. Equal as approved by the Professional

B. Provide Architectural square panel ceiling diffusers of the sizes and mounting types shown on the plans or outlet schedule. The diffuser shall have an one piece square face plaque not exceeding 18”x18” for 24”x24” panel sizes and 9”x9” for 12”x12” panel sizes and constructed of 16 gage steel with rounded corners that have a minimum radius of 3/4”. Face plaques that have a secondary wrapper are not acceptable. The face plaque shall not extend below the ceiling more than 3/8” and shall be removable from the back-pan. Optional damper is not required. The diffuser back-pan shall be one piece stamped construction of 22 gage steel and have an integrally drawn round neck.

C. Directional blow tabs shall be constructed of heavy gage steel and offered to provide 1-way, 2-way and 3-way throw patterns.

D. The manufacturer shall provide published (printed or electronic) performance data for the diffuser. Performance data shall include 2 - 7 octave band sound power levels. The diffuser shall be tested in accordance to the data standards at the time of product introduction or ANSI/ASHRAE Standard 70.

E. Diffusers shall include factory furnished insulation blanket.

F. Factory painted finish shall be of color as selected by the Professional.

2.04 SLOT DIFFUSERS

A. Acceptable Manufacturers:
1. Krueger DesignFlo® series DFL with Frame FF (Basis of Design)
2. Anemostat
3. Price
4. Titus
5. Equal as approved by the Professional

B. Linear slot diffusers shall be Krueger DesignFlo® series for supply or return with slot widths of 1”, 1 1/2”, 2”, 2 1/2”, and 3” available. Linear slot diffusers shall be available in single piece construction up to 12’. Slot diffuser lengths greater than 12’ shall be furnished in multiple sections and will be joined together with end alignment strips to form a continuous slot appearance. Alignment strips to be provided by the manufacturer.

C. The linear slot diffuser shall have a 1/2” flange border (Frame F) on both sides of the linear.

D. The linear slot diffuser shall have the ability to support the ceiling. Brackets, which are integral to the diffuser, must allow mounting in hard ceilings and suspended ceilings. Linear diffusers supported by the plenum are not acceptable.

E. The same manufacturer as the linear slot diffuser shall manufacture the plenums.

F. Pattern controllers shall be of two piece extruded aluminum construction. Pattern controllers shall be assembled on 24” centers and supported by permanently lubricated fire retardant polymer spacers. The pair of pattern controllers shall allow for the air stream to be directed along the ceiling in either direction. The pattern controllers must also allow the airflow to be adjusted. Airflow rate can be varied without changing the air pattern. The pattern controllers in the diffuser that control the air pattern and flow rate shall perform these functions satisfactorily without the use of an additional damper.

G. The design of the spacers shall allow for removal and installation of pattern controllers without disassembly of the slot diffuser. The spacers shall be self lubricating, allowing for easy adjustment of pattern controllers. The region of the spacer which is in direct contact with plenum supply air shall have an airfoil design.

H. The color of the face of the linear diffuser shall be as selected by the Professional. All other surfaces including pattern controllers shall be black.

I. The manufacturer shall provide published (printed or electronic) performance data for the diffuser. Performance data shall include 2 - 7 octave band sound power levels. The diffuser shall be tested in accordance to the data standards at the time of product introduction or ANSI/ASHRAE Standard 70.

2.05 DRUM LOUVERS

A. Acceptable Manufacturers

1. Krueger Model DPL2 (Basis of Design)
2. Anemostat
3. Price
4. Titus
5. Equal as approved by the Professional

B. The industrial supply drum louver shall be a Krueger model DPL2. The drum louver shall be constructed with extruded aluminum frame and corners that are mitered and reinforced with aluminum chevrons by full penetration welds. This frame shall have countersunk screw holes and form a 1 1/4” border around the drum louver. The vanes shall be a heavy gage extruded aluminum and fully adjustable. The DPL2 shall have a split vane that allows independent adjustment of the top and bottom blades. The drum shall be extruded aluminum and able to rotate a minimum of 25° up or down from the centerline of the drum louver. The drum shall be separated from the frame by utilizing felt gasketing material, which facilitates drum adjustment and minimizes vibration.

C. Provide optional heavy-duty damper made of heavy gage steel and operable from the face of the supply grille.

B. The manufacturer shall provide published (printed or electronic) performance data for the diffuser. Performance data shall include 2 - 7 octave band sound power levels. The diffuser shall be tested in accordance to the data standards at the time of product introduction or ANSI/ASHRAE Standard 70.

C. The paint finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The paint thickness shall be 0.8 – 1.0 mils, gloss at 60° per ASTM D523-89 of 50 – 85%, pencil hardness per ASTM D3363-92A of HB – H, crosshatch adhesion per ASTM D3359-83 of 4B – 5B, impact per ASTM D2794-93 of direct impact >100 in/lb and reverse impact >80 in/lb, salt spray per ASTM B117-9048 of 96 hours, humidity per ASTM D2247-92 of >500 hours and water soak per ASTM D870-92 of 250 hours. Color shall be as selected by the Professional.

2.06 FIXED LOUVERS

A. Acceptable Manufacturers:
   1. Ruskin Model ELF375D (Basis of Design)
   2. NCA Model XAD-45GL
   3. Greenheck
   4. Arrow
   5. American Warming and Ventilating
   6. Equal as approved by the Professional

B. Furnish and install fixed intake air or discharge air louvers.

C. Louvers shall be the stationary drainable blade type with a frame depth of 4 inches. Frames and blades shall be .081-inch thick 6063-T5 extruded aluminum alloy. Blades shall be located on a 45° blade angle. Bird screens shall be provided on the interior of the louver and shall consist of 3/4" mesh aluminum with an extruded aluminum frame. Screens shall be mounted to the frame face and be removable for cleaning. Louver finish shall be baked enamel Kynar of color selected by the Professional.

D. Louvers shall pass 1000 FPM with less than 0.2 inch WG pressure drop and shall carry less than .001 ounces of water per square foot free area during a 15 minute period when tested in accordance with AMCA Standard 500. Test criteria shall be based on a 48" square sample with a minimum 45.2 percent free area. Louvers shall bear the AMCA Certified Ratings Seal for both Air Performance and Water Penetration.

E. Louvers shall be furnished with blank-off panels constructed of .040" thickness sheet aluminum conforming to Aluminum Association Standards Designation No. 3003-H14. Blank-off panels shall be double skinned panel sandwiching 1" thick, 3 PSF density fiberglass insulation fill. Panels shall be fabricated by spot-welding the sheet aluminum to a 1" aluminum channel frame around the entire panel perimeter. Panels shall be finished on all exposed surfaces to match louver finish and color.

F. The .2 Contractor will provide openings in the exterior walls and install the louvers in the existing building; the .2 Contractor shall be responsible for coordinating the exact sizes locations of all openings required. Furnish all clip angles, mounting hardware, and frames for installation. In the new building the General Contractor shall be responsible for openings and the .2 Contractor shall be responsible for the installation of the louvers.

2.07 GRAVITY ROOF VENTILATORS

A. Acceptable Manufacturers:
   1. Twin City (Basis of Design)
   2. Greenheck “Fabra-Hood”
   3. PennBarry
   4. Equal as approved by the Professional

B. Furnish and install gravity type roof ventilators and prefabricated curbs. Ventilators higher in height than that shown, or ventilators of different types and configurations from that shown will not be acceptable.

C. Factory-built roof curbs for all gravity ventilators shall be furnished and installed by the .2 Contractor. Curbs shall be constructed of galvanized steel with rigid fiberglass insulation and shall be of the self-flashing type. Minimum height of curb shall be 16 inches. Curb shall be constructed to conform to roof slope and arranged so that the roof ventilator is installed level. Curbs shall be as hereinafter specified. The .2 Contractor shall be responsible for furnishing the .1 Contractor with dimensions of roof openings and shall cooperate with the roofing subcontractor in properly flashing and counter flashing around all curbs. Roof curbs shall be securely fastened to the roof deck in accordance with details furnished by the roof curb

manufacturer. Top of curb shall be level. .2 Contractor shall anchor ventilators to curbs with stainless steel or cadmium plated screw or bolts 12'' on centers on each side of curbs, or as recommended by the curb manufacturer. Strip flashing, roofing cement and finished roofing will be furnished and installed by the Roofing Subcontractor.

D. Roof Ventilators shall be fabricated from heavy gauge aluminum with galvanized steel support frame. Finish on ventilators shall be unpainted mill-finished aluminum.

E. The .2 Contractor shall furnish and install backdraft dampers of type herein specified.

F. Gravity type roof ventilators shall be similar to the "Fabra-Hood" square or rectangular type as manufactured by the Greenheck Fan Corp. or approved equivalent. Ventilators shall be complete with curb base ½'' by ½'' galvanized steel or aluminum bird screen, and shall be of the very low profile type.

G. Type B-1 gravity type roof ventilators shall be connected to ducts provided with watertight depressions.

H. Type B-2 gravity roof ventilator shall have galvanized steel metal drip pan suspended under The ventilator base. Pan shall be formed of No. 20 galvanized sheet metal, with bottom cross-broken and the rim turned up 1-1/2''. Top edge of rim shall be hemmed, all corners lapped and soldered. Hangers shall be of No. 20 gauge, galvanized sheets, 1-1/2'' wide, with edges beaded, riveted to each corner and anchored to the building construction. Coat bottom and sides of drip pan with Bitumastic.

I. Provide drip pan with a ¾'' Type "K" copper tubing sweat connection for extension of drain line by the .3 Contractor.

2.08 ROUND SUPPLY AND RETURN AIR DIFFUSERS

A. Acceptable Manufacturers

1. Krueger Model RM2PLQ (Basis of Design)
2. Anemostat
3. Price
4. Titus
5. Equal as approved by the Professional

B. The architectural round ceiling diffuser shall have a removable plaque core supported by a safety cable to provide ease of installation and maintenance for all neck sizes.

C. The center plaque assembly shall be adjustable to provide three different discharge settings from horizontal to vertical and easily removable using a spring locking mechanism.

D. The center plaque assembly shall be supported by a safety cable to provide ease of installation and maintenance.

E. Round outer cone shall be constructed of 18-gage steel and a heavy gage aluminum plaque face.

F. The manufacturer shall provide published (printed or electronic) performance data for the diffuser. The diffuser shall be tested in accordance to the data standards at the time of product introduction or ANSI/ASHRAE Standard 70.

G. The paint finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The paint thickness shall be 0.8 – 1.0 mils, gloss at 60° per ASTM D523-89 of 50 – 85%, pencil hardness per ASTM D3363-92A of HB – H, crosshatch adhesion per ASTM D3359-83 of 4B – 5B, impact per ASTM D2794-93 of direct impact >100 in/lb and reverse impact >80 in/lb, salt spray per ASTM B117-9048 of 96 hours, humidity per ASTM D2247-92 of >500 hours and water soak per ASTM D870-92 of 250 hours. Color shall be as selected by the Professional.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation per manufacturers recommendations.

B. All diffusers, grilles, and registers shall be sealed at their neck connections to the ductwork.

END OF SECTION

SECTION 235100

BREECHING AND STACKS – INSULATED

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provision of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SUMMARY

A. This Section includes the following:

1. Listed double-wall vents.

1.04 SUBMITTALS

A. Product Data for the following:

1. Boiler breeching.
2. F.G.R. (Flue Gas Regulation) duct.
3. Equal as approved by the Professional

B. Shop Drawings: Shop Drawings: For vents, breechings, chimneys and stacks. Include plans, elevations, sections, details and attachments to other work.

C. Welding certificates.

D. Warranties: Special warranties specified in this section.

1.05 QUALITY CONTROL

A. Source Limitations: Obtain listed system components through one (1) source from a single manufacturer.

B. Welding: Qualify processes and operators according to A.W.S. D1.1, “Structural Welding Code-Steel,” for hangers and supports and A.W.S. D9.1, “Sheet Metal Welding Code,” for shop and field welding of joints and seams in vents, breechings and stacks.

C. Codes and Standards:

1. N.F.P.A.: Comply with N.F.P.A. 211 “Standard for Chimney’s, Fireplaces, Vents and Solid Fuel Burning Appliances.”
2. U.L.: Comply with applicable portions of U.L. safety standards; provide products which have been U.L. listed and labeled.
3. S.M.A.C.N.A.: Comply with S.M.A.C.N.A. Low Pressure Duct Standards for fabricated breeching and smoke pipe.
4. A.S.H.R.A.E.: Comply with the A.S.H.R.A.E. Equipment Handbook, Chapter 27, for Chimney, Gas Vent, Fireplace Systems, and material requirements and design criteria.

D. Certified Sizing Calculations: Manufacturer shall certify venting system sizing calculations.

1.06 WARRANTY

A. The flue systems shall be warranted against functional failure due to defects in material and manufacturer’s workmanship for a period of ten (10) years from date of delivery. For the warranty to be in effect the following two (2) actions must be performed by the contractor.

B. Drawings showing the actual layout and drawn to scale, shall be provided by the manufacturer. The system shall be installed as designed by the manufacturer and in accordance with the terms of the manufacturer’s ten (10) year warranty and in conjunction with sound engineering

practice.

C. The inner diameter for flue system shall be verified by the manufacturer's computations. The computation shall be technically sound, shall follow A.S.H.R.A.E. calculation methods and incorporate the specific flow characteristics of the inner pipe. The Client Agency shall furnish the exact appliance operating characteristics to the factory representative. Operating characteristics shall include flue gas flow rate, BTU input, outlet temperature, local altitude, stack layout and available external pressure at boiler outlet etc. necessary to determine system operation at maximum and minimum levels of burner turndown range.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Manufacturers: Subject to compliance with requirements, provide products by one (1) of the manufacturers specified.

2.02 LISTED TYPE VENTS

A. Manufacturers:

1. Van Packer Co.
2. Ampco.
3. Security Chimneys International, division of Lennox.
4. Selkirk
5. Equal as approved by the Professional

B. Flues/breeching and F.G.R. duct shall be dual wall construction. Inner wall shall be 316 stainless steel and outer wall shall be aluminized steel. Inner wall shall have a 1" insulation space to outer wall. The 1" inner space shall be factory packed with ceramic wool insulation. The system shall be laboratory tested and listed by Underwriters' Laboratories for outer pipe surface temperature.

C. Outer jacket shall be aluminized steel. All sections exposed to the outdoors will have a 304 stainless steel jacket.

D. Thickness of outer casing 0.034" for 6" to 24" diameter, 0.048" for larger diameters. Thickness of inner liner shall be 0.035" for all diameters.

E. System must be capable of handling equipment which produces exhaust flue gas at a temperature not exceeding 1000˚F under continuous operation, and 1400˚F under intermittent operation conditions.

F. The flue system shall be designed and installed to be gas tight and thus prevent leakage of combustion of products. The flue shall be listed under U.L. 103 for 60" w.c. pressure without the use of sealants on the outer jacket. The system design shall compensate for all flue gas induced thermal expansion.

G. The inner pipe joints shall be sealed by use of overlapping Type V bands with a premix 2000˚F sealant. The outer channel bands shall be sealed with a 600˚F sealant.

H. Sealing: R.T.V. high temperature silicone sealant for flue gas temperatures up to 600˚F. Sauereisen #33 ceramic joint cement or equivalent for flue gas temperatures over 600˚F.

I. When installed according to the manufacturer's installation instructions the flue and its supporting system shall resist side loads at least 1.5 times the weight per foot of the flue. Wall supports shall support 40' of vertical flue with a factor of safety of at least four (4). Plate supports shall support 200' of vertical flue in 6" through 20" I.D. sizes, 100' of vertical flue in 24" I.D. and larger sizes with a factor of at least four (4). The maximum distance between lateral supports for horizontal flue shall be 10' for 6" through 12" I.D. sizes and 15' for over 12" I.D.

J. Fabricate flues and breeching with fittings and accessories required.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Furnish and install flue from the outlets of the gas appliance to the exit point.

B. Locate to comply with minimum clearances from combustibles and minimum termination heights according to produce listing or N.F.P.A. 211, N.F.P.A. 31, N.F.P.A. 54, whichever is most stringent.

C. Seal between sections of positive pressure vents according to manufacturer's written installation instructions, using sealants recommended by manufacturer.

D. Support flues at intervals recommended by manufacturer to support weight of sections and all accessories, without exceeding appliance leading.

E. Slope flues down in direction of appliance, with condensate drain connection at lowest point piped to nearest drain. Provide trap in drain piping.

F. Join sections with acid-resistant joint cement to provide continuous joint and smooth interior finish to A.S.T.M. C105.

G. Erect flues plumb to finished tolerance of no more than 1" out of plumb from top to bottom.

H. Install slip joints allowing removal of appliances without removal or dismantling of flue system.

I. Coordinate flashing and insulated thimble installation with roofing work.

J. Flue elbows shall be long radius type.

K. An insulating thimble shall be installed at the roof penetration with proper flashing and counter flashing installed to provide a leak proof installation.

L. All flues shall terminate a minimum of 3' above the highest roof within a 10' radius of the flue, or as required by State or Municipality Codes and by N.F.P.A. 211.

M. Coordinate interconnection to stack economizer. Refer to Specification Section 23 5150

3.03 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt and construction debris and repair damaged finishes.

B. Clean flues and combustion air piping internally, during and after installation, to remove dust and debris. Clean external surfaces.

C. Provide temporary closures at ends of flues and combustion air piping that are not completed or connected to equipment.

END OF SECTION

SECTION 235233

GAS-FIRED CONDENSING BOILERS – HOT WATER

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Bryan Bfit Condensing Boiler, Model BFIT 650. Refer to the Equipment Schedule in the Contract Drawings for the specific design and performance criteria.

B. It shall be the responsibility of the Contractor to insure that any substituted equipment is equivalent in fit, form and function to the specified equipment. The cost of any additional work caused by the substitution of equipment shall be borne by the Contractor.

C. Other acceptable manufacturers: Cleaver Brooks, Lochinvar, equal as approved by the Professional.

2.02 GENERAL REQUIREMENTS

A. Boiler

1. The boiler shall be assembled, firetested and shipped as a factory-packaged unit, complete with jacket, gas manifold, burner and controls mounted & wired, with boiler connections specified in this Section.
2. The boiler shall be constructed in conformance to ASME Section IV, ASME CSD-1 and UL 795. The boiler shall bear the ASME “H” stBfit with a maximum allowable working pressure (MAWP) of 160 PSI. Pressure vessel shall be subjected to a hydrostatic pressure test of 240 PSIG at the factory.
3. The boiler shall be an ultra-high efficiency condensing boiler with a pressure vessel, constructed of 316L stainless steel and of water tube design, which shall not require a refractory combustion chamber. Pressure vessel shall have a minimum heat transfer area of 52 square feet. Pressure vessel shall be capable of handling water flow rates between 25 gpm and 84 gpm.
4. The boiler shall be equipped with an integral pre-mix, stainless steel forced draft burner incorporating full modulation with 5:1 turndown. The burner shall be of high flame retention design and have a static swirl device to get uniform flame stability all around the combustion surface. Burner shall be equipped with a sliding guide rail with hinged door to gain full access and inspection of the burner and combustion chamber.
5. The boiler gas valve will be designed with zero pressure regulation and equipped with a variable speed blower system to precisely control the fuel/air mixture, providing fully modulating firing rates for maximum efficiency.
6. Water connections shall be located at the top of the boiler; flue gas exhaust, combustion air intake and condensate drain connections shall be located in the rear of the boiler and incoming gas connection shall be located on the left side of the boiler. A factory supplied oversized ASME relief valve shall be provided with the boiler(s).
7. The flue passages and combustion chamber shall be accessible from the front of the boiler for cleaning.

8. The boiler shall be provided with a heavy duty 16 gauge steel jacket with a rust resistant powder coat finish. Jackets made of plastic or resin material shall not be acceptable. The boiler jacket shall contain an internal electrical cabinet for power and limit circuit wiring, providing a clean finished look when the jacket is installed. Electrical connections shall be accessible from top and/or left-side of the boiler on five (5) printed circuited boards (120VAC high and 24VAC/5VDC low voltage) with fused connections for protection and clear labeling for simple and accurate wiring.
    a. The electrical components shall be separated from incoming combustion air gas, which may contain excess humidity, dust and other contaminants brought through ducted combustion air.
9. A polypropylene condensate trap with a float-actuated shut-off switch shall be supplied with the boiler.
10. Electrical input to the boiler shall be 120v/1ph/60hz.
11. Boiler shall be capable of variable primary or primary/secondary piping arrangements.
12. The boiler shall come on a base with forklift opening all sides and lifting lugs for ease of moving and rigging.

B. Boiler Control System

1. Scope of Supply
   Boiler Control System shall provide safety interlocks and water temperature control. The control system shall be fully integrated into the boiler control cabinet and incorporate single and multiple boiler control logic, inputs, outputs and communication interfaces. The control system shall coordinate the operation of up to eight (8) fully modulating hot water boilers and circulation pumps. The control system shall simply control boiler modulation and on/off outputs based on the boiler water supply temperature and an operator-adjusted setpoint. However, using parameter menu selections, the control system shall allow the boiler to respond to remote system water temperature and outside air temperatures with domestic hot water priority (DHWP) and warm weather shut down (WWSD) or energy management system (EMS) firing rate demand, remote setpoint or remote start/stop commands. In order to support large domestic demands it shall be parameter selectable to start two boilers simultaneously in response to a DHWP demand.
2. Boiler Control
   Using PID (proportional-integral-derivative) based control, the remote system water temperature shall be compared with a setpoint to establish a target boiler firing rate. If the secondary loop flow speed is greater than the primary loop flow speed, firing rate is increased in response to the decrease in secondary loop temperature. When the remote system temperature is near the boiler high limit temperature, the boiler supply sensor shall limit the maximum boiler supply temperature to prevent boiler high limit events. Alternately, using parameter menu selections, the control system shall allow the boiler to respond directly to boiler supply temperature and setpoint to establish a target boiler firing rate while remote system water temperature is used for display purposes only. Each boiler's fuel flow control valve shall be mechanically linked to the air flow control device to assure an air rich fuel/air ratio. All the automated logic required to ensure that pre-purge, post-purge, light-off, and burner modulation shall be provided.
3. Hot Water Temperature Setpoint
   When the controller is in the local control mode, the control system shall establish the setpoint based on outside air temperature and a reset function curve, or be manually adjusted by the operator. When enabled, the setpoint shall be adjusted above a preset minimum setpoint upon sensing a domestic hot water demand contact input. When in remote mode, the control system shall accept a 4-20ma or Modbus remote setpoint or firing rate demand signal from an external EMS.
4. Multiple Boiler Sequence
   The controller shall incorporate its peer-to-peer communications on each connected boiler

(up to eight [8] units) by using standard RJ45 ethernet cables. The control system shall allow the connected boilers to exchange signals as required to provide coordinated fully modulating lead/lag functions. It shall not be required to wire individual control signals between boilers. Multiple boilers shall be modulated in “Unison” (all at the same firing rate). To increase operational efficiency, the control system shall utilize both water temperature and firing rate based boiler sequencing algorithms to start and stop the boilers and shall minimize the total number of boilers in operation. The control system shall start and stop boilers when the water temperature is outside the adjustable temperature limit for longer than the adjustable time delay. In order to minimize temperature deviations, the control system shall start and stop the next boiler when the “lead” boiler is at an adjustable firing rate limit for longer than the adjustable time delay. The control system shall monitor both boiler lockout and limit circuits to automatically skip over those boilers that are powered down for maintenance, tripped or otherwise will not start. The boiler shall be run at low fire for warm-up for a preset low fire hold time. When enabled, warm weather shut down control logic shall prevent boiler operation. The controller shall also be capable of auto-rotation of the boilers based on user-selected run time hours.

5. User Interface
   A touch screen message display shall be provided to display real time BTU/hr, numeric data, startup and shutdown sequence status, alarm, system diagnostic, first-out messages and boiler historical information. In the event of a fault condition, the display shall provide help screens to determine the cause of the problem and corrective actions. Historical information shall include graphical trends, lockout history, boiler & circulator cycle counts and run time hours.

6. Circulator Control
   The controller shall be capable of sequencg the boiler, domestic hot water or system circulators. Simple parameter selections shall allow all three pumps to respond properly to various hydronic piping arrangements including either a boiler or primary piped indirect water heater. The controller shall perform circulator exercise to help prevent pump rotor seizing.

7. EMS Communication
   Control and monitor the boiler via communication RS485 Modbus or direct wiring. The control shall allow for simultaneous communication for boiler peer-to-peer communication and EMS communication interfaces. Loss of EMS communication shall automatically transfer the boiler control to local operation. Boiler operation shall not be lost due to corrupt or loss of EMS communication. The boiler control system shall allow individual boiler limits, lockout, boiler and system temperatures and firing rate status to be readable and water setpoint, boiler firing rate, and start/stop command to be readable and writable. The control shall provide easy parameter selection and options for the following: Modulation Source (4-20ma or Modbus); Setpoint Source (4-20ma or Modbus); and Enable/Disable (contact wired or Modbus). The control shall allow a real time, live & convenient list of all interface signals to allow for quick interface verification.

8. External Data Transfer

   The control system shall include the ability to transfer parameters from boiler to boiler. Upon completion of commissioning the first boiler, a USB flash drive shall allow settings to be “downloaded” from one boiler and “uploaded” into the next. Additionally, these files shall be able to be sent via email and “uploaded” to a remote technical support system. Additionally, it shall be possible to restore parameters to the “as shipped state” by selecting a “Factory Default” Button.

9. Archive History

   All hard lockouts, soft lockouts (holds), sensor faults, Energy Management System (EMS) signal faults, sequencer faults and limit string faults shall be recorded with a time and date stBfit. The time and date log shall stores up to 3000 alarm & events even after power

cycle." The alarm & event log must be downloadable to a USB thumb drive. The control shall include collect and store supply & return temperature, flame intensity and firing rate for at least 4 months. It shall be a simple matter to page through the boiler's operation using the boiler mounted display or download the historical data to a USB thumb drive for off-site analysis. All data must be stored in standardly compatible CRV files.

10. Quality Assurance

    The boiler control system shall be supplied as part of a factory-assembled and tested burner control cabinet.

C. Boiler Trim

1. Combination pressure-temperature gauge, 3-1/2 inch diameter.
2. Supply and return temperature sensors - shall be mounted on the supply and return connections outside of the boiler jacket. Each sensor shall be accessible from the top of the boiler. The boiler control shall measure supply and return temperatures and notify the operator if the direction of flow is reversed.
    a. The boiler control shall adjust to impending temperature changes in such a way to minimize fuel consumption and maximize efficiency. The control shall measure temperatures and the rate of change in those temperatures and respond early, rather than waiting for temperatures to exceed limit control settings.
3. Flue gas temperature sensor shall be mounted in the flue vent connector to monitor flue gas temperatures and reduce the blower speed when flue gas temperatures exceed 189°F. If the flue temperatures exceed 195°F, a forced boiler recycle results.
4. ASME Section IV safety relief valve sized to exceed the gross output of the boiler which shall be factory set to relieve pressure at 75 psig water working pressure.
5. Water flow switch to prevent the burner operation during low water flow conditions.
6. High Temperature Limit, automatic and manual reset, to prevent burner operation if water temperature conditions rise above maximum boiler design temperature, wired to put the boiler into a hard lockout, requiring manual reset of the boiler primary control.
7. High and low gas pressure switches with manual reset and a range of 4 - 14 in W.C., wired to put the boiler into a hard lockout, requiring manual reset of the boiler primary control.
8. Low water cutoff (LWCO) device with manual reset. Boiler shall be fitted with a probe type LWCO located above the lowest safe permissible water level established by the boiler manufacturer. LWCO shall be UL listed and suitable for commercial hydronic heating service.

D. Vent & Intake Air Connections

1. The exhaust vent must be UL 1738 listed for use with Category II and IV appliances and compatible with operating temperatures up to 210°F, positive pressure, condensing flue gas service. UL certified vent material shall be CPVC, Polypropylene or Stainless Steel.
2. The exhaust vent system shall be in accordance with National Fuel Code, NFPA 54/ANSI Z221.3 or CAN/CSA B149.1 Installation Code for Canada, or, applicable provisions of local building codes.
3. Combustion air intake shall be capable of drawing air from inside the room or ducted from outdoors. Ducted piping shall be PVC or galvanized smoke pipe that is sealed and pressure tight. Pipe must be at least the same size as the inlet air connection on the boiler.
4. Combustion air intake shall be connected into the boiler vestibule NOT directly into the boiler blower assembly. Combustion air shall be preheated by passing around the exterior of the boiler furnace section before entering the pre-mix gas/air assembly.
5. Boiler shall be capable of common venting with an engineered vent system.

6. Venting shall have an equivalent length of up to 200 feet maximum when drawing air from inside the room or Venting shall have an equivalent length of up to 100 feet maximum and ducted combustion intake air shall have an equivalent length of up to 100 feet maximum.

2.03 PERFORMANCE

A. Boiler thermal efficiency shall be no less than 97.0%.

B. The burner shall emit low NOx (corrected to 3% O_2) emissions at all firing rates.

C. Provide services of a manufacturer's authorized representative to perform combustion test including boiler firing rate, gas flow rate, heat input, burner manifold gas pressure, percent carbon monoxide, percent oxygen, percent excess air, flue gas temperature at outlet, ambient temperature, net stack temperature, percent stack loss, percent combustion efficiency, and heat output. Perform test at minimum, mid-range, and high fire.

2.04 EMERGENCY SHUTDOWN SYSTEM

A. Furnish and install at each internal and external door exit from the boiler room, a break glass push button station equal to Allen-Bradley Bulletin 800T-NX114. Station shall have bright red finish, hammer with attaching chain and name plate reading "TO OPERATE, BREAK GLASS TO STOP BOILER".

B. The break glass stations shall be series wired to a new multi-pole relay in NEMA 1 enclosure. The relay contacts shall be wired into the burner limit circuit of the new boiler and existing water heaters.

C. An additional relay contact shall close to energize an Edwards No. 52 AdaptaBeacon with rotating light in an amber color lens. Beacon shall be mounted near the ceiling at a point relatively common to all equipment. This beacon will alert operator that multi-pole relay is de-energized.

2.05 COMBUSTION AIR DAMPER OPEN SWITCH

A. This Contractor shall provide and install for each boiler unit and domestic water heater a mercury wetted tip switch for positive proof that the combustion air dampers are in the open position prior to unit firing sequence. Switch shall be rated for no less than 15 amp A.C. and shall be affixed directly to one of the damper blades.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install boiler per manufacturers recommendations.

3.02 INSTRUCTION AND SERVICE

A. The boiler vendor, through the Contractor, shall furnish a start-up Professional to provide complete and detailed instruction for the operating personnel in the proper operation, care, and maintenance of all equipment. All required free service and maintenance of the first complete heating season shall be provided by this Contractor.

B. After each burner and combustion control system has been placed in operation, all equipment shall be adjusted for maximum combustion efficiency. In the process of effecting these adjustments, a combustion efficiency test shall be conducted with the use of an absorption type analyzer capable of measuring carbon dioxide, oxygen, and carbon monoxide. This test shall continue for the length of time necessary to adjust the burner for maximum efficiency at 100, 75, 50, and 25 percent of rating. Stack temperature, overfire draft, carbon dioxide, and oxygen shall be recorded. A written report of the combustion test shall be rendered, in duplicate, to the Professional.

C. As part of his boiler submittals, the successful .2 contractor shall include the name, address and phone of the boiler supplier from whom he proposes to obtain the boilers. The Professional reserves the right to approve, or disapprove, the submittals based solely on the information pertaining to the boiler supplier, regardless of the manufacturer of the boilers themselves. This method of submittal review will serve to assure all of the following:

1. The proper boiler equipment, including trim and accessories, has been submitted.
2. The boiler supplier will be able to provide all of the proper service and maintenance requirements 24 hour / 7 day per week / 365 day per year accessibility, adequate local parts inventory, adequate factory-trained personnel, minimum 5 year history of quality service within the boiler industry, etc.
3. The proper warranties will be obtainable.
4. Random selection of a boiler supplier not associated with the project will be curtailed, so as not to circumvent the **proper** boiler supplier's involvement.

D. The boiler supplier shall be responsible for supplying to the .2 Contractor a comprehensive, interconnecting wiring diagram, which shall indicate all terminal connections for items such as the boiler(s), Emergency Shutdown Switch, Draft Sequencing Controls, combustion air damper, Cycle Minimizer, A.T.C., circulating pumps, and any other electrically-powered devices directly related to the operation of the boiler(s).

E. The boiler supplier shall also be responsible for physically wiring all **control** devices described above within the boiler room. The wiring responsibility shall begin at the transition point where the .4 Contractor provides **power** wiring in the boiler room. The boiler supplier shall assume all responsibility in resolving any **conflicts** within the overall wiring schematics as they pertain to the boiler room.

END OF SECTION

SECTION 236416

CENTRIFUGAL WATER COOLED CHILLERS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

PART 2 - PRODUCTS

2.01 GENERAL

A. Acceptable Manufacturers:

1. York MAXE (Basis of Design)
2. Trane
3. Carrier
4. Equal as approved by the Professional

B. The YORK MAXE Centrifugal Liquid Chillers are completely factory-packaged including the evaporator, condenser, compressor, motor, lubrication system, control center, and all interconnecting unit piping and wiring.

C. The initial charge of refrigerant and oil is supplied for each chiller. Condenser isolation valves are required. The unit will ship fully charged with refrigerant and oil. Actual shipping procedures will depend on a number of project-specific details.

D. The services of a YORK factory-trained, field service representative are incurred to supervise or perform the final leak testing, charging, the initial start-up, and concurrent operator instructions. The factory trained field service representative shall provide 16 hours of training to operating personnel.

2.02 COMPRESSOR

A. The compressor is a single-stage centrifugal type powered by an open-drive electric motor. The casing is fully accessible with vertical circular joints and fabricated of close-grain cast iron. The complete operating assembly is removable from the compressor and scroll housing.

B. The rotor assembly consists of a heat-treated alloy steel drive shaft and impeller shaft with a high strength, cast aluminum alloy, fully shrouded impeller. The impeller is designed for balanced thrust and is dynamically balanced and overspeed tested for smooth, vibration free operation.

C. The insert-type journal and thrust bearings are fabricated of aluminum alloy and are precision bored and axially grooved. The specially engineered, single helical gears with crowned teeth are designed so that more than one tooth is in contact at all times to provide even distribution of compressor load and quiet operation. Gears are integrally assembled in the compressor rotor support and are film lubricated. Each gear is individually mounted in its own journal and thrust bearings to isolate it from impeller and motor forces.

2.03 CAPACITY CONTROL

A. Pre-rotation vanes (PRV) modulate chiller capacity from 100% to 15% of design for normal air conditioning applications. Operation is by an external, electric PRV actuator which automatically controls the vane position to maintain a constant leaving chilled liquid temperature. Rugged airfoil shaped cast manganese bronze vanes are precisely positioned by solid vane linkages connected to the electric actuator.

2.04 LUBRICATION SYSTEM

A. Lubrication oil is force-fed to all bearings, gears and rotating surfaces by a variable speed drive pump which operates prior to startup, continuously during operation and during coastdown. A gravity-fed oil reservoir is built into the top of the compressor to provide lubrication during coastdown in the event of a power failure.

B. An oil reservoir, separate from the compressor, contains the submersible oil pump, 2 HP pump motor and 3000 watt immersion-type oil heater. The oil heater is thermostatically controlled to remove refrigerant from the oil.

C. Oil is filtered by an externally mounted 1/2 micron replaceable cartridge oil filter equipped with service valves. Oil is cooled via a refrigerant-cooled oil cooler, eliminating the requirement for field water piping. The oil side of the oil cooler is provided with service valves. An automatic oil return system recovers any oil that may have migrated to the evaporator. Oil piping is completely factory-installed.

2.05 MOTOR DRIVELINE

A. The compressor motor is an open drip-proof, squirrel cage, induction type constructed to YORK design specifications. 60 hertz motors operate at 3570 rpm. 50 hertz motors operate at 2975 rpm.

B. The open motor is provided with a D-flange, and is factory-mounted to a cast iron adaptor mounted on the compressor. This unique design allows the motor to be rigidly coupled to the compressor to provide factory alignment of motor and compressor shafts.

C. Motor drive shaft is directly connected to the compressor shaft with a flexible disc coupling. Coupling has all metal construction with no wearing parts to assure long life, and no lubrication requirements to provide low maintenance.

D. For units utilizing remote electro-mechanical starters, a large, steel terminal box with gasketed front access cover is provided for field-connected conduit. There are six terminals (three for medium voltage) brought through the motor casing into the terminal box. Jumpers are furnished for three-lead types of starting. Motor terminal lugs are not furnished. Overload/over-current trans form ers are fur nished with all units. For units furnished with factory-packaged Variable Speed Drive, refer to the Accessories and Modifications Section.

2.06 HEAT EXCHANGERS

A. Shells - Evaporator and condenser shells are fabricated from rolled carbon steel plates with fusion welded seams. Carbon steel tube sheets, drilled and reamed to accommodate the tubes, are welded to the end of each shell. Intermediate tube supports are fabricated from carbon steel plates, drilled and reamed to eliminate sharp edges, and spaced no more than four feet apart. The refrigerant side of each shell is designed, tested, and stamped in accordance with ASME Boiler and Pressure Vessel Code, Section VIII – Division I, or other pressure vessel code as appropriate.

B. Tubes - Heat exchanger tubes are state-of-the-art, high-efficiency, externally and internally enhanced type to provide optimum performance. Tubes in both the evaporator and condenser are 3/4" O.D. copper alloy and utilize the “skip-fin” design, providing a smooth internal and external surface at each intermediate tube support. This provides extra wall thickness (up to twice as thick) and non work-hardened copper at the support location, extending the life of the heat exchangers. Each tube is roller expanded into the tube sheets providing a leakproof seal, and is individually replaceable.

C. Evaporator - The evaporator is a shell and tube, flooded type heat exchanger. A distributor trough provides uniform distribution of refrigerant over the entire shell length to yield optimum heat transfer. A suction baffle or aluminum mesh eliminators are located above the tube bundle to prevent liquid refrigerant carryover into the compressor. A 1-1/2" liquid level sight glass is conveniently located on the side of the shell to aid in determining proper refrigerant charge. The evaporator shell contains a dual refrigerant relief valve arrangement set at 180 PSIG as the chiller must be supplied with the optional refrigerant isolation valves. A 1" refrigerant charging valve is provided.

D. Condenser - The condenser is a shell and tube type, with a discharge gas baffle to prevent direct high velocity impingement on the tubes. The baffle is also used to distribute the refrigerant gas flow properly for most efficient heat transfer. An integral sub-cooler is located at the bottom of the condenser shell providing highly effective liquid refrigerant subcooling to provide the highest cycle efficiency. The

condenser contains dual refrigerant relief valves set at 235 PSIG (1620 kPa).

D. Marine Water Boxes - The removable water boxes are fabricated of steel. The design working pressure is 150 PSIG (1034 kPa) and the boxes are tested at 225 PSIG (1551 kPa). Integral steel water baffles are located and welded within the water box to provide the required pass arrangements. Stub-out water nozzle connections with Victaulic grooves are welded to the water boxes. These nozzle connections are suitable for Victaulic couplings, welding or flanges, and are capped for shipment. Plugged 3/4" drain and vent connections are provided in each water box. Connection arrangements for each chiller shall be as shown on the contract documents.

2.07 WATER FLOW SWITCHES

A. Thermal type water flow switches are factory mounted in the chilled and condenser water nozzles, and are factory wired to the Optiview control panel. These solid state flow sensors have a small internal heating element. They use the cooling effect of the flowing fluid to sense when an adequate flow rate has been established. The sealed sensor probe is 316 stainless steel, which is suited to very high working pressures.

2.08 REFRIGERANT FLOW CONTROL

A. Refrigerant flow to the evaporator is controlled by the YORK variable orifice control system. Liquid refrigerant level is continuously monitored to provide optimum subcooler, condenser and evaporator performance. The variable orifice electronically adjusts to all Real-World operating conditions, providing the most efficient and reliable operation of refrigerant flow control. Units with fixed refrigerant flow control orifices, controlling refrigerant flow to the evaporator, are not acceptable.

2.09 OPTIVIEW CONTROL CENTER

A. The chiller is controlled by a stand-alone microprocessor based control center. The chiller control panel provides control of chiller operation and monitoring of chiller sensors, actuators, relays and switches.

B. The control panel includes a 10.4-in. diagonal color liquid crystal display (LCD) surrounded by “soft” keys which are redefined based on the screen displayed at that time, mounted in the middle of a keypad interface and installed in a locked enclosure. The screen details all operations and parameters, using a graphical representation of the chiller and its major components. Panel verbiage is available in other languages as an option, with English always available. Data can be displayed in either English or Metric units. Smart Freeze Point Protection will run the chiller at 36°F (2.2°C) leaving chilled water temperature, and not have nuisance trips on low water temperature. The sophisticated program and sensor monitors the chiller water temperature to prevent freeze-up. Hot Gas Bypass is reequired. The panel displays countdown timer messages so the operator knows when functions are starting and stopping. Every programmable point has a pop-up screen with the allowable ranges, so that the chiller can not be programmed to operate outside of its design limits.

C. The chiller control panel also provides:

1. System operating information including:
    a. return and leaving chilled water temperature
    b. return and leaving condenser water temperature
    c. evaporator and condenser saturation temperature
    d. differential oil pressure e. percent motor current
    f. evaporator and condenser saturation temperature
    g. compressor discharge temperature h. oil reservoir temperature
    i. compressor thrust bearing positioning (J & H3 compressors only)
    j. operating hours
    k. number of compressor starts
2. Digital programming of setpoints through the universal keypad including:
    a. leaving chilled water temperature
    b. percent current limit

c. pull-down demand limiting
d. six-week schedule for starting and stopping the chiller, pumps and tower
e. remote reset temperature range

3. Status messages indicating:
   a. system ready to start
   b. system running
   c. system coastdown
   d. system safety shutdown – manual restart
   e. system cycling shutdown – auto restart
   f. system prelube
   g. start inhibit
4. The text displayed within the system status and system details field must be displayed as a color-coded message to indicate severity: red for safety fault, orange for cycling faults, yellow for warnings, and green for normal messages.
5. Safety shutdowns enunciated through the display and the status bar, and consist of system status, system details, day, time, cause of shutdown, and type of restart required. Safety shutdowns with a fixed speed drive include:
   a. evaporator – low pressure
   b. evaporator – transducer or leaving liquid probe
   c. evaporator – transducer or temperature sensor
   d. condenser – high pressure contacts open
   e. condenser – high pressure
   f. condenser – pressure transducer out-of-range
   g. auxiliary safety – contacts closed
   h. discharge – high temperature
   i. discharge – low temperature
   j. oil – high temperature
   k. oil – low differential pressure
   l. oil – high differential pressure
   m. oil – sump pressure transducer out-of-range
   n. oil – differential pressure calibration
   o. oil – variable speed pump – pressure setpoint not achieved
   p. control panel – power failure
   q. motor or starter – current imbalance
   r. thrust bearing – proximity probe clearance (J & H3 compressors only)
   s. thrust bearing – proximity probe out-of-range (J & H3 compressors only)
   t. thrust bearing – position switch (P, Q & H5-H9 compressors)
   u. watchdog – software reboot
6. Safety shutdowns with a VSD include:
   a. VSD shutdown – requesting fault data
   b. VSD – stop contacts open
   c. VSD – 105% motor current overload

d. VSD – high phase A, B, C inverter heatsink temp.
e. VSD – high converter heatsink temperature
f. harmonic filter – high heatsink temperature
g. harmonic filter – high total demand distortion

7. Cycling shutdowns enunciated through the display and the status bar, and consists of system status, system details, day, time, cause of shutdown, and type of restart required.

   Cycling shutdowns with a fixed speed drive include:

   a. multi unit cycling – contacts open
   b. system cycling – contacts open
   c. oil – low temperature differential
   d. oil – low temperature
   e. control panel – power failure
   f. leaving chilled liquid – low temperature
   g. leaving chilled liquid – flow switch open
   h. motor controller – contacts open
   i. motor controller – loss of current
   j. power fault
   k. control panel – schedule
   l. starter – low supply line voltage (SSS option)
   m. starter – high supply line voltage (SSS option)
   n. proximity probe – low supply voltage (J & H3 Compressor)
   o. VSD – initialization failed
   p. VSD – high phase A, B, C instantaneous current
   r. VSD – phase A, B, C gate driver
   s. oil – variable speed pump – drive contacts open

8. Cycling shutdowns with a VSD include:

   a. VSD shutdown – requesting fault data
   b. VSD – stop contacts open
   c. VSD – single phase input power
   d. VSD – high DC bus voltage
   e. VSD – precharge DC bus voltage imbalance
   f. VSD – high internal ambient temperature
   g. VSD – invalid current scale selection
   h. VSD – low phase A, B, C inverter heatsink temp.
   i. VSD – low converter heatsink temperature
   j. VSD – precharge – low DC bus voltage
   k. VSD – logic board processor
   l. VSD – run signal
   m. VSD – serial communications (Filter Option Only)
   n. harmonic filter – logic board or communications
   o. harmonic filter – high DC bus voltage

p. harmonic filter – high phase A, B, C current
q. harmonic filter – phase locked loop
r. harmonic filter – precharge – low DC bus voltage
s. harmonic filter – DC bus voltage imbalance
t. harmonic filter – 110% input current overload
u. harmonic filter – logic board power supply
v. harmonic filter – run signal
w. harmonic filter – DC current transformer 1
x. harmonic filter – DC current transformer 2

9. Security access to prevent unauthorized change of setpoints, to allow local or remote control of the chiller, and to allow manual operation of the prerotation vanes and oil pump. Access is through ID and password recognition, which is defined by three different levels of user competence: view, operator, and service.
    a. Trending data with the ability to customize points of once every second to once every hour. The panel will trend up to 6 different parameters from a list of over 140, without the need of an external monitoring system.
10. The operating program stored in non-volatile memory (EPROM) to eliminate reprogramming the chiller due to AC power failure or battery discharge. Programmed setpoints are retained in lithium battery-backed RTC memory for a minimum of 11 years with power removed from the system.
11. A fused connection through a transformer in the compressor motor starter to provide individual overcurrent protected power for all controls.
12. A numbered terminal strip for all required field interlock wiring.
13. An RS-232 port to output all system operating data, shutdown/cycling message, and a record of the last 10 cycling or safety shutdowns to a field-supplied printer. Data logs to a printer at a set programmable interval. This data can be preprogrammed to print from 1 minute to 1 day.
14. The chiller shall include Bacnet MSTP interface to the building automation system to provide read/write functions to all chiller read/write points.

2.10 CODES AND STANDARDS

A. ASME Boiler and Pressure Vessel Code – Section VIII Division 1.
B. ARI Standard 550/590
C. U.L. – Underwriters Laboratory
D. ASHRAE 15 – Safety Code for Mechanical Refrigeration
E. ASHRAE Guideline 3 – Reducing Emission of Halogenated Refrigerants in Refrigeration and Air-Conditioning Equipment and Systems
F. N.E.C. – National Electrical Code
G. OSHA – Occupational Safety and Health Act

2.11 FACTORY PERFORMANCE TESTING

A. A two (2) day factory performance test will be performed in accordance with the specified points on the contract documents. This is a test to demonstrate submitted unit performance and shall run for four (4) hours uninterrupted at maximum and minimum specified performance.

2.12 MEDIUM VOLTAGE VARIABLE SPEED DRIVE FOR CENTRIFUGAL CHILLERS

A. Related Standards
    1. National Electrical Code (NEC), ANSI/NFPA-70.
    2. Underwriters Laboratories Standard UL 347, UL 347B.

3. Canadian Standards Association (CSA) Std. C22.2 No. 14-91
4. IEC Standards EN61000-5-4:2001, EN61000-6-4:2001, EN60204-1:1998, EN60204-11:2001.
5. NEMA Standards, Industrial Controls and Systems, Pub. No. ICS
6. NEMA Standards, Motors and Generators, Pub. No. MG1
7. CE Drawings 024-24056D, 0024-26513D, 024-26514D, 024-27800D and 024-27801D Motors, Open, D Flange.
8. CE Drawing 024-26516D, Motors, Open (Based mounted).
9. CE Standard R-1018: Motors, Open, HP Rated.
10. CE Standard C-143: Motors, Open, D-Flange.
11. FCC Part 15 Subpart J
12. CE Product Specification Medium Voltage Variable Speed Drives

B. Requirements

1. Code Agencies - York Medium Voltage Variable Speed Drives (MVVSD) supplied under this standard must comply with the requirements of the NEC, ANSI/NFPA, IEC, and NEMA standards as referenced in paragraph 2 of this standard, must have UL/cUL listing and must carry the CE mark. On points of difference with the above referenced standards and codes, the requirements of this standard shall prevail.
2. Specifications - Pertinent standard MVVSD specifications are as follows –
    a. MVVSD Type: Variable Speed Drive NEMA 1 cabinet, IP20 & IEC-529 rated, gasketed, & filtered air cooled.
    b. York Model Number nomenclature – see figure 3.3(b).
    c. Permissible voltage dip up to 10% of standby voltage
    d. Line frequency tolerance 50/60 Hz + 2Hz
    e. Phase voltage imbalance + 3% maximum. Maximum rate of change of input voltage (generator applications) is 10 Hz/second.
    f. The unit shall be suitable for use on a circuit capable of delivering not more than 50KA RMS symmetrical amperes at the nameplate voltage.
    g. Efficiency: 96.0%.
    h. The fundamental power factor shall be .95 typical or greater at full load.
    i. The unit shall automatically restart with power interruptions greater than one cycle provided the run command from the system control panel remains asserted.
    j. The unit per phase input current THD (total harmonic distortion) shall not exceed 5% over the operating range of 30% to 100% of rated output power.
    k. The unit shall provide output voltage equal to fundamental input RMS voltage ±2% at nominal 4160V input voltage.
    l. The unit shall include a unit mounted load break rated input disconnect switch with interlocked, padlockable handle. Positive disconnecting means shall be visible from the outside of the enclosure, in the operator area. All doors shall be interlocked with the disconnecting means.
    m. Unit output voltage rate of change shall not exceed 5000 volts per microsecond at 4160 volts. Motor peak voltage line to line and line to ground shall not exceed 136% of peak nominal voltage. Voltage rise/fall time between motor terminals or between motor terminals and ground shall not exceed.0.4 microsecond.
    n. Wiring length from drive to motor shall not exceed 500 feet.
    o. Units switching frequency shall be 2KHz nominal

p. Output frequency range shall be 30Hz to 60Hz on 60Hz output applications. Frequency error shall be ±0.5Hz

q. The unit overload shall be 105% of full load for 40 seconds.

r. The unit shall be capable of safely tripping off without component damage if an output line is grounded. Unit shall be capable of starting into an output short circuit without damage. If the unit attempts to start with the driveline in a locked rotor condition the unit shall trip on an over current safety and shall require manual restart.

s. The unit shall be capable of operating with continuous vibration levels of 0.5G or less, 10 to 60Hz.

t. The unit shall carry a sound rating as follows: The A-weighted sound pressure level shall not exceed 80 dBA at a distance of 3.3 feet from the unit, and at a height of 5 feet from the floor, on each of the four sides of the unit.

u. The unit shall include distribution class surge arrestors to protect the starter system against voltage surges.

v. The unit shall include a Control Power Transformer, rated at 115VAC nominal (earth grounded neutral), 2.0KVA and fused with 20A, Class CC fuses. Maximum operating tolerance of the control supply shall be 100 to 130 VAC over all line and load conditions, including dip voltage (+10%, -15% about nameplate voltage rating).

w. The unit shall be capable of operating continuously over a temperature range of 0° to 40° C. The storage temperature range shall be -20° to 70° C.

x. The unit shall be capable of continuous operation up to a maximum altitude of 5000 ft. without de-rating.

y. The unit shall be capable of operating with humidity of 95% non-condensing.

z. Input transformer is to include thermal over-temperature sensing means.

3. Enclosure – The enclosure for the starter shall be NEMA 1, IP 20 & IEC-529 rated. The door hinges shall provide total service access and allow a minimum 90° door opening.

   a. Unit fans are to be ball bearing type with a life expectancy of 10 years. Filters are to be cleanable and reusable. Filters are to be accessible from outside the enclosure and replaceable while unit is running.

   b. The units cooling fans will be energized when the unit is running and de-energized when the unit stops.

   c. Input/Output Connection means shall be available through both top or bottom access. All Input and Output busbars used within the drive shall either be tin or nickel plated copper.

   d. This unit to be packaged and shipped as one unit below Hp ratings of 1000/4160V, with no breakdown required for shipping. Lifting provisions shall be via slots at the bottom of the enclosures, for use with forklift or slings. Fans are shipped loose.

4. Control Circuit Wiring - Control circuit wiring and terminal blocks shall be provided as described in section 3.7. Cover plates shall be provided for control and oil pump wiring to the internal oil pump fused power supply (optional – see section 3.12.

5. Power Wiring Terminations, Entrance, Exit & Marking – The unit's line side terminals shall be marked "L1", "L2" and "L3". The unit's line side earth connection shall be marked "GRD". The unit's load side terminals shall be marked "T1", "T2" and "T3". The unit's load side earth connection shall be marked "GRD". Both line and load side terminals shall be field provided. All busbars used within the starter shall be either copper or tin/nickel plated aluminum. Input and output connection means shall be available through either top or bottom access. Cover plates shall be provided for power wiring entrance/exit. All field connections including unit assembly and options must be easily accessible when the enclosure is installed.

6. Opti-view Control Panel/York MVSSS Interface -

   a. Start-stop signal - The MVVSD is actuated by two separate “Run” signal sources. Both must be asserted to initiate a system run. A 115 VAC nominal “Run” signal applied between terminals “24” and “2” from the York Control Center, and a “Run” signal generated over the serial communications link. The “Stop” function is accomplished by terminating either or both “Run” signals.

   b. Inverter Initiated Stop – The MVVSD can initiate a system stop by opening a 120 VAC “SIS” contact located within the MVSSS, present between terminals “16” and “53”. The contact is a normally open contact that is closed during normal system operation and opens to stop the system.

   c. Serial Communications Link - One serial RS-485 three-wire + shield remote powered (isolated power supplied by MVVSD) opto-coupled asynchronous data link operating at 19,200 baud. Terminal blocks within the MVSSS to be provided and labeled - “DRAIN” (shield), “WHT” RS-485+, “GRN” RS-485- & “BLK” IGND The serial communications link shall interface with the York Opti-view control center using a proprietary communications protocol, as prescribed by York ESG Engineering.

7. Motor Overload – Motor overload protection is provided within the York MVVSD. Reference section 3.3(o).

8. Control Power Transformer - A control power transformer shall be supplied in the standard unit. Reference section 3.3(t).

9. LED’s provided within the drive - See Table below:

10. Display and Status Metering – The following status parameters are conveyed to the Opti-view chiller control center for display –

    a. Motor current –

Subassembly	LED	Function
Power Cell (all ratings)	Charge	Displays presence of +/-DC link voltage – 2 per Power Cel
ModBus™ comm card	TX	RS232
ModBus™ comm card	RX	RS232
ModBus™ comm card	TX	RS485/Ethernet
ModBus™ comm card	RX	RS485/Ethernet
ARND-3126B	LD4 Red	Blinking red -healthy
ARND-3126B	LD3 TX	Green Ethernet
ARND-3126B	LD2 RX	Green Ethernet
ARND-3126B	LD1 Com	Green Ethernet
Keypad	Local remote	See manual for function
Keypad	Run	See manual for function

    b. True RMS three pb.phases of motor current (Amperes).

    c. Input Voltage – Measured total RMS voltage average of the three phases.

    d. VSD Operating Output Frequency – measured in Hertz.

    e. VSD Output Voltage – Measured fundamental voltage all three phases.

    f. VSD Input Power – KW Input power derived from output power.

    g. VSD cumulative Input Energy Consumption – KWH (capable of being zeroed)

generated by the control panel.

h. Magnitude of Job FLA – Programmable by the system control panel

i. VSD DC Link voltage – Volts.

j. VSD Pre-charge Command – On/Off

k. VSD Cooling Fans Running/Stopped

11. MVVSD Initiated System Shutdown – The York MVVSD may initiate a system shutdown. If a York MVVSD initiated shutdown occurs, a snapshot of the MVSSS status parameters shall be taken just prior to the shutdown, and this snapshot will be available for transmission to the control panel together with the root cause of the starter initiated shutdown. Non-volatile memory, with a minimum lifetime of one year shall be used to store status information in the event of a unit shutdown followed by power loss. The following starter initiated system shutdowns are generated within the MVVSD and conveyed to the Opti-view chiller control center for display –

    a. Initialization Failed

    b. Loss of Serial Communications

    c. Pre-charge Low Voltage

    d. Pre-charge Bus Voltage Imbalance

    e. Pre-charge Failure/Retry

    f. Run Relay

    g. DC Bus Overvoltage

    h. DC Bus Under-Voltage

    i. DC Bus Voltage Imbalance

    j. Over-Current Fault

    k. IGBT Gate Driver Fault

    l. Heatsink Overtemperature

    m. Single Phase Fault

    n. Motor Current Overload

    o. Power Supply Fault

    p. Output Current Imbalance Fault

    q. Power Transformer High Temperature Fault

    r. Main control Board Fault

    s. High Output Frequency

    t. Ground Fault

    u. Contactor Fault

    v. Cooling Fan Loss

    w. Interlock

12. Field Adjustments

    a. Job Full Load Amps – Adjustable 30% to 100% of the full load rating of the drive. The magnitude is sent to the drive by the system control panel.

    b. Acceleration/Deceleration – The rate of acceleration/deceleration is set by the drive at 1.5 Hz/sec for 60Hz models and 1.25Hz/sec for 50Hz drive models.

    c. Motor RMS Current Limit Threshold – set by the drive manufacturer at 110%of the drive full load output rating.

    d. No other field adjustments are required all others are factory-preset and password

protected.

13. Optional Three-Phase Fused Oil Pump Power Supply - When specified on the Purchase Order using the appropriate York P/N, a three-phase 460VAC/60 Hz or 400V/50 Hz power supply will be provided within the York MVVSD for powering the chiller oil pump system. Wiring from MVVSD to the chiller oil pump system shall be field supplied. Specifications for the options are as follows -
    a. 3 Phase, 3.6 FLA (YK chillers), 460V, 60HZ. Wiring connections to be 1TB terminal blocks, labeled -67, -68, -69, -GND. Removable plates to be provided for oil pump field wiring.

2.13 ISOLATION MOUNTING

A. The unit is provided with four spring vibration isolation mounts of nominal 1" operating height. The spring vibration isolation assemblies mount under steel plates affixed to the chiller tube sheets.

2.14 REFRIGERANT CONTAINMENT

A. The standard unit has been designed as a complete and compact factory-packaged chiller. As such, it has minimum joints from which refrigerant can leak. The entire assembly has been thoroughly leak tested at the factory prior to shipment. The YORK chiller includes service valves conveniently located to facilitate transfer of refrigerant to a remote refrigerant storage/recycling system. Optional condenser isolation valves allow storage of the charge in the condenser.

2.15 PAINT

A. Exterior surfaces are protected with one coat of Caribbean blue, durable alkyd-modified, vinyl enamel, machinery paint.

2.16 SHIPMENT

A. Protective covering is furnished on the motor starter, Control Center VSD and unit-mounted controls. Water nozzles are capped with fitted plastic enclosures. Entire unit is protected with industrial-grade, reinforced shrink wrapped covering.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install per manufacturers recommendations.

END OF SECTION

SECTION 237300

MODULAR AIR HANDLING UNITS (AHU-7 AND AHU-8)

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SECTION INCLUDES

A. Indoor and outdoor air handling units and components as scheduled and shown on drawings.

B. Motor disconnects, motor starters, and variable frequency drives.

1.03 RELATED SECTIONS

A. The requirements of the General Conditions, Supplementary Conditions, Division 1, equipment schedules, and drawings apply.

1.04 REFERENCES

A. AMCA 99 – Standard Handbook

B. AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes

C. AMCA 500 – Test Methods for Louvers, Dampers, and Shutters

D. AMCA 611-95 – Methods of Testing Airflow Measurement Stations for Rating

E. ANSI/AFBMA 9 – Load Ratings and Fatigue Life for Ball Bearings

F. ANSI/UL 900 – Test Performance of Air Filter Units

G. ARI 260 – Sound Rating of Ducted Air Moving and Conditioning Equipment

H. ARI 410 – Forced-Circulation Air Cooling and Air Heating Coils

I. ARI 430 – Testing and Rating of Central-Station Air Handling Units

J. ASHRAE 52.1/52.2 – Method of Testing General Ventilation Air Cleaning Devices for Removal Efficiency by Particle Size

K. ASHRAE 62 – Ventilation for Acceptable Indoor Air Quality

L. ASHRAE 90.1 – Energy Standard for Buildings Except Low-Rise Residential Buildings

M. ASTM-C 1338 – Standard Test Method for Determining Fungi Resistance of Insulation Material and Facings.

N. NFPA 70 – National Electric Code (conductors, equipment and raceways)

O. NFPA 90A – Installation of Air Conditioning and Ventilation Systems

P. SMACNA – HVAC Duct Construction Standards

Q. UL-181 – Mold Growth and Humidity Test

R. UL-1995 – Standard for Safety for Heating and Cooling Equipment

S. ISO/PWD 13261-3 – Sound Power Rating of air-conditioning and air-source heat pump equipment: Part 3, Ducted Equipment.

T. ISO 9614 – Determination of sound power levels of noise sources using sound intensity: Part 1, Measurement at discrete points; Part 2, Measurement by scanning, and Part 3, Precision method for measurement by scanning.

1.05 QUALITY ASSURANCE

A. Manufacturer shall have a minimum of 25 years of experience in designing, manufacturing, and servicing air-handling units.

B. The design indicated on the schedules and shown on the drawings is based upon the products of the named manufacturer. Alternate equipment manufacturers are acceptable if equipment meets scheduled performance requirements and dimensional requirements.

C. If equipment is supplied by a manufacturer other than the one named, coordinate with the .1 Contractor and affected subcontractors to ensure the specified performance is met. This coordination shall include (but is not limited to) the following:

1. Structural supports for units.
2. Size and location of concrete bases/housekeeping pads
3. Location of roof curbs, unit supports and roof penetrations
4. Ductwork sizes and connection locations
5. Piping size and connection/header locations
6. Interference with existing or planned ductwork, piping and wiring
7. Electrical power requirements and wire/conduit and over current protection sizes.
8. Trap height requirements

1.06 RATINGS AND CERTIFICATIONS

A. Air Handling Unit safety: ETL or UL 1995

B. Air Handling Unit energy use: ASHRAE 90.1

C. Fans: AMCA 210

D. Air Coils: ARI 410

E. Air Handling Unit certification program: ARI 430

F. Filter media: ANSI/UL 900 listed Class I or Class II

G. Control wiring: NEC codes & ETL requirements

H. Motors: Federally mandated Energy Policy Act (EPACT).

I. Airflow Monitoring Stations: AMCA 611-95

1.07 SUBMITTAL DOCUMENTATION REQUIRED

A. Furnish fan performance ratings and fan curves with specified operating point clearly plotted.

B. Furnish drawings indicating unit dimensions, required clearances, field connection locations, wiring diagrams, shipping drawings, and curb drawings.

C. Furnish performance report showing fan, motor, coil, and component performance details. Performance report shall detail unit casing performance and include materials, gauges, and finishes.

D. Furnish operation and maintenance data, including instructions for lubrication, filter replacement, motor and drive replacement, and condensate pan cleaning; spare parts lists, and wiring diagrams.

E. Adjust and report performance ratings for the proper altitude of operation.

F. Report air-handling unit performance ratings in accordance with ARI-430 (static pressure, airflow, fan speed, and fan brake horsepower).

G. Report static pressure profiles by component section.

H. Report coil ratings in accordance with ARI-410 (capacities and pressure drops).

I. Report and rate sound power levels in accordance with ARI-260 (ducted discharge, ducted inlet, free inlet sound).

J. Airflow measuring device performance shall be certified and rated in accordance with AMCA-611. Report data in accordance with AMCA-611. Provide AMCA Certified Rating Seal for Airflow Measurement Performance.

K. Report panel deflection at +/-8" w.g., stated in terms of 'L/X' where 'L' is the casing panel length and 'X' is a constant provided by the AHU manufacturer.

L. Report casing leakage rate at +/-8" w.g., specified in terms of percentage of design airflow.

M. Report weight loads and distributions by component section.

N. Report product data for filter media, filter performance data, filter assembly, and filter frames.

O. Report electrical requirements for power supply wiring including wiring diagrams for interlock and control wiring, clearly indicating factory-installed and field-installed wiring.

P. Report motor electrical characteristics.

1.08 DELIVERY, STORAGE AND HANDLING

A. Comply with ASHRAE 62, Section 5 (mold and corrosion resistant casings, filters upstream of wetted surfaces, and drain pan design).

B. Comply with ASHRAE 62, Section 7 (practices to be followed during construction and startup). Protect equipment from moisture by appropriate in-transit and on-site procedures.

C. Follow manufacturer's recommendations for handling, unloading and storage.

D. Protect, pack, and secure loose-shipped items within the air-handling units. Include detailed packing list of loose-shipped items, including illustrations and instructions for application.

E. Protect, pack and secure controls devices, motor control devices and other electronic equipment. Do not store electronic equipment in wet or damp areas even when they are sealed and secured.

F. Enclose and protect control panels, electronic or pneumatic devices, and variable frequency drives. Do not store equipment in wet or damp areas even when they are sealed and secured.

G. Seal openings to protect against damage during shipping, handling and storage.

H. Wrap indoor units with a tight sealing membrane. Wrapping membrane shall cover entire AHU during shipping and storage. Cover equipment, regardless or size or shape. Alternatively AHU must be tarped for shipment and storage.

I. Wrap equipment, including electrical components, for protection against rain, snow, wind, dirt, sun fading, road salt/chemicals, rust and corrosion. Keep equipment clean and dry.

J. Tarp outdoor units to protect against rain and road debris during shipping.

K. Clearly mark AHU sections with unit tag number, segment sequence number, and direction of airflow. Securely affix safety-warning labels.

1.09 EXTRA MATERIALS

A. Provide one set of filters for balancing, and one additional set for final turnover to Client Agency.

B. Provide one extra set of belts, in addition to the factory-installed set.

1.10 WARRANTY

A. Provide warranty for 18 months from date of substantial completion. Warranty shall cover manufacturer defects. Warranty work shall be performed by manufacturer's factory-trained and factory-employed technician. Service technician must be based within 50 miles of job site.

B. Include factory-provided controls in the parts warranties.

C. Parts associated with routine maintenance, such as belts and air filters shall be excluded.

1.11 SYSTEM STARTUP

A. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.

B. Comply with manufacturer's start-up requirements to ensure safe and correct operation and integrity of warranty.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Basis of Design: YORK Solution

B. Trane – PCC

C. Buffalo

D. Equal as approved by the Professional

2.02 GENERAL DESCRIPTION

A. Air Handling Unit (AHU) consists of a structural base, insulated casing, access doors, fans, motors, motor controls, coils, filters, dampers, controls, components, and accessories; as shown on drawings, schedules, and specifications.

B. Provide AHU to meet the specified levels of performance for scheduled items including airflow, static pressure, cooling capacity, heating capacity, electrical characteristics, sound, casing leakage, panel deflection and casing thermal performance.

C. AHU shall maintain structural integrity when wall panels are removed.

D. Provide internal components and accessories as specified and scheduled. Components and accessories shall be installed by the AHU manufacturer in an ISO-9002 certified facility.

E. Ship units in one piece. Split units only where necessary for shipping and installation.

F. Manufacturer shall provide detailed, step-by-step instructions for disassembly and reassembly.

G. For AHU segments that must be broken down for rigging and installation: segment shall be disassembled and reassembled by manufacturer's factory-trained service personnel.

H. Manufacturer shall provide a written statement confirming that the unit is built to the manufacturer's factory standards and that the unit will carry the full warranty.

2.03 STANDARDS COMPLIANCE

A. Comply with ratings and certifications referenced in this specification.

B. Manufacturers who do not comply with ARI-430 shall factory test EACH unit to verify brake horsepower rating, airflow performance and total static pressure performance. See specification Section 2.23 (VERIFICATION OF PERFORMANCE) for testing requirements.

C. Manufacturers who do not conform to requirements of ARI 260 for ducted discharge and return air sound shall submit EACH unit to an independent sound test laboratory for ARI 260 testing. The test laboratory shall conform to ARI 260, Section 4.4, Test Equipment and Facilities.

2.04 BASE RAIL

A. Provide a structural base rail under the full perimeter of the unit, formed from mill galvanized steel.

B. Provide clearance for proper external trapping of drain pans steam condensate.

C. Provide base rail and lifting lug system that does not require additional support for rigging. Include base rail lifting lugs at unit corners.

2.05 CASING

A. Provide double wall AHU casing. Exposed insulation is not acceptable.

B. Panel assembly shall meet UL standard 1995 for fire safety. Panel insulation shall comply with the requirements of NFPA 90A.

C. Provide an insulation system that is resistant to mold growth in accordance with a standardized test method such as UL 181 or ASTM C 1338.

D. Encapsulate insulation with sheet metal so that air does not contact insulation. Solid lined panels insulated with spray injected foam shall be hermetically sealed at each corner and around their entire perimeter, to eliminate airflow through the panel and to eliminate microbial growth potential within the casing wall.

E. Provide casing with minimum thermal resistance (R-value) of 13 hr-ft^2-°F/BTU.

F. Roof, wall, floor, and access door panels shall be galvanized steel.

G. Provide a unit frame of galvanized steel that provides the overall structure of the unit and does not rely on the casing panels for structural integrity. Insulate frame in the same manner as panels, roof, and floors.

H. Provide AHU casing that leaks no more than 1% of design airflow at +/-8" w.g.

I. Provide wall panels and access doors that deflect no more than L/240 when subjected to +/- 8" w.g. 'L' is the panel-span length and 'L/240' is the deflection at panel midpoint.

J. Provide floors and roofs that deflects no more than L/240 when subjected to a 300 lb load at mid-span. 'L' is the panel-span length and 'L/240' is the deflection at panel midpoint.

K. Provide outdoor AHUs with a roof system that deflects no more than L/240 when subjected to a snow load of 30 lb/ft2. 'L' is defined as the panel-span length and 'L/240' is the deflection at the panel midpoint.

L. Provide outdoor AHUs with a roof sloped at a minimum pitch of 1/4" per foot. The roof shall overhang side and end panels by a minimum of 2."

M. Provide an exterior finish on outdoor units that shows a breakdown of less than 1/8" on either side of a scribed line when subjected to ASTM B117 500 hour, 5% salt spray conditions. This is equivalent to an ASTM D1654 rating of '6.'

2.06 PRIMARY DRAIN PANS

A. Panel assembly shall meet UL standard 1995 for fire safety. Panel insulation shall comply with the requirements of NFPA 90A.

B. Provide an insulation system that is resistant to mold growth in accordance with a standardized test method such as UL 181 or ASTM C 1338.

C. Provide floors that deflect no more than L/240 when subjected to a 300 lb load at mid-span. 'L' is the panel-span length and 'L/240' is the deflection at panel midpoint.

D. Comply with the stated intent of ASHRAE Standard 62.

E. Provide a stainless steel drain pan under each cooling coil and humidifier. Drain pans for cooling coils and humidifiers shall meet the requirements of ASHRAE 62.

F. Provide drain connection made of same material as drain pan. Do not use dissimilar metals because of the risk of galvanic corrosion. Weld connection to the drain pan.

G. Drain pan shall be double wall with an insulation R-value of 6.25 hr-ft^2-°F/(BTU-in).

H. Provide drain pan under the complete width and length of cooling coil and humidifier sections. Drain pan shall be full width, and extend a minimum of 6" downstream of cooling coil.

I. Drain pan shall allow visual inspection and physical cleaning on 100% of the pan surface without removal of the coil or humidifier.

J. Provide a minimum of 1" clearance between the drain pan and any coil casing, coil support or any other obstruction.

K. Provide drain pan that allows the design rate of condensate drainage regardless of fan status.

L. Provide drain pan sloped in at least two planes by at least 1/8" per foot toward a single drain. Locate drain connection at the lowest point of the pan. Pan shall have no horizontal surfaces.

2.07 ACCESS DOORS

A. Provide access door(s) that meet requirements for the AHU casing.

B. Provide industrial style stainless steel hinges that permit 180 degrees of door swing.

C. Provide latches with roller cam mechanisms that ensure a tight seal. Rotating knife-edge or "paw" latches are not acceptable.

D. Provide each door with a single handle linked to multiple latching points or a separate handle for each latching point. Doors serving access segments shall have an interior latch handle.

E. Provide access doors with a locking hasp to accommodate a lockout device.

F. Provide double-pane viewing windows. Windows shall be a non-condensing type consisting of a desiccant dehumidification layer. Minimum dimension shall be 3” x 8”.

2.08 FANS

A. Provide single width single inlet (SWSI) plenum fans as shown on equipment schedule and drawings.

B. Airfoil fans shall comply with AMCA standard 99-2408-69 and 99-2401-82. Provide an AMCA Seal on airfoil fans. Airfoil fan performance shall be based on tests made in accordance with AMCA standards 210 and comply with the requirements of the AMCA certified ratings program for air performance.

C. Provide fans with true airfoil blades unless otherwise scheduled.

D. Provide fans with the following accessories:

1. Fan inlet screens in the inlets of fan housing (REQUIRED on SWSI plenum fans)
2. Access door inlet screen (on AHU casing)

E. Provide airfoil fans with blades formed of extruded aluminum, as scheduled. Bent sheet metal blades are not acceptable.

F. Provide fans with polished steel shafts with first critical shaft speed at least 125% of the maximum operating speed for the fan pressure class. Shaft shall have an anti-corrosion coating.

G. Provide fan motor on an adjustable base to allow adjustable and consistent belt tension.

H. Mount the fan and motor assembly on a common adjustable base. This common base shall attach to vibration isolators, which mount to structural support channels. These channels shall span the AHU floor and mount directly to the AHU frame. Manufacturers not complying with this requirement must submit detailed structural and weight data to a licensed structural engineer for review and stamped certification. The Professional shall review these engineers’ final reports prior to submittal approval.

I. Provide vibration isolation springs with 2” static deflection.

J. Provide horizontal thrust restraints between AHU casing and fan housings with end discharge. This requirement applies to the following cases:

1. SWSI fans operating at greater than 3” of total static pressure

2.09 BEARINGS AND DRIVES

A. Provide bearings complying with ANSI/AFBMA 9 for fatigue life ratings.

B. Provide fan bearings with an average life L10 of at least 200,000 hours, as scheduled.

C. Provide permanently lubricated bearings on forward curved fans smaller than 18.” On other fans, provide re-greaseable bearings with hydraulic grease fittings and lube lines extended to the motor side of the fan.

D. Provide plenum fans with direct-drive transmissions.

E. Provide drives selected with a 1.5 service factor. Sheaves shall be machined from a close grain cast iron and statically balanced by the manufacturer. Provide a fixed pitch sheave on the motor.

F. Provide fixed pitch sheaves on both the fan and motor. Fans with motors rated at 15 hp or less may be field balanced using variable pitch sheaves. Provide fixed pitch sheaves when final balance is complete. Air balancer shall select and provide final set of sheaves.

2.10 ELECTRICAL MOTORS

A. Provide fan motors built in accordance with the latest standards of the NEMA and IEEE.

B. Provide AHU and fan motors in compliance with ASHRAE 90.1.

C. Provide fan motors with the following characteristics:

1. 60 hertz, 1750 rpm operation
2. Service factor of 1.15
3. Premium efficiency, or as required to meet ASHRAE 90.1
4. NEMA design ball bearing type
5. Rated for continuous duty at full load in a 104°F (40°C) ambient
6. Totally enclosed, fan cooled (TEFC).
7. Suitable for use in variable frequency application, per NEMA MG-1 Part 30
8. Premium Efficiency Inverter ready per NEMA STD MG1 PART 31.4.4.2

D. Provide direct drive plenum fans coupled to premium efficiency motors with matching speed, as scheduled.

2.11 FAN-MOTOR DISCONNECTS

A. Provide UL or ETL listed fan-motor disconnects and associated components, as scheduled and shown on drawings. Disconnects shall comply with applicable provisions of the National Electric Code.

B. Provide fused fan-motor disconnects in NEMA 1, enclosures, as scheduled and shown on drawings.

C. Mount disconnects on the primary access side of the associated fan segment.

1. Mount unit main disconnect (on units with single point power) on the primary access side of supply fan section.

D. Disconnect shall be suitable for use as an OSHA lockout/tagout disconnect when applied in accordance with part IV, Department of Labor OSHA 29 CFR Part 1910, Control of Hazardous Energy Source (lockout/tagout): final rule.

E. Disconnect handles shall be lockable in the “off” position with up to three padlocks. Switch mechanism shall be directly lockable in the “off” position via padlock when door is open.

F. Provide disconnects with integral ground lug.

1. Provide two (2) #14 ground wires on 16A to 100A disconnects.
2. Provide one (1) #6-250 ground wire on 200A to 400A disconnects.

G. Provide auxiliary contacts, as scheduled.

2.12 FAN-MOTOR VARIABLE FREQUENCY DRIVES (VFDS)

A. VFD’s will be by the ATC Contractor.

2.13 FACTORY INSTALLED ELECTRICAL ACCESSORIES

A. In addition to motor power terminals, provide an independent power terminal for convenience receptacles and lights. Provide switches as shown on drawings.

B. Provide incandescent lights in accessible segments. Provide a single light switch for all lighted segments.

C. Provide a 120v convenience receptacle on supply fan segment.

2.14 HEATING AND COOLING COMPONENTS

A. Provide coils manufactured by AHU manufacturer, except where noted in contract documents.

B. Coils shall meet or exceed performance scheduled on drawings.

1. When applicable, provide coils with performance certified in accordance with ARI Standard 410 for coil capacity and pressure drop. Circuit coils such that the fluid velocity is within the range of certified rating conditions at design flow.

C. Provide cooling coils with a maximum face velocity as scheduled. Face velocity calculations shall be based on the finned area of the coil.

D. Provide cooling coil drain pan that is sufficient to contain coil condensate. Drain pan shall extend a minimum of 6”downstream of the face of the coil.

E. Provide coil segment casing to accommodate full-face or reduced-face coils as scheduled. Provide face and bypass coil segments with factory installed bypass damper.

F. Provide at least 18” of access between coils. Provide an easily operable access panel or door, as shown on drawings.

G. Provide coil segment casing that meets or exceeds casing performance of the unit.

H. Provide panels that are easily removable with no special tools.

I. Locate access doors to provide clearance for pipe insulation, connectors, and accessories. Space shall allow a minimum of 90 degrees of door swing.

J. Provide coils built in their own full perimeter frame. Tube sheets on each end shall have fully drawn collars to support and protect tubes. Horizontal coil casing and support members shall allow moisture to drain. Casing and support members shall not block finned area.

K. Individual coils shall be removable from the side of the AHU.

L. Provide an intermediate drain pan on stacked cooling coils. Intermediate drain pan shall slope in a minimum of two planes toward a single drain connection.

M. Provide a single intermediate vertical coil support on coils with a finned length greater than 62.” Provide two vertical supports on coils with a finned length greater than 100,” and three vertical supports on coils with a finned length greater than 141.”

N. Provide a 1/4" FPT plugged vent/drain tap on each connection. Circuiting shall allow draining and venting when installed. Extend coil connections through AHU casing. Extend vent, drain, and coil connections through AHU casing.

O. Staggered Coil bank shall be provided. Provide a 1/4" FPT plugged vent/drain tap on each connection. Circuiting shall allow draining and venting when installed. Vent, drain, and coil connections shall be supplied within 10” of the header. Extend vent, drain, and coil connections through AHU casing.

P. Insulate gap between coil stub out connection and AHU casing with a spool-shaped sleeve grommet. Adhesive rings applied the casing walls are not acceptable.

Q. Water and glycol coils shall be operable at 250 psig working pressure and up to 300° F. Factory test water and glycol coils with 325 psig compressed air under water.

R. Steam distributing coils shall be operable at 50 psig pressure and a corresponding saturated steam temperature of 298° F. Factory test steam coils with 315 psig compressed air under water. Dehydrate and seal coils prior to shipping.

S. Provide steam-distributing coils with a tube outer diameter (OD) of 1" and an inner distribution tube of 5/8" O.D. Circuit coils for gravity drain of condensate without trapping. Steam shall discharge in the direction of condensate flow to ensure even heat transfer across each tube.

T. Provide water and glycol coils with a tube OD of 5/8” or 1/2”. Mechanically expand tubes to form fin bond and provide burnished, work-hardened interior surface. Tubes shall have a minimum tube wall thickness of 0.020" for 5/8” tubes, and 0.016" for 1/2” tubes.

U. Provide coils with copper tube return bends with the following final minimum thicknesses:

1. 0.035” for 5/8” diameter tubes
2. 0.032” for 1/2” diameter tubes with 0.020” or 0.032” tube wall thicknesses
3. 0.020” for 1/2” diameter tubes with 0.016” tube wall thickness.

V. Provide water, glycol and steam coil headers made of seamless copper tubing. Pipe connections shall be steel. Header connections (tubes and piping connections) shall be silver-brazed or TIG welded.

W. Provide DX coils with brass distributor and solder-type connections. Suction and discharge connections shall be on the same end regardless of coil depth. Mount refrigerant specialties outside of unit. Provide DX coils with a hot gas bypass port on distributor.

X. Provide coils with die-formed, continuous aluminum fins. Fins shall have fully drawn collars to accurately space fins and protect tubes. Fins shall be 0.006" thick.

Y. Provide coil coatings as scheduled or indicated on drawings.

2.15 FILTERS

A. Provide filter segments with filters and frames as scheduled.

B. Provide side or front loading filters for filter segments located upstream of coil segment(s) with an access door on the drive side through which filters can be easily loaded.

C. Provide face loading filters for segments located downstream of coil segment(s). Provide an 18” (minimum) access plenum and access door on the drive side through which face loading filters can be easily loaded.

D. Provide Class 2 or Class 1 filter media per U.L. 900 and as required by local codes.

E. Filter types, efficiencies, and nominal depths shall be scheduled.

F. Provide a flush mounted, factory installed differential pressure gage on the drive side of unit to measure pressure drop across filters. Manufacturer shall provide fully functional gauges, complete with tubing.

2.16 DAMPERS

A. Provide dampers tested in accordance with AMCA 500.

B. Provide factory-installed dampers at the discharge, return and outside air openings.

C. Dampers shall have airfoil blades, extruded vinyl edge seals, and flexible metal compressible jamb seals.

D. Dampers shall have a maximum leakage rate of 4 CFM/square foot at 1" w.g., and shall comply with ASHRAE 90.1.

E. Damper blades shall be parallel acting unless otherwise indicated.

F. Damper blades shall be galvanized steel.

2.17 DIFFUSERS

A. Provide diffuser segments as shown on drawings.

B. Diffuser plates shall ensure proper air flow across components downstream of DWDI fans.

2.18 FINISHES

A. Manufacturer shall clean the exterior surfaces of units prior to finishing, painting, or shipment.

B. Manufacturer shall paint outdoor units prior to shipment. Manufacturer shall paint indoor units, as scheduled or shown on drawings.

1. Manufacturer shall apply a primer prior to painting units.
2. Manufacturer shall apply a finish coat of acrylic polyurethane paint.
3. Finished unit shall exceed 500-hour salt spray solution (5%) test without any sign of red rust when tested in accordance with ASTM B-117.

2.19 TESTS AND INSPECTIONS

A. Manufacturer shall dynamically balance fan/motor/base assembly.

1. Balance variable volume fan assemblies from 10% to 100% of design RPM.

2. Take filter-in measurements in the horizontal and vertical axes on the drive and opposite-drive sides of fan shafts.
3. Variable speed fan vibration limits: filter -in measurements shall not exceed 7 mils.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install equipment per industry standards, applicable codes, and manufacturer's instructions.

B. Do not use AHUs for temporary heating, cooling or ventilation prior to complete inspection and startup performed per this specification.

C. Install AHUs on a concrete pad, roof curb, or structural steel base, as shown on drawings.

D. Install AHUs with manufacturer's recommended clearances for access, coil pull, and fan removal.

E. Provide one complete set of filters for testing, balancing, and commissioning. Provide second complete set of filters at time of transfer to Client Agency.

F. Install AHU plumb and level. Connect piping and ductwork according to manufacturer's instructions.

G. Install supports and anchors per applicable local building codes.

H. Insulate plumbing associated with drain pan drains and connections.

I. Install insulation on all staggered coil piping connections, both internal and external to the unit.

3.02 FIELD QUALITY CONTROL

A. Store per AHU manufacturer's written recommendations. Store AHUs indoors in a warm, clean, dry place where units will be protected from weather, construction traffic, dirt, dust, water and moisture. If units will be stored for more than 6 months, follow manufacturer's instruction for long-term storage.

B. Rig and lift units according manufacturer's instructions.

3.03 AHU INSPECTION

A. Hire manufacturer's factory-trained and factory-employed service technician to perform an inspection of unit and installation prior to startup. Technician shall inspect and verify the following as a minimum:

1. Damage of any kind
2. Level installation of unit
3. Proper reassembly and sealing of unit segments at shipping splits.
4. Tight seal around perimeter of unit at the roof curb
5. Installation of shipped-loose parts, including filters, air hoods, bird screens and mist eliminators.
6. Completion and tightness of electrical, ductwork and piping connections
7. Tight seals around wiring, conduit and piping penetrations through AHU casing.
8. Supply of electricity from the building's permanent source
9. Integrity of condensate trap for positive or negative pressure operation
10. Condensate traps charged with water
11. Removal of shipping bolts and shipping restraints
12. Sealing of pipe chase floor(s) at penetration locations.
13. Tightness and full motion range of damper linkages (operate manually)
14. Complete installation of control system including end devices and wiring
15. Cleanliness of AHU interior and connecting ductwork

16. Proper service and access clearances
17. Proper installation of filters
18. Filter gauge set to zero

B. Resolve any non-compliant items prior to proceeding with the inspection of the fan assembly.

3.04 INSPECTION AND ADJUSTMENT: AHU FAN ASSEMBLY

A. Hire the manufacturer's factory-trained and factory-employed service technician perform an inspection of the AHU fan assembly subsequent to general AHU inspection and prior to startup. Technician shall inspect and verify the following as a minimum:

1. Fan isolation base and thrust restraint alignment
2. Tight set screws on pulleys, bearings and fan
3. Tight fan bearing bolts
4. Tight fan and motor sheaves
5. Tight motor base and mounting bolts
6. Blower wheel tight and aligned to fan shaft
7. Sheave alignment and belt tension
8. Fan discharge alignment with discharge opening
9. Fan bearing lubrication
10. Free rotation of moving components (rotate manually)

B. Manufacturer shall perform service to bring fan performance within factory specifications.

3.05 STARTUP SERVICE AND TRAINING

A. Manufacturer's factory-trained and factory-employed service technician shall startup AHUs. Technician shall perform the following steps as a minimum:

1. Energize the unit disconnect switch
2. Verify correct voltage, phases and cycles
3. Energize fan motor briefly ("bump") and verify correct direction of rotation.
4. Re-check damper operation; verify that unit cannot and will not operate with all dampers in the closed position.
5. Energize fan motors and verify that motor FLA is within manufacturer's tolerance of nameplate FLA for each phase.
6. Rebalance each fan and check for vibration.

B. Provide a minimum of 4 hours of training for Client Agency's personnel by manufacturer's factory-trained and factory-employed service technician. Training shall include AHU controls, motor starter, VFD, and AHU.

C. Training shall include startup and shutdown procedures as well as regular operation and maintenance requirements.

D. Submit a startup report summarizing any problems found and remedies performed.

3.06 FIELD PERFORMANCE VERIFICATION

A. Leakage: Pressurize casing to +/-8" w.g. and measure leakage of each AHU. If leakage exceeds 1% of design airflow, seal leakage points with a permanent solution. Repeat test. If the AHU still does not pass, contact the manufacturer to seal unit.

B. Submit a field test report with testing data recorded. Include description of corrective actions taken.

3.07 CLEANING

A. Clean unit interior prior to operating. Remove tools, debris, dust and dirt.

B. Clean exterior prior to transfer to Client Agency.

3.08 DOCUMENTATION

A. Provide Installation Instruction Manual, & Startup checklist in the supply fan section of each unit.

B. Provide six copies of Spare Parts Manual for Department's project system manual.

END OF SECTION

SECTION 237330
PACKAGED ROOFTOP UNITS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SECTION INCLUDES

A. Packaged roof top units and components as scheduled and shown on drawings.

B. Motor disconnects, motor starters, and variable frequency drives.

1.03 RELATED SECTIONS

A. The requirements of the General Conditions, Supplementary Conditions, Division 1, equipment schedules, and drawings apply.

1.04 GENERAL

A. Outdoor, rooftop mounted, electrically controlled, heating and cooling unit utilizing a fully hermetic, suction gas cooled, direct drive compressor(s) for cooling duty and gas combustion or nickel chromium elements for heating duty.

B. Factory assembled, single- piece heating and cooling rooftop unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and special features required prior to field start- up.

C. Unit shall use R-454B refrigerant.

D. Unit shall have a factory installed refrigeration detection systems (RDS) which includes two refrigerant leak detection sensors to protect the unit from any damage caused by the leakage of the mildly flammable R454B refrigerant. Choice units provide an RDS as factory and field installed options. The RDS sensor can detect a refrigerant leak according to UL60335-2-40 (edition 4.0) with an accuracy of +/- 5% LFL across the working range (0-25% LFL)

E. Unit shall be installed in accordance with the manufacturer's instructions.

F. Unit must be selected and installed in compliance with local, state, and federal codes.

1.05 QUALITY ASSURANCE

A. Unit meets ASHRAE 90.1 minimum efficiency requirements.

B. Unit shall be rated in accordance with AHRI Standards 210/240 or 340/360.

C. Unit shall be designed to conform to ASHRAE 15, 2001.

D. Unit shall be UL- tested and certified in accordance with ANSI Z21.47 -2012/CSA 2.3-2012, CSA C22.2 No. 236-11 (UL 1995) 4th edition and CSA C22.2 No. 3 - M 1988.

E. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

F. Unit casing shall be capable of withstanding 1000- hour salt spray exposure per ASTM B117 (scribed specimen).

G. Unit shall be designed in accordance with ISO 9001, and shall be manufactured in a facility registered by ISO 9001.

H. Roof curb shall be designed to conform to NRCA Standards.

I. Unit shall be subjected to a completely automated run test on the assembly line. The data for each unit will be stored at the factory and must be available upon request.

J. Unit shall be designed in accordance with UL Standard 1995, including tested to withstand rain.

K. Unit shall be constructed to prevent intrusion of snow and tested to prevent snow intrusion into the control box.

L. Unit shake tested to Truck 2, ASTM D4169 to ensure shipping reliability.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Unit shall be stored and handled per manufacturer's recommendations.

B. Overhead crane can be used to place the units on a roof using rigging holes built into the unit base rails without any additions to the unit.

C. Unit shall only be stored or positioned in the upright position.

1.07 OPERATING CHARACTERISTICS

A. Unit shall be capable of starting and running at 125°F (52°C) ambient outdoor temperature, meeting maximumload criteria of AHRI Standard 210/240 or 340/360 at □□10% voltage.

B. Compressor with standard controls shall be capable of operation down to 30°F (-1°C), ambient outdoor temperatures. Low ambient kit is necessary if mechanically cooling at ambient temperatures below 30°F (-1°C).

C. Unit shall discharge supply air vertically or horizontally as shown on contract drawings.

D. Unit shall be factory configured for vertical supply & return configurations.

E. Unit shall be field convertible from vertical to horizontal airflow on all models.

F. Unit shall be capable of mixed operation: vertical supply with horizontal return or horizontal supply with vertical return.

1.08 ELECTRICAL REQUIREMENTS

A. Main power supply voltage, phase, and frequency must match those scheduled on the drawings.

PART 2 – PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Addison – Basis of Design

B. JCI/York

C. Trane

D. Equal as approved by the Professional

2.02 EQUIPMENT SCHEDULES

A. Rooftop unit schedule.

1. Refer to the schedule on the drawings.

2.03 HVAC EQUIPMENT INSULATION

A. Evaporator fan compartment:

1. Interior cabinet surfaces shall be insulated with a minimum 1 in. thick, foil faced fiber glass insulation with thermal conductivity of 0.24 or better, adhered with acrylate polymer-based adhesive.

2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

B. Gas heat compartment:

1. Interior cabinet surfaces shall be insulated with a minimum 1 in. thick, foil faced fiber glass insulation with thermal conductivity of 0.24 or better, adhered with acrylate polymer-based adhesive.

2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

C. Economizer and Control compartment:

1. Interior cabinet surfaces shall be insulated with a minimum 1 in. thick, foil faced fiber glass insulation with thermal conductivity of 0.24 or better, adhered with acrylate polymer-based adhesive.
2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

D. Partition, Base Pan, and Duct Panel:

1. Interior cabinet surfaces shall be insulated with a minimum 1 in. thick, foil faced fiber glass insulation with thermal conductivity of 0.24 or better, adhered with acrylate polymer-based adhesive.
2. Insulation and adhesive shall meet NFPA 90A requirements for flame spread and smoke generation.

2.04 ELECTRIC AND ELECTRONIC CONTROL SYSTEM FOR HVAC

A. General:

1. Shall be complete with self- contained low- voltage control circuit protected by a resettable circuit breaker on the 24- v transformer side. Transformer shall have 75VA capability.
2. Shall utilize color- coded wiring.
3. Shall include a central control terminal board to conveniently and safely provide connection points for vitalcontrol functions such as: smoke detectors, phase monitor, gas controller, economizer, thermostat, DDC control options, and low- and high-pressure switches.
4. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor. See heat exchanger section of this specification.

B. Safeties:

1. Compressor over- temperature, over- current. High internal pressure differential.
2. Low pressure switch and high-pressure switch
   a. Low pressure switch shall use different color wire than the high-pressure switch. The purpose is to assist the installer and service technician to correctly wire and or troubleshoot the rooftop unit.
3. Automatic reset, motor thermal overload protector.
4. Heating section shall be provided with the following minimum protections:
   a. High temperature limit switches.
   b. Induced draft pressure sensor.
   c. Flame rollout switch.
   d. Flame proving controls.
5. Refrigerant Detection System shall be factory-installed with integrated sensors providing R-454B leak detection. The RDS shall be connected to the unit controls and automatically start a sequence to dilute refrigerant gas. When the presence of refrigerant is detected in the cabinet, it shall set off an alarm upon indicating a leak equal to 25% of the lower flammability limit. These sensors shall be positioned to ensure accurate and timely sensing of a leak.

2.05 PANEL AIR FILTERS

A. Standard filter section.

1. Shall consist of factory installed, low velocity, disposable 2- in. thick fiberglass filters of commercially available sizes.
   a. Filters shall be accessible through an access panel; hinged panel with “no- tool” removal option is available as described in the Features Options and Accessories section of this specification

b. Filters shall be 2” MERV 8 pleated

2.06 UNIT CABINET

A. Unit cabinet shall be constructed of galvanized steel with exterior surfaces coated with a non-chalking, powder paint finish, certified at 1000 hour salt spray test per ASTM-B117 standards.

B. Unit cabinet exterior paint shall be: film thickness, (dry) 3.0 MILS minimum, gloss (per ASTM D523, 60°F /16°C): 80+/-5, Hardness: H- 2H Pencil hardness.

C. Unit cabinet shall have gas and electric utility knockouts in the side of the unit and in the unit underside. Base of unit shall have a minimum of four locations for through- the- base gas and electrical connections standard.

D. Base Rail

1. Unit shall have base rails on a minimum of 4 sides.
2. Holes shall be provided in the base rails for rigging shackles to facilitate maneuvering and overhead rigging.
3. Holes shall be provided in the base rail for moving the rooftop by fork truck.
4. Base rail shall be a minimum of 15-gauge thickness.

E. Condensate pan and connections:

1. Shall be an internally sloped condensate drain pan made of a non- corrosive material.
2. Shall comply with ASHRAE Standard 62.
3. Shall use a 1” NPT drain connection, possible either through the bottom or side of the drain pan. Connection shall be made per manufacturer’s recommendations.

F. Top panel:

1. Shall be a multi piece top panel.

G. Gas Connections:

1. All gas piping connecting to unit gas valve shall enter the unit cabinet at a single location on side of unit.
2. Through- the- base capability
   a. Standard unit shall have a through- the- base gas- line location using a raised, embossed portion of the unit base-pan.
   b. Optional, factory approved, water- tight connection method must be used for through- the- base gas connections.
   c. No base-pan penetration, other than those authorized by the manufacturer, is permitted.

H. Electrical Connections

1. All unit power wiring shall enter unit cabinet at a single, factory prepared, and knockout location.
2. Through- the- base capability.
   a. Standard unit shall have a through- the- base electrical location(s) using a raised, embossed portion of the unit base-pan.
   b. Factory approved, water- tight connection method must be used for through- the- base electrical connections.
   c. No base-pan penetration, other than those authorized by the manufacturer, is permitted.

I. Units meet the seismic capacity requirements of the International Code Council Evaluation Service (ICC- ES) document AC156 (Acceptance Criteria for Seismic Qualification by Shake-Table Testing of Nonstructural Components and Systems), the International Building Code (IBC 2009), and the California Building Code (CBC 2010) with quality testing conducted in accordance with the standards of the American Society of Civil Engineers (ASCE 7-05).

1. Units are certified with an SDS (g) value of 2.0 using seismic design parameters of z/h=1.0, Ip=1.5 and certified by independent structural Professionals.

2.07 GAS HEAT-FULLY MODULATING WITH SUPPLY AIR TEMPERING

A. General – GAS HEAT MUST be able to fire and supply heat at all operating conditions. Gas heat for morning warm up only is NOT PERMITTTED.

1. Heat exchanger shall be an induced draft design. Positive pressure heat exchanger designs shall not be allowed.
2. Shall incorporate a direct- spark ignition system and redundant main gas valve.
3. Gas supply pressure at the inlet to the rooftop unit gas valve must match that required by the manufacturer.
4. All units shall have two stages of heating capacity with equal capacity on each stage.

B. The heat exchanger shall be controlled by an integrated gas controller (IGC) microprocessor.

1. IGC board shall notify users of fault using an LED (light- emitting diode).
2. The LED shall be visible without removing the control box access panel.
3. Unit Control Board shall contain algorithms that modify evaporator fan operation to prevent future cycling on high temperature limit switch.
4. Unit shall be equipped with anti- cycle protection with one cycle on unit flame rollout switch or 3 short cycles on the high temperature limit switch. Fault indication shall be made using an LED.

C. Stainless Steel Heat Exchanger construction

1. Use energy saving, direct- spark ignition system.
2. Use a redundant main gas valve.
3. Burners shall be of the in- shot type constructed of aluminum- coated steel.
4. All gas piping shall enter the unit cabinet at a single location on side of unit (horizontal plane).
5. The optional stainless-steel heat exchanger shall be of the tubular- section type, constructed of a minimum of 20- gauge type 409 stainless steel.
6. Type 409 stainless steel shall be used in heat exchanger tubes and vestibule plate.

D. Induced draft combustion motor and blower

1. Shall be a direct- drive, single inlet, forward- curved centrifugal type.
2. Shall be made from steel with a corrosion- resistant finish.
3. Shall have permanently lubricated sealed bearings.
4. Shall have inherent thermal overload protection.
5. Shall have an automatic reset feature.

E. Modulating Gas Heat - Unit heat shall be engineered to deliver variable heat to the supply air stream. The amount of heat available to the air stream shall be adjustable between the minimum turndown and the maximum capacity of the unit's heat. The modulating gas valve shall incorporate an outlet pressure slightly above atmospheric with the bypass closed and zero control voltage being applied. Minimum flow rate is adjusted by a manual adjustment screw on the side of the modulating valve. Controls shall be integrated into the main unit control board with a sub processor controlling modulating gas functions. An automatic safety shutoff valve is installed in series with the modulating gas valve for positive shut off in the no-heat mode of operation. In addition to all standard factory installed safeties the unit shall be equipped with the following additional safeties: Air proving flow switch, fan starter interlock, and an isolated modulating gas control power transformer.

F. Modulating Gas Heat - Vent and Combustion Hoods - Any required hoods, stacks, and hardware are shipped inside the unit. Each hood or stack must be properly attached to the furnace doors to assure proper operation and compliance with any CSA/ETL certifications. Information in the IOM that ships with the unit will provide details on the hood and stack connections particular to this unit.

G. Modulating Gas Heat - Gas Train Piping - Unit gas heat sub-system shall be piped to provide a fuel gas connection at a point within 2 inches of the base unit fuel gas connection point. Size of the connection shall remain unchanged from the base unit. An external regulator and shutoff valve must be provided by the installing contractor. The gas connections must be made in accordance with all state and local codes. No gas train specialty not specifically identified in the standard factory literature for the base unit or in this addendum is provided.

H. Modulating Gas Heat – Controls – Discharge Air Temperature Control - The unit shall deliver discharge air at the setpoint determined by adjusting a potentiometer in the unit control panel, an LCD display, or communicated to the unit over the building automation system network, depending upon which options have been selected. Refer to the sequence of operation in this document for further details.

I. Modulating Gas Heat – Controls – Supply Air Tempering - The unit shall deliver tempered supply air at the supply air tempering setpoint determined by adjusting a potentiometer in the unit control panel or over a network variable, depending upon selected options. The minimum turndown capability of the modulating gas heat may cause discharge air temperatures above the supply air tempering setpoint. Refer to the sequence of operation in this document for further details.

J. Network Compatible Controls (BACnet, Lon, N2, Modbus) - The unit controls shall be equipped with a communications interface to provide network access over the selected network

K. Modulating Gas Heat

1. Mode Initiation – This mode is entered upon a heat one call being present at the unitary controller.

2. Gas Heat Staging – Upon entering a heating mode, the unit shall index the modulating stage of gas heat to full fire and begin the ignition sequence. After 90 seconds, control of discharge air temperature to discharge air temperature setpoint shall be initiated. Setpoint is adjusted by adjusting the heat supply air temperature setpoint on a potentiometer installed in the unit control panel, an LCD display, or communicated to the unit over the building automation system network, depending upon which options have been selected. The setpoint is adjustable between 60ºF and 110ºF.

3. After the 90 second ignition sequence the modulating stage of heat shall ramp from minimum fire to full fire. If additional heat is required the modulating stage shall be reset to minimum fire and the second stage of heat enabled if present. As the heat demand continues to increase the modulating stage shall be ramped towards full fire. Additional stages of heat behave in a similar fashion.

4. Safety Interlocks –A fan proving switch and a supply fan VFD or motor starter auxiliary switch must be made prior to enabling gas heat functions. Additional high limit temperature switches are installed in the burner cabinet for safety. These additional high limit safety switches are non-adjustable limit switches. The automatic reset limit switches trip at 180ºF and the manual reset limit switches trip at 200ºF.

5. Supply Air Temperature Reset – If a call for stage two heat is present at the unitary controller, the discharge air setpoint shall be indexed upwards by 20ºF.

L. Supply Air Tempering

1. Mode Initiation – This mode is entered when mixed air temperature is below the supply air tempering setpoint and no compressors are enabled. Supply air tempering setpoint is changed by adjusting a potentiometer installed in the unit control panel, an LCD display, or communicated to the unit over the building automation system network, depending upon which options have been selected.

2. Modulating Gas Heat – Modulating gas heat is enabled and operates to maintain the discharge air temperature at the discharge air temperature setpoint. Minimum turndown capability of the modulating gas heat may cause discharge air temperatures above the supply air tempering setpoint. Supply air tempering shall turn off when supply air temperature rises above supply air tempering setpoint plus dead band.

M. Safety Interlocks – Compressor operation is disabled when in this mode of operation.

2.08 HOT GAS REHEAT

A. The dehumidification system is factory installed and provides dehumidification of an occupied space while maintaining temperature control utilizing a hot gas reheat coil.

B. Determination of unit functionality in straight cooling, straight heating, or reheat mode shall come from standard SSE control board.

C. Reheat mode shall utilize a specific reheat coil placed after the evaporator coil to heat the conditioned air back to a neutral temperature when the occupied space requires dehumidification, but the temperature requirements are satisfied.

D. The reheat circuit shall utilize solenoids to alter the refrigerant flow from being directed through the condenser circuit to the hot gas reheat circuit.

E. Changeover from cooling mode to reheat mode shall be accomplished in 30 seconds or less.

2.10 COILS

A. Standard Aluminum Fin - Copper Tube Coils:

1. Standard evaporator coils shall have aluminum plate fins mechanically bonded to seamless internally grooved copper tubes with all joints brazed.

2. Shall be leak tested to 150 PSIG, pressure tested to 250 PSIG, and qualified to CSA C22.2 No. 236-11(UL 1995) 4th edition burst test at 1775 PSIG.

3. Assembled unit shall be pressure tested to 450 PSIG.

B. Standard All Aluminum Microchannel Coils:

1. Standard condenser coils shall have all aluminum microchannel design consisting of aluminum multiport flat tube design and aluminum fin. Coils shall be a furnace brazed design and contain epoxy lined shrink wrap on all aluminum to copper connections.

2. Condenser coils on all Heat Pump and Hot Gas Reheat units shall be Standard Aluminum Fin – Copper Tube coils as defined above.

3. Microchannel condenser coils shall be leak tested to 150 PSIG, pressure tested to 650 PSIG, and qualified to UL 1995 bursttest at 1980 PSIG.

4. Assembled unit shall be pressure tested to 450 PSIG.

2.11 REFRIGERANT CIRCUITS

A. High Efficiency AC units shall utilize FOUR (4) Compressors for VAV Anything less than four will not be accepted – no exceptions.

B. Refrigerant circuit shall include the following control, safety, and maintenance features:

1. Thermostatic Expansion Valve (TXV) shall help provide optimum performance across the entire operating range. Shall contain removable power element to allow change out of power element and bulb without removing the valve body.

2. The lead circuit shall be furnished with hot gas by-pass for unloading.

3. Refrigerant filter drier - Solid core design.

4. Service gauge connections on suction and discharge lines.

C. Compressors

1. Unit shall use fully hermetic scroll compressors for each independent refrigeration circuit.

2. Compressors shall be specifically designed for R454B refrigerant.

3. Two stage models shall use a single stage compressor on each refrigeration circuit.
4. Four stage models that are 15, 17.5, or 20 tons shall use a two-stage compressor on circuit one and a single stage compressor on circuit two.
5. Four stage models that are 25 or 27.5 tons shall use a tandem compressor set on circuit one and a single stage compressor on circuit two.
6. Compressor motors shall be cooled by refrigerant gas passing through motor windings.
7. Compressors shall be internally protected from high discharge temperature conditions.
8. Compressors shall be protected from an over- temperature and over- amperage conditions by an internal, motor overload device.
9. Compressor shall be factory mounted on rubber grommets.
10. Crankcase heaters shall be installed in the factory as needed on tandem compressor sets.

2.12 FILTERS SECTION

A. Filters access is specified in the unit cabinet section of this specification.

2.13 EVAPORATOR FAN AND MOTOR

A. Evaporator fan motor:
1. Shall have permanently lubricated ball-bearings.
2. Shall have inherent automatic- reset thermal overload protection.
3. The job site selected brake horsepower shall be required to not exceed the motor's nameplate horsepower rating plus the service factor.

B. Evaporator Fan:
1. Fan shall be a belt drive assembly with an adjustable pitch motor pulley.
2. Shall use sealed, permanently lubricated ball-bearing type.
3. Blower fan shall be double-inlet type with forward-curved blades.
4. Shall be constructed from steel with a corrosion resistant finish and dynamically balanced.

2.14 CONDENSER FANS AND MOTORS

A. Condenser fan motors:
1. Shall be a totally enclosed motor.
2. Shall use permanently lubricated ball-bearings.
3. Shall have inherent thermal overload protection with an automatic reset feature.
4. Shall use a shaft- down design.

B. Condenser Fans:
1. Shall be a direct- driven propeller type fan.
2. Shall have aluminum blades riveted to corrosion- resistant steel spider brackets and be dynamically balanced.

2.15 VARIABLE FREQUENCY DRIVE (VFD)

A. Shall be installed inside the unit cabinet, mounted, wired and tested.

B. Shall contain Electromagnetic Interference (EMI) frequency protection.

C. Insulated Gate Bi- Polar Transistors (IGBT) used to produce the output pulse width modulated (PWM) waveform.

D. Built in LED display and controls. Does not require additional kit or options.

E. RS485 capability standard.

F. Electronic thermal overload protection.

G. 5% swinging chokes for harmonic reduction and improved power factor.

H. All printed circuit boards shall be conformal coated.

2.16 STANDARD INTEGRATED ECONOMIZER

A. Integrated, gear driven opposing modulating blade design type capable of simultaneous economizer and compressor operation.

B. Independent modules for vertical or horizontal return configuration shall be available. Vertical return modules shall be available as a factory installed option.

C. Damper blades shall be galvanized steel with metal gears. Plastic or composite blades on intake or return shall not be acceptable.

D. Damper blades shall be class 1A dampers.

E. Shall include all hardware and controls to provide free cooling with outdoor air when temperature and/or humidity are below set points.

F. Shall be equipped with gear driven dampers for both the outdoor ventilation air and the return air for positive air stream control.

G. Economizer shall comply with, and be certified to, the AMCA 511 standard.

H. Standard leak rate shall be equipped with dampers not to exceed 3 cfm/ft^2 leakage at 1 in. WG pressure differential.

I. Economizer controller shall be the Johnson Controls SE Economizer Controller

1. On- board Fault Detection and Diagnostics (FDD) that senses and alerts when the economizer is notoperating properly, meets the requirements for California Title 24, IECC 2015, and ASHRAE 90.1.
2. Display alarms if the following occur
    a. Economizer is economizing when conditions do not support
    b. Economizer is not economizing when conditions do support
    c. Damper Stuck
    d. Excess Outdoor Air
    e. Failed Sensor
3. Automatic sensor detection
4. Capabilities for use with multiple- speed indoor fan systems
5. Utilize digital sensors: Dry bulb and Enthalpy
6. UL, CSA, and ICES-003 recognized and FCC compliant to CFR47

J. Shall be capable of introducing up to 100% outdoor air.

K. Shall be equipped with power exhaust capable of relieving up to 100% return air and contain seals that meet ASHRAE 90.1 requirements.

L. Shall be designed to close damper(s) during loss- of- power situations with spring return built into motor.

M. Dry bulb outdoor air temperature sensor shall be provided as standard. Enthalpy sensor is also available on factory installed only. Outdoor air sensor set point shall be adjustable and shall range from 40° to 80°F / 4° to27°C. Additional sensor options shall be available as accessories.

N. The economizer controller shall also provide control of an accessory power exhaust unit function. Factoryset at 100%, with a range of 0% to 100%.

O. The economizer shall maintain minimum airflow into the building during occupied period and provide design ventilation rate for full occupancy.

P. Dampers shall be completely closed when the unit is in the unoccupied mode.

Q. Economizer controller shall accept a 2- 10 Vdc CO_2 sensor input for IAQ/DCV control. In this mode,dampers shall modulate the outdoor air damper to provide ventilation based on the sensor input.

R. Actuator shall be direct coupled to economizer gear. No linkage arms or control rods shall be acceptable.

S. Economizer controller shall provide indications when in free cooling mode, in the DCV mode, or the exhaust fan contact is closed.

2.17 PROPELLER POWER EXHAUST

A. Power exhaust shall be used in conjunction with an integrated economizer.

B. Horizontal power exhaust shall be mounted in return ductwork.

C. Power exhaust shall be controlled by economizer controller operation. Exhaust fans shall be energized when dampers open past the 0- 100% adjustable set point on the economizer control.

2.18 PHASE MONITOR

A. Shall provide protection against phase reversal, phase loss, and phase unbalance.

B. Switch shall automatically shut off unit control circuit if any of the above conditions is detected.

C. Shall have visual LED indication of operational status.

2.19 HINGED AND TOOL LESS ACCESS PANELS (FACTORY INSTALLED)

A. Cabinet panels shall be hinged.

B. Shall provide easy access with molded composite handles that are permanently attached and recessed into the panel.

C. Shall be on major panels of filter, control box, fan motor, and compressor.

2.20 UNIT-MOUNTED, NON-FUSED DISCONNECT SWITCH

A. Switch shall be factory installed, internally mounted.

B. National Electric Code (NEC) and UL approved non- fused switch shall provide unit power shutoff.

C. Shall be accessible from outside the unit.

D. Shall provide local shutdown and lockout capability.

2.21 CONVENIENCE OUTLET

A. Powered convenience outlet.

1. Outlet shall be powered from main line power to the rooftop unit.
2. Outlet shall be factory installed and internally mounted with easily accessible 115- v female receptacle.
3. Outlet shall include 15-amp GFI receptacles with independent fuse protection.
4. Voltage required to operate convenience outlet shall be provided by a factory installed step- downtransformer.
5. Outlet shall be accessible from outside the unit.

2.22 ROOF CURBS (PLENUM FOR VERTICAL DISCHARGE)

A. Where indicated on the drawings provide vibration isolation, sound attenuating plenum curb in lieu of RTU Manufacturer's curb. Refer to the RTU schedule.

B. Full perimeter roof curb with supply & return capability and side duct connections.

C. Formed galvanized steel with wood nailer strip and shall be capable of supporting entire unit weight.

D. Permits installation and securing of ductwork to curb prior to mounting unit on the curb.

2.23 SINGLE ENTHALPY SENSOR KIT

A. The single enthalpy sensor kit shall provide a relative humidity sensor to be mounted in the outdoor air stream to provide single enthalpy economizer control.

B. The sensor allows the unit to determine if outside air is suitable for free cooling.

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install equipment per industry standards, applicable codes, and manufacturer's instructions.

B. Do not use RTUs for temporary heating, cooling or ventilation prior to complete inspection and startup performed per this specification.

C. Install RTUs on roof curb, as shown on drawings.

D. Install RTUs with manufacturer's recommended clearances for access, coil pull, and fan removal.

E. Provide one complete set of filters for testing, balancing, and commissioning. Provide second complete set of filters at time of transfer to Client Agency.

F. Install RTU plumb and level. Connect piping and ductwork according to manufacturer's instructions.

G. Install supports and anchors per applicable local building codes.

H. Insulate plumbing associated with drain pan drains and connections.

I. Install insulation on all staggered coil piping connections, both internal and external to the unit.

3.02 FIELD QUALITY CONTROL

A. Store per RTU manufacturer's written recommendations. Store RTUs indoors in a warm, clean, dry place where units will be protected from weather, construction traffic, dirt, dust, water and moisture. If units will be stored for more than 6 months, follow manufacturer's instruction for long-term storage.

B. Rig and lift units according manufacturer's instructions.

3.03 RTU INSPECTION

A. Hire manufacturer's factory-trained and factory-employed service technician to perform an inspection of unit and installation prior to startup. Technician shall inspect and verify the following as a minimum:

1. Damage of any kind
2. Level installation of unit
3. Proper reassembly and sealing of unit segments at shipping splits.
4. Tight seal around perimeter of unit at the roof curb
5. Installation of shipped-loose parts, including filters, air hoods, bird screens and mist eliminators.
6. Completion and tightness of electrical, ductwork and piping connections
7. Tight seals around wiring, conduit and piping penetrations through RTU casing.
8. Supply of electricity from the building's permanent source
9. Integrity of condensate trap for positive or negative pressure operation
10. Condensate traps charged with water
11. Removal of shipping bolts and shipping restraints
12. Sealing of pipe chase floor(s) at penetration locations.
13. Tightness and full motion range of damper linkages (operate manually)
14. Complete installation of control system including end devices and wiring
15. Cleanliness of RTU interior and connecting ductwork
16. Proper service and access clearances

17. Proper installation of filters

B. Filter gauge set to zero

C. Resolve any non-compliant items prior to proceeding with the inspection of the fan assembly.

3.04 INSPECTION AND ADJUSTMENT: RTU FAN ASSEMBLY

A. Hire the manufacturer's factory-trained and factory-employed service technician perform an inspection of the RTU fan assembly subsequent to general RTU inspection and prior to startup. Technician shall inspect and verify the following as a minimum:

1. Fan isolation base and thrust restraint alignment
2. Tight set screws on pulleys, bearings and fan
3. Tight fan bearing bolts
4. Tight fan and motor sheaves
5. Tight motor base and mounting bolts
6. Blower wheel tight and aligned to fan shaft
7. Sheave alignment and belt tension
8. Fan discharge alignment with discharge opening
9. Fan bearing lubrication
10. Free rotation of moving components (rotate manually)

B. **Manufacturer shall perform service to bring fan performance within factory specifications.**

3.05 STARTUP SERVICE AND CLIENT AGENCY TRAINING

A. Manufacturer's factory-trained and factory-employed service technician shall startup RTUs. Technician shall perform the following steps as a minimum:

1. Energize the unit disconnect switch
2. Verify correct voltage, phases and cycles
3. Energize fan motor briefly ("bump") and verify correct direction of rotation.
4. Re-check damper operation; verify that unit cannot and will not operate with all dampers in the closed position.
5. Energize fan motors and verify that motor FLA is within manufacturer's tolerance of nameplate FLA for each phase.
6. Rebalance each fan and check for vibration.

B. Provide a minimum of 2 hours of training for Client Agency's personnel by manufacturer's factory-trained and factory-employed service technician. Training shall include RTU controls, motor starter, VFD, and RTU.

C. Training shall include startup and shutdown procedures as well as regular operation and maintenance requirements.

D. Submit a startup report summarizing any problems found and remedies performed.

3.06 CLEANING

A. Clean unit interior prior to operating. Remove tools, debris, dust and dirt.

B. Clean exterior prior to transfer to Client Agency.

3.07 DOCUMENTATION

A. Provide Installation Instruction Manual, & Startup checklist in the supply fan section of each unit.

B. Provide six copies of Spare Parts Manual for Client Agency's project system manual.

END OF SECTION

SECTION 237335

PACKAGED 100% OUTDOOR AIR, HEATING AND COOLING MAKEUP AIR UNITS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. This section includes packaged heating and cooling units capable of supplying up to 100 percent outdoor air.

1.03 SUBMITTALS

A. The manufacturer assumes no liability for the use or results of use of this document. This specification is to be reviewed by the engineer to confirm requirements of the project and building codes are met.

B. As the manufacturer continues product development, it reserves the right to change design and specifications without notice.

1.04 SEISMIC DESIGN

A. Should the project be located within a seismic zone requiring special provisions for support and restraint of equipment, components, and piping. Refer to state or local codes for Seismic, Wind, Flood Load Design for additional requirements.

1.05 WIND LOAD DESIGN

A. Refer to state or local codes for Seismic, Wind, Flood Load Design for additional requirements.

B. Miami Dade rated up to ±150psf per TAS 201, 202 & 203 paired with 20” curb or shorter.

1.06 QUALITY ASSURANCE

A. All models shall be ETL listed and comply to safety standards UL 1995, the Standard for Safety for Heating and Cooling Equipment. The Engineer of Record shall take responsibility for the approval of any modifications or additions to the unit, including aftermarket UV or ionization filtration devices.

B. All models shall be ETL listed and comply to safety standards CSA Std. C22.2, No. 236-11.

C. Units outfitted with indirect fired heaters shall also comply with ANSI Z83.8-2013, and CSA 2.6-2013.

D. This unit has been tested in accordance to the following standards:

1. ANSI/AHRI Standard 340/360
2. ANSI/ASHRAE Standard 37
3. AHRI Standard 270/370

1.07 WARRANTY

A. All units shall be provided with the following standard warranties:

1. 10-Year (non-prorated) parts warranty covering the entire unit when accompanied by a company provided service plan. 5-Year (non-prorated) parts warranty covering the entire unit otherwise.
2. 25-year (non-prorated) parts warranty for SS heat exchanger on indirect fired units.

B. This warranty shall not apply if:

1. The equipment is not installed by a qualified installer per the manufacturer’s installation instructions shipped with the product.

2. The equipment is not installed in accordance with Federal, State, and Local codes and regulations.
3. The equipment is misused, neglected, or not maintained per the manufacturer's maintenance instructions.
4. The equipment is not operated within its published capacity.
5. The invoice is not paid within the terms of the sales agreement.

C. The manufacturer shall not be liable for incidental and consequential losses and damages potentially attributable to malfunctioning equipment. Should any part of the equipment prove to be defective in material or workmanship within the 10-year period, upon examination by the manufacturer, such part will be repaired or replaced by manufacturer at no charge. The buyer shall pay all labor costs incurred in connection with such repair or replacement. Equipment shall not be returned without manufacturer's prior authorization and all returned equipment shall be shipped by the buyer, freight prepaid to a destination determined by the manufacturer.

PART 2 – PRODUCTS

2.01 GENERAL

A. Supply single zone one piece packaged units that are complete as per the following specification, deliver all capacities scheduled, and conform to design indicated herein. Alternate layouts or dimensional changes will not be accepted.

B. Units shall be manufactured for kitchen make-up air and conditioning (heating/cooling) by one of the following:

1. Captiveaire (Basis of Design)
2. Accurex
3. Halton
4. Equal as approved by the Professional

2.02 CABINET

A. Size 1 unit(s) cabinets shall be constructed of minimum 24-gauge. Sizes 2, 3, or 4 cabinets shall be 20-gauge G-90 galvanized steel riveted together via structural pop-rivets. All metal shall be CNC bent for precise assembly.

1. Rigging Provisions: The unit shall have a structural base constructed of minimum 18-gauge in cabinet size 1 and 14-gauge in cabinet sizes 2, 3 & 4 G-90 galvanized steel, and include full sized fork pockets and lifting points on all four sides.
2. Roof Construction: The lids shall be fabricated by forming a double-standing, self-locking seam that requires no additional support. Roof shall be pitched to allow for proper drainage.
3. Exterior Wall Construction: All exterior walls shall consist of a double wall, G-90 galvanized steel construction. Cabinet size 1 shall be insulated with 1-inch thick, R4.3 fiber glass duct board insulation. Cabinet sizes 2, 3 & 4 shall be insulated with 2-inch thick, R13 closed cell foam.
4. Service Access Doors: All door jambs shall be gasketed around their perimeter, and allow for doors to be mounted via removable, spring actuated, stainless steel hinges with stainless steel rivets, and self-compressing latches. Each compartment shall have removable access panels to allow for ease of service and maintainability. Electrical cabinet access doors shall have a door hold installed to prop doors open. All doors shall have stainless steel latches which are pad lockable. Electrical cabinet doors shall be outfitted with schematic/manual pouches formed into the door, along with wiring diagram attached to the indoor of the door from the factory.

B. Entire interior and exterior casing shall be constructed of minimum G90 galvanized steel. Unit shall have undergone a salt spray corrosion test as per ASTM B 117.

C. Entire unit shall be Miami-Dade wind rated up to ±150psf per TAS 201, 202 & 203 on any units utilizing a 20" or shorter factory provided roof curb.

2.03 AIRFLOW CONFIGURATIONS

A. Discharge: Unit shall be configurable for Down (vertical) discharge through the unit's base or Side (horizontal) discharge through the cabinet.

B. Return: Unit shall also be configurable for No Return, Down (vertical) Return through the unit's base, or Side (horizontal) Return through the cabinet.

C. Intake Airflow: Unit configuration shall be through use of a fresh/outdoor and return air damper.

1. Damper: Shall exceed AMCA Class 1A standard for low leakage. Damper assembly shall be a single assembly, and outfitted with an integral bird screen and louver/gutter system to divert any drainage through the base of the unit – intake air hood not required.

2. Actuator: A single direct drive damper actuator shall be used with spring return to ensure that the outdoor air section closes when not powered.

2.04 SUPPLY AIR BLOWER AND MOTOR

A. All supply fans shall be direct drive (belt-drive not acceptable) variable speed plenum fans.

B. Blower Motor: Motor shall be a premium efficiency motor available as:

1. Open Drip Proof (ODP) or Totally Enclosed Fan Cooled (TEFC) motor driven by a Variable Frequency Drive.

2. Electronically Commutated Motor (ECM) modulated using a Pulse Width Modulating (PWM) signal.

C. Fans to be selected at or near efficiency peak. (Submit fan curves).

D. Blower and motor assembly shall be dynamically balanced. The entire blower and motor assembly shall be mounted on rubber vibration isolators. Wheels balanced as per AMCA 204-96, Balance Quality and Vibration Levels for fans.

E. Unit equipped with total CFM monitoring to measure airflow across supply discharge.

2.05 REFRIGERATION SYSTEM

A. Unit shall utilize a variable speed inverter duty scroll compressor with the following features:

1. Modulation: Compressor shall be capable of compressor speed modulation from 15%-100% on 5, 6, 7.5, 8, 10, & 12.5 Ton units. Compressor shall be capable of compressor speed modulation from 25%-100% on 15, 20, 22, 25, 30, 40, and 50 Ton units.

2. Refrigerant: Unit shall be factory charged with R410A refrigerant.

3. Vibration Isolation: Compressor as well as blower assembly shall each be mounted on rubber vibration isolators to reduce transmission of vibration to the building structure.

4. Internal Overload Protection: Compressor shall include internal thermal overload production to protect against excessive motor temperatures.

5. Crankcase Heater: Compressor shall include a crankcase heater to protect against liquid flood-back and elimination of oil foaming on startup. The crankcase heater must remain powered when the compressor is not in operation.

6. Oil Management: Unit shall utilize both passive and active oil return management using Oil Level Sensor and scheduled oil boosts.

7. Monitored Envelope: Unit shall monitor all critical refrigeration points to ensure compressor does not operate outside of safe operating envelope.

8. Throttling Logic: Unit shall allow for high head pressure monitoring throttle mode for high ambient operation, and low suction pressure throttle mode for low capacity operation or any conditions resulting in low suction pressure.

9. Pump-Down: Active pump-down mode with discharge line check valve to protect against liquid migration into compressor during idle times.
10. Defrost mode in optional Heat Pump: When outdoor coils are deemed at risk of freezing, the unit shall simultaneously turn on auxiliary heat while running the heat pump in “cooling” mode to help defrost outdoor coils as needed while still maintaining desired leaving air temperatures.

B. The unit shall be outfitted with the following:
1. Indoor Coil: Indoor coil shall be a high efficiency 4-10 row coil design with aluminum fins mechanically bonded to copper tubes. Coil is staggered to increase turbulence, reduce the coil bypass factor, and ultimately increase the time the air stays within the coil. Includes two probe sensors to read average coil face temperature.
2. Electronic Expansion Valve: Each refrigeration circuit will be outfitted with an electronic expansion valve metering device which can be throttled from 0-100% open to allow for precise superheat control.
3. Indoor Coil Drain Pan: The indoor coil shall be outfitted with a sloped stainless steel drain pan. This pan shall be insulated along the entire base to prevent condensation, and outfitted with a safety overflow switch which will automatically shut down cooling operation prior to water overflowing the drain pan in the event of a drain clog. The entire drain pan shall be 20 GA Stainless Steel construction and wrap beneath the entire coil with flashing on entering side of coil to ensure capture of all condensate. Drain pan discharge pipe shall also be stainless steel construction. Drain pan shall be pitched to exceed ASHRAE 62.1 standard.
4. Base of the condensing coil cabinet shall be pitched away from the unit as a safety to ensure all draining exits away from the curb.
5. Optional Hot Gas Reheat Coil: The unit shall include an optional copper tube and aluminum fin hot gas reheat coil mounted downstream of the indoor coil. This coil shall be controlled via fully modulating hot gas reheat valve to provide precise reheat temperature control. This coil shall include the addition of an evaporative coil leaving condition sensor to maintain a coil dew point. This also prevents operation of a dehumidification call when intake dew point conditions are found to be below space dew point conditions, preventing wasted energy.
6. Outdoor (Condenser) Coil: Outdoor coil shall be a high efficiency coil design with aluminum fins mechanically bonded to copper tubes. The coil shall be downward sloped to protect coil from hail damage. Optional hail guards may also be outfitted to the outdoor coil for added protection from hail bouncing off the unit's roof up the coil.
7. Outdoor Fans: The outdoor coil shall have a vertical discharge outfitted with quiet, efficient, fully modulating Electronically Commutated Motor (ECM) condensing fans. These fans shall modulate to maintain a temperature differential between outside air and the outdoor coil.

C. To help mitigate any long-term potential for leaks or hardware failures, the unit shall be outfitted with the following protection measures:
1. Suction line accumulator for added protection against liquid entering suction line of compressor.
2. Bi-flow, low pressure drop, filter drier.
3. Electronic Expansion Valve (EEV) for precise superheat control. EEV shall open partially allowing system pressure equalization prior to activation of the compressor.
4. On optional heat pump units, use of a single 3-way reheat valve to prevent obstructions due to valve failure.
5. Protective rubber sleeves installed on all distribution lines of indoor coil to prevent wear from rubbing.
6. All refrigeration ports shall be short-stub assembly and any access port with a transducer or switch is mounted vertically to mitigate risk of bent/cracked stub joints.

7. Refrigeration circuit shall be mechanically CNC pre-bent tubing wherever possible with minimal brazed joints to minimize points for potential refrigeration leaks.
8. Factory tested for leaks via high pressure nitrogen decay and helium tracer gas testing.
9. Suction line temperature sensor failure detection.
10. Preventative failure alerts through a manufacturer provided, cloud based, cellular remote monitoring system.

2.06 HEATING SYSTEM

A. The gas burner shall be an indirect-fired, push-through type, using natural gas or liquid propane gas. The inlet-supply pressure to the unit for natural gas must be 7" w.c. minimum. For liquid propane gas, the minimum must be 11" w.c.

B. Burner shall be a tubular in-shot fired design capable of using natural or LP type gas. Each burner ignition shall be of the direct-spark design with remote flame sensing at inlet of the last firing tube of the gas manifold.

C. Direct-sparking sequence shall last through the complete duration of the trial for ignition period for guaranteed light-off. Burner shall always be lit at maximum gas flow and combustion airflow for guaranteed light-off. Each burner ignition module shall have LED indicators for troubleshooting and a set of exposed prongs for testing flame indication signal.

D. All furnaces shall be controlled by an electronic Vernier-type fully modulating control system capable of achieving 81% combustion efficiency over the entire gas firing range of the unit.

E. Each furnace shall have:

1. A minimum turndown ratio of 6:1 for natural gas and 5:1 for LP gas while maintaining a constant 81% efficiency (90% for high efficiency furnace option). No cold air bypass of the heat exchanger.
2. Each furnace heat exchanger shall be a bent-tube style design made entirely of stainless steel.
3. Stainless steel Quick Seal Connection for gas connection.
4. Manifold and Input gas pressure gauges.
5. Factory piped condensate drain to exterior of cabinet.
6. A combustion flue to be installed on adjacent side as combustion intake with integrated high velocity wind cap.
7. A blocked vent safety airflow switch with high temperature silicone tubing operating off of absolute pressure measured inside of the power-vent blower housing.
8. A high temperature auto-recycling limit with a maximum non-adjustable set point.
9. A manual reset high temperature flame roll out switch with a non-adjustable set point.
10. Each furnace compartment shall have a removable post and panel that allows the furnace to be easily removed for service and maintainability.
11. A power-vent assembly for exhausting flue gases with a PSC or ECM type motor that is securely mounted and easily accessible/removable for service.
12. A 0-10" w.c. gas pressure gauge installed on the gas manifold.

F. Each electric heater shall have:

1. SCR electric inserts for side or down discharge supply.
2. Electric coils are controlled using SCR controls. SCR is a time proportioning type controller that modulates the heater and supplies the exact amount of power to match the heat demand with a 10:1 turndown per stage with full modulation between minimum turndown and max output.

2.07 FILTERS

A. Provide filters as part of unit. All filters shall be furnished and installed to meet the performance requirements set forth in the schedule and as specified under another section of this work.

B. All filters shall be installed on tracks for easy removal from the unit.

C. Up to 3 layers of outdoor air filtration installed. Unit shall ship with a 2" washable metal mesh outdoor air filter. Mixed air shall have optional 2" MERV-8. Mixed air shall have optional MERV-13 filters. Mixed air shall have optional 4" MERV-15. Mixed air shall have optional 4" HEPA filter banks factory installed.

D. Unit shall have an optional adjustable pressure differential sensor for the filter bank to alert in the event of a clogged filter.

2.08 ELECTRICAL

A. All controls shall be pre-wired and housed in an insulated electrical cabinet within the unit to protect against risk of condensation.

B. Units shall be provided with single point electrical connection or separate electrical heat connection.

C. Unit shall be provided with a door safety switch that de-energizes the supply fan when the door is opened.

D. Unit shall be provided with a factory mounted averaging supply air temperature sensor to allow for accurate discharge temperature readings within unit when a downstream sensor is not installed. Field mounted and wired discharge air sensors will not be accepted.

E. Unit shall be provided with a factory mounted averaging intake air temperature sensor to allow for accurate intake temperature reading regardless of how the OA/RA dampers are positioned.

F. The electrical cabinet shall be outfitted with the following:

1. LED electrical cabinet service light with automatic activation upon door switch.
2. Color wiring schematics, laminated to the interior wall of the cabinet doors.
3. Factory mounted disconnect with unit bottom knockouts.
4. A LED backlit, LCD Human-Machine Interface (HMI) shall be mounted within the unit's control cabinet to allow for all set points configuration and refrigeration system monitoring at the unit.
5. Up to 4 additional space mounted HMIs available. Additional HMIs shall allow for full programming capabilities and are outfitted with integral temperature and humidity sensors. Additional HMIs shall be capable of being individually averaged for space temperature/humidity readings. All HMIs shall be wired using standard CAT5/6 cables.
6. Optional 120V, 15A unit powered or unpowered convenience outlet.

G. All sensors shall be wired back to the main control board that continuously monitors all critical components and makes decisions based on pre-determined logic to accurately control the following:

1. PID logic to control heater modulation ensuring precise discharge/space temperature control.
2. PID logic to control compressor speed to provide precise control over evaporative coil temperatures, leaving dew point, and discharge/space temperatures.
3. PID logic for Outdoor fan modulation to maintain an optimal outdoor coil temperature.
4. PID logic for Electronic Expansion Valve (EEV) position to maintain a precise superheat temperature
5. PID logic for Modulating Reheat valve to limit supply air temperature and relative humidity based off of space or discharge conditions.

2.09 CONTROLS

A. Unit shall be outfitted with a control board to allow for full control of the entire unit.

B. Provide air flow switch on the supply fan system to sense air flow with available set of contacts for connection to BMS for airflow alerts.

C. All unit controls shall be compatible with BACnet and LonWorks based building management systems.

D. All units shall be outfitted with CASLink cloud based monitoring, which monitors every point of operation. Provides configurable automated fault alert e-mails, and remote control capabilities.

E. Integrated cellular module to provide remote connection to monitoring services to view both real time and historical unit operation. Data shall be stored a minimum of 3 years on the cloud. Data sample rate shall be a maximum of 60 seconds.

F. Temperature Control System

1. Low-Ambient Cooling: Unit is factory outfitted with logic allowing for low-ambient operation of the DX system

    a. Standard low-ambient operation: Unit(s) with a DX system may operate down to 0°F outdoor temperatures purely through software utilizing the standard factory modulating components.

    b. Extreme low-ambient operation: Unit(s) with a DX system may operate to extreme low-ambient conditions, down to -25°F outdoor temperatures, are factory fitted with a bypass solenoid.

2. Discharge Temp Control (Heating)
   Unit modulates the burner flame (current supply in the case of electric heating) to accurately maintain the desired discharge temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using heating PID controls designed specifically for the DOAS.

3. Discharge Temp Control (Cooling)
   Unit modulates the compressor frequency to accurately maintain the desired discharge temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using proprietary cooling PID controls designed specifically for the DOAS.

4. Discharge Temp Control (Heat Pump)
   Unit modulates the compressor frequency to accurately maintain the desired discharge temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using heating PID controls designed specifically for the DOAS. Minimum and maximum discharge set points can be set to limit the temperature entering the space. When ambient temperatures drop below a user configurable minimum outdoor air temperature set point, or the unit is not able to maintain a user configurable minimum discharge temp for 5 minutes time, the heat pump will initiate its backup heat source. Initiation of backup heater operation shall ensure discharge temps are maintained prior to disabling heat pump to make sure discharge temps are never impacted during changeover. An optional additional HMI or room thermostat can be used to determine the space temperature. In the case that no temperature sensor is available in the space, the unit will use an internal return temperature sensor.

5. Discharge Humidity Control (Dehumidification)
   Unit modulates the compressor frequency to accurately maintain a desired evaporative coil dew point measured via a coil mounted temperature sensor between the evaporative and hot gas reheat coils. A fully modulating hot gas reheat valve shall utilize excess waste heat from the condensing section feeding the hot gas reheat coil with the precise amount of heat needed to accurately reheat the airstream in order to maintain a desired discharge temperature compensating for fluctuations in entering air temperature, air volume and % of OA using proprietary dehumidification PID controls designed specifically for DOAS.

6. Space Temp Control (Heating)
   Unit modulates the burner flame (current supply in the case of electric heating) to accurately maintain the desired space temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using heating PID controls designed specifically for the DOAS. Minimum and maximum discharge set points can be set to limit the temperature entering the space. An optional additional HMI or room thermostat can be used to determine the space temperature. In the case that no temperature sensor is available in the space, the unit will use an internal return temperature sensor.
7. Space Temp Control (Cooling)
   Unit modulates the compressor frequency to accurately maintain the desired space temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using cooling (heating when in heat pump mode) PID controls designed specifically for the DOAS. Minimum and maximum discharge set points can be set to limit the temperature entering the space. An optional additional HMI or room thermostat can be used to determine the space temperature. In the case that no temperature sensor is available in the space, the unit will use an internal return temperature sensor.
8. Space Temp Control (Heat Pump)
   Unit modulates the compressor frequency to accurately maintain the desired space temperature set point and compensate for fluctuations in entering air temperature, air volume and % of OA using heating PID controls designed specifically for the DOAS. Minimum and maximum discharge set points can be set to limit the temperature entering the space. When ambient temperatures drop below a user configurable minimum outdoor air temperature set point, or the unit is not able to maintain a user configurable minimum discharge temp for 5 minutes time, the heat pump will initiate its backup heat source. Initiation of backup heater operation shall ensure discharge temps are maintained prior to disabling heat pump to make sure discharge temps are never impacted during changeover. An optional additional HMI or room thermostat can be used to determine the space temperature. In the case that no temperature sensor is available in the space, the unit will use an internal return temperature sensor.
9. Space Humidity Control (Dehumidification)
   Unit modulates the compressor frequency to accurately maintain a desired evaporative coil dew point measured via a coil mounted temperature sensor between the evaporative and hot gas reheat coils. A fully modulating hot gas reheat valve shall utilize excess waste heat from the condensing section feed the hot gas reheat coil with the precise amount of heat needed to accurately reheat the airstream in order to maintain a desired space temperature compensating for fluctuations in entering air temperature, air volume and % of OA using proprietary dehumidification PID controls designed specifically for the DOAS.
10. Advanced Total Unit Economizer: The control system is outfitted standard, without need for any additional hardware, with an Advanced Total Unit Economizer which will take maximum advantage of as much energy available in the outdoor air conditions in order to run the compressor the minimum amount required at any given incoming air conditions. If the outdoor enthalpy (temperature and relative humidity) permits, the unit will be capable of completely modulating and shutting off compressor to provide “free” cooling and dehumidification as the outdoor air conditions allow.

G. Activation Controls:

1. Activate Based on Intake (Heating)
   Unit will activate heating when the intake temperature drops below the desired set point.
2. Activate Based on Intake (Cooling)
   Unit will activate cooling when the intake temperature rises above the desired set point.

3. Activate Based on Intake (Dehumidification)
   Unit will activate dehumidification when the intake conditions rise above the desired intake set point, with activation set points configured to a Dew Point, Relative Humidity or a combination of Dew Point/Relative Humidity.
4. Activate Based on Space (Heating)
   Unit will activate heating when the space temperature drops below the desired set point.
5. Activate Based on Space (Cooling)
   Unit will activate cooling when the space temperature rises above the desired set point.
6. Activate Based on Space (Dehumidification)
   Unit will activate dehumidification when the space set point rises above the desired space set point, with activation set points configured to a Dew Point, Relative Humidity or a combination of Dew Point/Relative Humidity.
7. Activate Based on Both (Heating)
   Unit will activate heating when the space AND intake temperature drop below the desired set point.
8. Activate Based on Both (Cooling)
   Unit will activate cooling when the space AND intake temperature rise above the desired set point.
9. Activate Based on Both (Dehumidification)
   Unit will activate dehumidification when the space and intake set point rise above the desired space and intake set point, with activation set points configured to a Dew Point, Relative Humidity or a combination of Dew Point/Relative Humidity.
10. Activate Based on Either (Heating)
    Unit will activate heating when the space OR intake temperature drops below the desired set point.
11. Activate Based on Either (Cooling)
    Unit will activate cooling when the space OR intake temperature rises above the desired set point.
12. Activate Based on Either (Dehumidification)
    Unit will activate dehumidification when the space or intake set point rises above the desired space or intake set point, with activation set points configured to a Dew Point, Relative Humidity or a combination of Dew Point/Relative Humidity.
13. Activate Based on Stat (Heating)
    Unit will activate heating when the space thermostat sends a 24V signal to W and G on the main control board. Unit will modulate to maintain a constant discharge heat set point.
14. Activate Based on Stat (Cooling)
    Unit will activate cooling when the space thermostat sends a 24V signal to Y and G on the main control board. Unit will modulate to maintain a constant discharge cool set point.

2.10 ROOF CURB

A. Unit shall be factory assembled, and constructed of 18GA galvanized steel, with optional 16GA available.

B. Curb shall be fully insulated with 1” acoustical and thermal insulation.

C. Curb shall be factory outfitted with duct support hangers.

2.11 VARIABLE FREQUENCY DRIVES

A. Provide Variable Frequency Drive for the compressor as part of the AC unit. VFD shall be furnished and installed to meet the performance set forth in the schedule and as specified under another section of this work.

1. Accessories to be furnished and mounted by the drive manufacturer and contained in a single enclosure. (The use of more than one enclosure is not acceptable).

B. Provide Variable Frequency Drive for speed control on all non-ECM direct drive supply fans.

C. All VFDs shall provide the following inherent protections:

1. Phase protection.
2. Brownout protection.
3. Overload/Overheat protection.
4. Soft starts to protect bearings/hardware.
5. Low & High voltage & over-torque protections.

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine areas and conditions under which packaged units are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.02 INSTALLATION

A. Install in accordance with manufacturer's instructions, drawings, written specifications, manufacturer’s installation manual and all applicable building codes.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of piping, fittings, and specialties. Install piping to allow service and maintenance.

B. Duct installation requirements are specified in other Division 23 Sections. Drawings indicate the general arrangement of ducts.

C. Electrical: Conform to applicable requirements in Division 26 Sections.

3.04 SYSTEM START-UP

A. System start-up is performed by a factory trained Service Technician.

END OF SECTION

SECTION 238126

INDOOR WALL—MOUNTED DUCTLESS AIR CONDITIONERS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SYSTEM DESCRIPTION

A. Indoor, wall-mounted, direct-expansion fan coils are matched with cooling only or heat pump outdoor unit.

B. Outdoor air-cooled split system compressor sections suitable for on-the-ground, rooftop, wall hung or balcony mounting. Units shall consist of a rotary compressor, an air-cooled coil, propeller-type draw-through outdoor fan, reversing valve (HP), accumulator (HP units), metering device(s), and control box. Units shall discharge air horizontally as shown on the contract drawings. Units shall function as the outdoor component of an air-to-air cooling only, or heat pump system.

C. Units shall be used in a refrigeration circuit matched to duct—free cooling only or heat pump fan coil units.

1.03 AGENCY LISTINGS

A. Indoor unit shall be rated per ARI Standards 210/240 and listed in the ARI directory as a matched system.

B. Outdoor Unit construction shall comply with ANSI/ASHRAE 15, latest revision, and with the NEC.

C. Outdoor Units shall be evaluated in accordance with UL standard 1995.

D. Outdoor Units shall be listed in the CEC directory.

E. Outdoor Unit cabinet shall be capable of withstanding 500--hour salt spray test per Federal Test Standard No. 141 (method 6061).

F. Air—cooled condenser coils shall be leak tested at 573 psig.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Units shall be stored and handled for unit manufacturer’s recommendations.

1.05 WARRANTY

A. Warranty shall be 1 year for parts and labor after installation and acceptance by the Client Agency.

PART 2 – PRODUCTS

2.01 INDOOR UNITS

A. Acceptable Manufacturers

1. Carrier Model 40 MCV/38MCV and 40 QNC/40QNQ
2. Sanyo
3. Mitsubishi
4. LG
5. Equal as approved by the Professional

B. General: Indoor, direct-expansion, wall-mounted fan coil. Unit shall be complete with cooling/heating coil, fan, fan motor, piping connectors, electrical controls, microprocessor control system, and integral temperature sensing. Unit shall be furnished with integral wall mounting bracket and mounting hardware.

C. Unit Cabinet: Cabinet discharge and inlet grilles shall be attractively styled, high-impact polystyrene. Cabinet shall be fully insulated for improved thermal and acoustic performance.

D. Fans:

1. Fan shall be tangential direct-drive blower type with air intake at the top of the unit and discharge at the bottom front. Automatic, motor-driven vertical air sweep shall be provided standard.

2. Air sweep operation shall be user selectable. The vertical sweep may be adjusted (using the remote control) and the horizontal air direction may be set manually.

E. Coil: Coil shall be copper tube with aluminum fins and galvanized steel tube sheets. Fins shall be bonded to the tubes by mechanical expansion. A drip pan under the coil shall have a drain connection for hose attachment to remove condensate. Condensate pan shall have internal trap.

F. Motors: Motors shall be open drip-proof, permanently lubricated ball bearing with inherent overload protection. Fan motors shall be 3-speed.

G. Controls: Controls shall consist of a microprocessor-based control system, which shall control space temperature, determine optimum fan speed, and run self-diagnostics. The temperature control range shall be from 62˚F to 84˚F. The unit shall have the following functions as a minimum:

1. An automatic restart after power failure at the same operating conditions as at failure.

2. A timer function to provide a minimum 24-hour timer cycle for system Auto Start/Stop.

3. Temperature—sensing controls shall sense return air temperature.

4. Indoor coil freeze protection.

5. Wireless infrared remote control to enter set points and operating conditions.

6. Automatic air sweep control, to provide on or off activation of air sweep louvers.

7. Dehumidification mode shall provide increased latent removal capability by modulating system operation and set point temperature.

8. Fan-only operation to provide room air circulation when no cooling is required.

9. Diagnostics shall provide continuous checks of unit operation and warn of possible malfunctions. Error messages shall be displayed at the unit.

10. Fan speed control shall be user-selectable: high, medium, low, or microprocessor controlled automatic operation during all operating modes.

11. Automatic heating-to-cooling changeover in heat pump mode. Control shall include deadband to prevent rapid mode cycling between heating and cooling.

12. Indoor coil high temperature protection shall be provided to detect excessive indoor discharge temperature when unit is in heat pump mode.

H. Filters: Unit shall have filter track with factory-supplied cleanable filters.

I. Electrical Requirements: Refer to the schedules on the drawings for voltages.

J. Operating Characteristics: The 40MVC, MVQ system shall have a minimum listed SEER (seasonal energy efficiency ratio) of 13 at ARI conditions, and a minimum HSPF of 7.7.

K. Refrigerant Lines: All units should have refrigerant lines that can be oriented to connect from the left, right or back of unit. Both refrigerant lines need to be insulated.

L. Special Features (Field Installed):

1. Condensate Pump:

a. The condensate pump shall remove condensate from the drain pan when gravity drainage cannot be used. Pump shall be designed for quiet operation. Pump shall consist of two parts: an internal reservoir/sensor assembly, and a remote sound-shielded pump assembly. A liquid level sensor in the reservoir shall stop cooling operation if the liquid level in the reservoir is unacceptable.

b. Where refrigerant piping is exposed to the occupied space indoors, the Contractor shall a provide a unit manufacturer pipe cover to conceal the refrigerant piping. The cover shall match the construction and color of the indoor evaporator unit.

2.02 OUTDOOR UNITS

A. Acceptable Manufacturers
   1. Carrier Model 38MVC/38MVQ and 38 HDR/38QRF (Basis of Design)
   2. Sanyo
   3. Mitsubishi
   4. LG
   5. Equal as approved by the Professional

B. General: Factory assembled, single piece, air-cooled outdoor unit. Contained within the unit enclosure shall be all factory wiring, piping, controls, and the compressor.

C. Unit Cabinet:
   1. Unit cabinet shall be constructed of galvanized steel, bonderized and coated with a baked-enamel finish on inside and outside.
   2. Unit access panels shall be removable with minimal screws and shall provide full access to the compressor, fan, and control components.
   3. Outdoor compartment shall be isolated and have an acoustic lining to assure quiet operation.

D. Fans:
   1. Outdoor fans shall be direct—drive propeller type, and shall discharge air horizontally. Fans shall draw air through the outdoor coil.
   2. Outdoor fan motors shall be totally-enclosed, single phase motors with class B insulation and permanently-lubricated ball bearings. Motor shall be protected by internal thermal overload protection.
   3. Shaft shall have inherent corrosion resistance.
   4. Fan blades shall be non metallic and shall be statically and dynamically balanced.
   5. Outdoor fan openings shall be equipped with PVC metal/mesh coated protection grille over fan.

E. Compressor:
   1. Compressor shall be fully hermetic rotary type.
   2. Compressor shall be equipped with oil system, operating oil charge, and motor. Internal overloads shall protect the compressor from over-temperature and over-current.
   3. Motor shall be NEMA rated class F, suitable for operation in a refrigerant atmosphere.
   4. Compressor assembly shall be installed on rubber vibration isolators.
   5. Compressors shall be single phase.

F. Outdoor Coil: Coil shall be constructed of aluminum fins mechanically bonded to seamless copper tubes, which are cleaned, dehydrated, and sealed.

G. Refrigeration Components: Refrigerant circuit components shall include brass external liquid line service valve with service gage port connections, suction line service valve with service gage connection port, service gage port connections on compressor suction and discharge lines with Schrader type fittings with brass caps, accumulator, reversing valve.

H. Controls and Safeties: Operating controls and safeties shall be factory selected, assembled, and tested. The minimum control functions shall include the following:
   1. Controls:
      a. A time delay control sequence is provided standard through the fan coil board.

b. Automatic outdoor-fan motor protection.

2. Safeties:

a. System diagnostics.

b. Compressor motor current and temperature overload protection.

c. Outdoor fan failure protection.

I. Electrical Requirements:

1. Refer to the schedules on the drawings for voltages.
2. Unit electrical power shall be a single point connection.
3. Unit control voltage to the indoor-fan coil shall be 24 VDC.
4. All power and control wiring must be installed per NEC and all local electrical codes.
5. Unit shall have high-and low-voltage terminal block connections.

J. Special Features (Field Installed):

1. Low-Ambient Kit: Control shall regulate fan-motor cycles in response to saturated condensing temperature of the unit. The control shall be capable of maintaining a condensing temperature of 100˚F ± 10˚F with outdoor temperatures to -20˚F. Installation of kit shall not require changing the outdoor fan motor.
2. Crankcase Heater
3. Wind baffle (field fabricated)

PART 3 – EXECUTION

3.01 INSTALLATION

A. Install units per manufacturer's recommendations.

END OF SECTION

SECTION 238213

TERMINAL HEATING-COOLING UNITS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 SCOPE

A. The equipment for the various HVAC systems shall be as hereinafter described in this section.

PART 2 - PRODUCTS

2.01 CABINET UNIT HEATER (HOT WATER)

A. Acceptable Manufacturers:

1. Trane (Basis of Design)
2. Dunham – Bush
3. Sterling
4. Price
5. Equal as approved by the Professional

B. Furnish and install complete cabinet type unit heaters. Unit heaters shall be as scheduled on the Drawings. Ceiling mounted units shall be suspended from overhead construction with vibration isolated supports.

C. Unit heaters shall each be of the multi-speed type consisting of fans, motor, factory-wired multi-speed switch with operating handle inside cabinet and nonferrous fin and tube heating element, all enclosed in a furniture steel cabinet with piping end compartments. Provision for expansion and contraction of the heating element shall be incorporated in the design of each unit. Heating elements shall be constructed of seamless copper tubes with aluminum fins.

D. Fans shall be of the centrifugal, double inlet aluminum wheel type with forward curved blades. Fans in each unit shall be mounted on a common shaft within steel scrolls, and shall be driven by a single direct-drive motor mounted inside the cabinet. Fans shall be especially designed for quiet operation.

E. Cabinets shall be constructed of furniture grade steel, complete with piping end compartment, discharge grille and return air grille and all finished with factory baked enamel finish of colors selected by the Professional from the manufacturer's standard colors. Supply duct collar and return air grille on units as indicated on the schedule.

F. Cabinet unit heaters shall have air handling and heating capacities as scheduled on the Drawings. Unit heaters shall be properly connected to hot water supply and return lines with ball valves and balancing cocks as herein specified. Valves, vents, and pressure taps shall be installed inside cabinets. Unit heaters shall be automatically controlled as hereinafter specified.

G. Motor for each cabinet unit heater shall be multi-speed type shown.

2.02 HORIZONTAL UNIT HEATERS (HOT WATER)

A. Acceptable Manufacturers:

1. Trane (Basis of Design)
2. Dunham – Bush

3. Sterling
4. Modine
5. Equal as approved by the Professional

B. Furnish and install suspended horizontal discharge type unit heaters. Unit heaters shall be of the multi-speed type, consisting of fan, fan guard, motor, nonferrous finned tube heating element, cabinet, double deflection discharge louvers, hangers, etc., and shall be constructed for quiet operation. Provision for expansion and contraction of heating elements shall be incorporated in the design of the units.

C. Heating elements shall have a water working pressure of 200 psig.

D. Motors for unit heaters shall be of the multi-speed type. Units shall be controlled as specified under "Automatic Temperature Control."

2.03 PEDASTAL MOUNT FIN-TUBE (HOT WATER)

A. Acceptable Manufacturers:

1. Runtal Commercial Model R2F-2 (Basis of Design)
2. Zehnder
3. Modine
4. Equal as approved by the Professional

B. Furnish and install steel double panel radiators of the lengths and in locations as indicated, and of capacities, style and having accessories as scheduled. The double heating panel radiation shall be of one-piece all-welded steel construction, consisting of a pair of flattened water tube panels welded to headers at each end. Welded to the inside of each panel shall be steel corrugated fins to increase the convective output of the radiator. The fins shall start at no less than 3” from the end of the radiator, and shall have no less than 32 fins per foot. The radiators shall include an integral heavy gauge (0.09” minimum) all-welded perforated top grille, which will cover the top of all of the finned areas.

C. Unit headers shall include all necessary inlet, outlet and vent connections as required. Standard connection sizes are ½” NPT tapered thread for supply and return piping, and 1/8” for the vent connection. Internal baffling shall be provided where required for proper water flow. The radiant heating panels shall be available in lengths from 2’-0” to 29’-6” in two inch even increments without the need for splicing. The panel radiation shall be manufactured in the USA.

D. The double panel radiators (up to four tubes tall) are to be provided with floor-mounted pedestals

E. Pressure Ratings: Pressure ratings for the radiation shall be as follows: STANDARD: Working pressure-56 PSI maximum, Test Pressure-74 PSI maximum. The installer shall provide adequate expansion compensation for each radiator.

F. Finishes: The panel radiation shall be cleaned and phosphatized in preparation for the powder coat finish. The radiation is then finish painted with a gloss powder coat finish, for a total paint thickness of 2-3 mils (0.002” - 0.003”). The color shall be selected from the Runtal’s standard colors by the Professional.

G. Warranty: All radiators shall be covered by a 5-Year Limited Warrant

H. The radiation manufacturer shall provide combination shutoff valve/union fitting of less than two inches in width for the supply and return to each panel radiator, to be field installed by the .2 Contractor.

I. Units shall be controlled as specified under "Automatic Temperature Control."

2.04 DUCT MOUNTED REHEAT COILS

A. Acceptable Manufacturers:

1. York/JCI (Basis of Design)
2. Trane
3. Modine
4. Equal as approved by the Professional

B. The hot water reheat coils shall be constructed with 1/2" or 5/8" O.D. copper tubes with pipe connections.
C. Plate type aluminum fins, seamless copper tubes and copper headers, with galvanized steel casings shall be included in the coil construction.
D. Coil shall be tested at 300 PSIG while under water.
E. Coil shall be suitable for at least 150 PSIG water-working pressure.
F. Coils shall be controlled by modulating valves as specified under "Automatic Temperature Control".
G. On units directly connected to outside air furnish with freezestat and connect to the temperature control system.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install per manufacturers recommendations.

END OF SECTION

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 EXECUTION OF THE WORK

A. The scope of work shown on the drawings and in these specifications, Division 26, 27 and 28 are all a part of this contract and shall be included in the base bid unless otherwise noted.

B. These Specifications call out certain duties of the .4 Contractor and/or Subcontractors. They are not intended as a material list of items required by the Contract.

C. These divisions of the Specifications cover the electrical systems of the project. It includes work performed by the electrical trades as well as trades not normally considered as electrical trades.

D. Provide all items and work indicated on the Drawings and all items and work called for in the Specifications in accordance with the conditions of Contract (Division 1 General Requirements Documents). This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor, consumable items, fees, licenses, etc., necessary to provide complete systems. Perform start-up and checkout on each item and system to verify the systems are fully operable.

E. Comply with all provisions of the Contract Documents including Division 1, General Conditions, and Supplementary General Conditions of the Specifications.

F. Certain terms such as "shall, provide, install, complete, start up" are not used in some parts of these Specifications. This does not indicate that the items shall be less than completely installed or that systems shall be less than complete.

G. Examine and compare the Electrical Drawings and Specifications with the Drawings and Specifications of other trades, and report any discrepancies between them to the Professional and obtain written instructions for changes necessary in the work. At time of bid the most stringent requirements must be included in said bid. Install and coordinate the electrical work in cooperation with other trades installing interrelated work. Before installation, make proper provisions to avoid interferences in a manner approved by the Professional. All changes required in the work of the Contractor caused by neglect shall be corrected at the expense of the Contractor.

H. It is the intent of the drawings and specifications to provide a complete workable system ready for the Department’s operation. These specifications are equipment and performance specifications. Items described or called out in the specification but not shown on the drawings are considered to be part of the project. Any item not specifically shown on the drawings or called for in the specifications, but normally required to conform to the intent are to be considered a part of the contract. Installation of the equipment shall be in accordance with the N.E.C., manufacturer recommendation, and industry standards.

I. All material furnished by the Contractor shall be new and unused (temporary lighting and power products are excluded) and free from defects. All materials used shall bear the Underwriters Laboratory, Inc label provided a standard has been established for the material in question.

J. All products and materials to be new, clean, free of defects and free of damage and corrosion.

K. No exclusion from, or limitation in, the symbolism used on the Drawings for electrical work or the languages used in the Specifications for electrical work shall be interpreted as a reason for omitting accessories necessary to complete any required system or item of equipment.

L. The use of words in the singular shall not be considered as limiting where other indications denote that more than one item is referred to.

M. Except for conduit, conduit fittings, outlet boxes, wire and cable, all items of equipment or material shall be the product of one manufacturer throughout. Multiple manufacturers will not be permitted.

1.03 COORDINATION OF THE WORK

A. Certain materials will be provided by other trades. Examine the Contract Documents to ascertain these requirements.

B. Carefully check space requirements with other trades and the physical confines of the area to ensure that all material can be installed in the spaces allotted thereto including finished suspended ceilings. Make modifications thereto as required and approved.

C. Transmit to other trades all information required for work to be provided under their respective sections in ample time for installation.

D. Wherever work interconnects with work of other trades, coordinate with other trades to ensure that all trades have the information necessary so that they may properly install all the necessary connections and equipment. Identify all items of work that require access so that the ceiling trade will know where to install access doors and panels.

E. Due to the type of the installation, a fixed sequence of operation is required to properly install the complete systems. Coordinate, project and schedule work with other trades in accordance with the construction sequence.

F. The locations of lighting fixtures, outlets, panels and other equipment indicated on the Drawings are approximately correct, but they are understood to be subject to such revision as may be found necessary or desirable at the time the work is installed in consequence of increase or reduction of the number of outlets, or in order to meet field conditions or to coordinate with modular requirements of ceilings, or to simplify the work, or for other legitimate causes.

G. Exercise particular caution with reference to the location of panels, outlets, switches, etc., and have precise and definite locations approved by the Professional before proceeding with the installation.

H. The Drawings show only the general run of raceways and approximate location of outlets. Any significant changes in location of outlets, cabinets, etc., necessary in order to meet field conditions shall be brought to the immediate attention of the Professional and shall receive approval before such alterations are made. All such modifications shall be made without additional cost to the Department.

I. Obtain from the Professional in the field the location of such outlets or equipment not definitively located on the Drawings.

J. Circuit "tags" in the form of arrows are used where shown to indicate the home runs of raceways to electrical distribution points. These tags show the circuits in each home run and the panel designation. Show the actual circuit numbers on the finished record tracing and on panel directory card. Where circuiting is not indicated, the Contractor must provide required circuiting in accordance with the loading indicated on the drawings and/or as directed.

K. The Drawings generally do not indicate the exact number wires in each conduit for the branch circuit wiring of fixtures, and outlets, or the actual circuiting. Provide the correct wire size and quantity as required by the indicated circuiting and/or circuit numbers indicated and control wiring diagrams, if any, specified voltage drop or maximum distance limitations, and the applicable requirements of the NEC.

L. Adjust locations of conduits, panels, equipment, pull boxes, fixtures, etc. to accommodate the work to prevent interferences, both anticipated and encountered. Determine the exact route and location of each raceway prior to installation.

1. Right of way: lines which pitch to have the right-of-way over those which do not pitch. For example: steam, condensate, and plumbing drains normally have right-of-way. Lines whose elevations cannot be changed to have right-of-way over lines whose elevations can be changed.

2. Make offsets, transitions and changes in direction in raceways and as required to maintain proper head room in pitch of sloping lines whether or not indicated on the Drawings.

M. Whenever the work is of sufficient complexity, prepare additional Detail Drawings to scale similar to that of the bidding Drawings, prepared on tracing medium of the same size as Contract Drawings. With these layouts, coordinate the work with the work of other trades. Such detailed work to be clearly identified on the Drawings as to the area to which it applies. Submit for review Drawings clearly showing the work and its relation to the work of other trades before commencing shop fabrication or erection in the field.

N. Contractor shall furnish services of experienced Superintendent, who shall be in constant charge of all work, and who shall coordinate his work with the work of other trades. No work shall be installed before coordinating with other trades.

1.04 EXAMINATION OF SITE

A. Prior to submitting of bids, the Contractor shall visit the site of the job and shall familiarize themselves with all conditions affecting the proposed installation and shall make provisions as to the cost thereof. Failure to comply with the intent of this paragraph will in no way relieve the Contractor of performing all necessary work shown on the Drawings.

1.05 PROGRESS OF WORK

A. The Contractor shall order the progress of his work so as to conform to the progress of the work of other trades and shall complete the entire installation as soon as the conditions of the building will permit. Any cost resulting from the defective or ill-timed work performed under this section shall be borne by the Contractor.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Ship and store all products and materials in a manner which will protect them from damage, weather and entry of debris. If items are damaged, do not install, but take immediate steps to obtain replacement or repair. Any such repairs shall be subject to review and acceptance of the Professional.

B. Delivery of Materials: Deliver materials (except bulk materials) in manufacturer's unopened container fully identified with manufacturer's name, trade name, type, class, grade, size and color.

C. Storage of Materials, Equipment and Fixtures: Store materials suitably sheltered from the elements, but readily accessible for inspection by the Professional until installed. Store all items subject to moisture damage in dry, heated spaces.

1.07 EQUIPMENT ACCESSORIES

A. Establish sizes and location of the various concrete bases required. Coordinate with .1 Contractor and provide all necessary anchor bolts together with templates for holding these bolts in position.

B. Provide supports, hangers and auxiliary structural members required for support of the work.

C. Furnish and set all sleeves for passage of raceways through structural, masonry and concrete walls and floors and elsewhere as will be required for the proper protection of each raceway and passing through building surfaces.

D. Wall mounted equipment, total weight of 100 pounds or less, may be directly secured to wall by means of steel bolts. Maintain at least 1" air space between equipment and supporting wall. Groups or arrays of equipment, with total weight of more than 100 pounds, shall be mounted on adequately free standing sized steel angles, channels, or bars. Prefabricated steel channels providing a high degree of mounting flexibility, such as those manufactured by Kindorf, Globe-Strutt and Unistrut, may be used for mounting arrays of equipment.

1.08 CUTTING, PATCHING, ETC.

A. The work shall be carefully laid out in advance. Where Cutting, channeling, chasing or drilling of floors, walls, partitions, ceilings or other surfaces is necessary for the proper installation, support or anchorage of raceway, outlets or other equipment, the work shall be carefully done. Any damage to the building, piping, equipment or defaced finish plaster, woodwork, metalwork, etc. shall be repaired by skilled mechanics of the trades involved at no additional cost to the Department.

B. The Contractor shall do no cutting, channeling, chasing or drilling of unfinished masonry, tile, etc., unless he first obtains permission from the Professional. If permission is granted, the Contractor shall perform this work in a manner approved by the Professional.

C. Where conduits, outlet, junction, or pullboxes are mounted on a painted surface, or a surface to be painted, they shall be painted to match the surface. Whenever support channels are cut, the bare metal shall be cold galvanized.

D. Slots, chases, openings and recesses through floors, walls, ceilings, and roofs will be provided by the various trades in their respective materials. The trade requiring them to properly locate such openings and be responsible for any cutting and patching caused by the neglect to do so.

1.09 NOMINAL VOLTAGES (UNLESS OTHERWISE NOTED)

A. Secondary distribution: 277/480 volt, 3 phase, 4 wire, 120/208 volt, 3 phase, 4 wire.

1.10 MOUNTING HEIGHTS

A. Unless otherwise noted or required because of special conditions, locate outlets as follows:

1. Heights listed are from finished floor to center of device. Verify exact locations with the Professional before installation.

a. Wall switch outlets 40"

b. Bracket outlets 7'- 0" to bottom

c. Convenience outlets (general) 18"

d. Convenience outlets (mechanical areas) 4' - 0"

e. Panelboard and distribution cabinet to top 6' - 6"

f. Fire alarm audio unit Lower of 80" AFF or 6" below ceiling

g. Fire alarm visual unit 80" to bottom or 96" to top AFF

h. Fire alarm stations 40" to top

i. Desk telephone outlets 18"

j. Wall telephone outlets 4' - 9"

k. Desk intercommunication outlets 1' - 6"

l. Television outlets 1' - 6"

1.11 CLEANING UP

A. Contractor shall take care to avoid accumulation of debris, boxes, crates, etc. resulting from the installation of work. Contractor shall remove from the premises each day all debris, boxes, etc., and keep the premises clean, subject to the Professional's instructions, which shall be promptly carried out.

B. Contractor shall clean all fixtures and equipment at the completion of the project.

C. All switchboards, panelboards, wireway, trench ducts, cabinets, enclosures, etc. shall be thoroughly vacuumed clean prior to energizing equipment at the completion of the project. Equipment shall be opened for observation by the Professional as required.

1.12 WATERPROOFING

A. Avoid, if possible, the penetration of any waterproof membranes such as roofs, machine room floors, basement walls, and the like. If such penetration is necessary, perform it prior to the waterproofing and furnish all sleeves or pitch-pockets required. Advise the Professional and obtain written permission before penetrating any waterproof membrane, even where such penetration is shown on the Drawings. Perform work so as to maintain any warranties currently in effect.

B. If this Contractor penetrates any walls or surfaces after they have been waterproofed, this Contractor shall restore the waterproof integrity of that surface at the expense of this Contractor and as directed by the Professional.

1.13 PRODUCTS

A. If products and materials are specified or indicated on the drawings for a specific item or system, use those products or materials. Where noted in other sections of this specification, equipment has been specified for a specific performance and substitutions are not permitted. If products and materials are not listed in either of the above, use first class products and materials, subject to approval of Shop Drawings where Shop Drawings are required or as approved in writing where Shop Drawings are not required.

1.14 OMISSIONS FROM THE DRAWINGS

A. Should a Bidder find discrepancies in or omissions from the drawings or specifications or be in doubt as to their meaning, he shall notify the Professional before submitting his proposal. The Professional will in turn, send written instructions to all Bidders. Neither the Professional nor the Department will be responsible for oral instructions. If the Contractor fails to comply with this requirement, he shall accept the Professional's interpretations as to the intended meaning of the drawings and specifications.

1.15 EXECUTION

A. Follow manufacturer's instructions for installing, connecting, and adjusting all equipment. Provide one copy of such instructions to the Professional before installing any equipment. Provide a copy of such instructions at the equipment during any work on the equipment. Provide all special supports, connections, wiring, accessories, etc.

B. Use mechanics skilled in their trade for all work.

C. Clean all items before and after installation. Clean up all debris.

D. Perform all tests required by local authorities in addition to tests specified herein, such as life safety systems.

E. Applicable equipment and materials to be listed by Underwriters' Laboratories and manufactured in accordance with ASME, NEMA, ANSI or IEEE standards and as approved by local authorities having jurisdiction.

F. Before commencing work, examine all adjoining, underlying, etc., work on which this work is in any way dependent for perfect workmanship and report any condition which prevents performance of first class work. Become thoroughly familiar with actual existing conditions to which connections must be made or which must be changed or altered.

1.16 VERIFICATION OF ELECTRICAL REQUIREMENTS FOR EQUIPMENT FURNISHED BY OTHERS

A. Prior to the installation of wiring systems for any equipment furnished by others, this contractor shall verify that the electrical requirements of the equipment match those shown on the electrical drawings by examining the approved shop drawings of that equipment. Any discrepancies shall be immediately reported to the Professional.

B. If the contractor fails to comply with this requirement, he shall be responsible for any additional costs incurred at no additional cost to the Department.

1.17 PROTECTION OF BUILDING FIRE/SMOKE BARRIERS

A. Passages of conduit through fire barriers and/or smoke barriers shall be protected as follows:

1. The space between the penetrating item and the fire barrier and/or smoke barrier shall be filled with a material capable of maintaining the fire/smoke resistance of the barrier or be protected by an approved device designed for the specific purpose.
2. Where the penetrating item uses a sleeve to penetrate the fire and/or smoke barrier the sleeve shall be solidly set in the fire/smoke barrier and the space between the item and the sleeve shall be filled as described above.
3. Fire barriers shall include 1-hour, 2-hour, and 3-hour rated floors and walls. Refer to architectural plans for location of fire barriers and smoke barriers and provide protection required to maintain ratings in accordance with all codes.
4. Approved fill material for fire barriers shall be packed mineral wool, with ASTME-136 rating and 3M Fire Barrier caulk. Coordinate sealing of all openings with requirements of Division 7 of this specification.
5. Perform work in accordance with the appropriate UL Ratings.
6. Product Data: Provide manufacturer's specifications, recommendations and installation instructions for each application.

1.18 CODES AND FEES

A. General: Comply with Codes in accordance with the Contract Documents.

B. The electrical installation shall be in compliance with the requirements of OSHA, NEC and the rules, regulations and requirements of the power company supplying power to the building.

C. The electrical installation shall comply fully with all township, county and state laws, ordinances and regulations applicable to electrical installations.

D. All equipment shall be equal to or exceed the minimum requirements of NEMA, IEEE and UL.

E. Should any change in Drawings or Specifications be required to comply with governmental regulations, the Contractor shall notify Professionals prior to execution of the work. The work shall be carried out according to the requirements of such code in accordance with the instruction of the Professional and at no additional cost to the Department.

F. The local fees and permits and services of inspection authorities shall be obtained and paid for by the Contractor. The Contractor shall cooperate fully with local utility companies with respect to their services.

G. Certificate of Inspection and approval shall be procured and paid for by this Contractor from an approved certified inspection agency.

1.19 GUARANTEE

A. General: Provide a Guarantee in accordance with the Contract Documents.

B. Submit a single guarantee stating that all portions of the work are in accordance with Contract requirements. Guarantee all work against faulty and improper material and workmanship for a period of one (1) year from date of final acceptance by the Department, except that where guarantees or warranties for longer terms are specified herein, such longer term to apply. Within 24 hours after notification, correct any deficiencies which occur during the guarantee period at no additional cost to Department, all to the satisfaction of the Department and Professional. Obtain similar guarantees from subcontractors, manufacturers, suppliers and subtrade specialists.

1.20 DISPOSAL

A. All electrical items not designated by the Client Agency for his use to be properly disposed of according to local, state and Federal regulations.

B. Items containing polychlorinated biphenyl (PCB) to be removed, transported and disposed of according to Federal Toxic Substances Control Act (TSCA). Contractor to submit certification that these items have been properly disposed.

1.21 EXCAVATION AND TRENCHING

A. Provide excavation for the work. Excavate all material encountered to the depths indicated on the Drawings or required. Remove from the site excavated materials not required or suitable for backfill. Provide grading as may be necessary to prevent surface water from flowing into trenches or other excavations. Remove any water accumulating therein. Provide sheeting and shoring as may be necessary for the protection of the work and for the safety of personnel.

B. Provide trenches of widths necessary for the proper execution of the work. Grade bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length. Where rock excavations are required, excavate rock to a minimum overdepth of 4 inches below the trench depths indicated on the Drawings or required. Backfill overdepths in the rock excavation and unauthorized overdepths with loose, granular, moist earth, thoroughly machine tamped to a compaction level as specified by the Professional. Whenever unstable soil incapable of properly supporting the work is encountered in the bottom of the trench as determined by the Professional, remove soil to a depth required and backfill the trench to the proper grade with coarse sand, fine gravel or other suitable material.

1. Primary electric service: 4 feet (minimum).
2. Secondary electric service: 2 feet (minimum).

1.22 BACKFILLING OF TRENCHES

A. Do not backfill trenches until all required tests have been performed and the installation observed by the Professional. Comply with the requirements of other sections of these Specifications. Deposit backfill in 6 inch layers and thoroughly and carefully tamp until for work has a cover of not less than 1 foot. Backfill and tamp remainder of trench at 12 inch intervals until complete. Uniformly grade the finished surface. Install a 6 inch marking ribbon 12 inches below finished grade.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 260500.10

ABBREVIATIONS AND DEFINITIONS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION

A. Utilize the following abbreviations and definitions for discernment within the Drawings and Specifications.

1. Abbreviations

a. NEC National Electrical Code

b. OSHA Occupational Safety and Health Act

c. ANSI American National Standards Institute

d. NFPA National Fire Protection Association

e. ASA American Standards Association

f. IEEE Institute of Electrical and Electronics Engineers

g. NEMA National Electrical Manufacturers Association

h. UL Underwriters' Laboratories, Inc.

i. IES Illuminating Engineering Society

j. ICEA Insulated Cable Engineers Association

k. ASTM American Society of Testing Materials

l. ETL Electrical Testing Laboratories, Inc.

m. CBM Certified Ballast Manufacturers

n. EIA Electronic Industries Association

o. OEM Original Equipment Manufacturer

p. ADA Americans with Disabilities Act

2. Definitions

a. "PROVIDE" means to supply, purchase, transport, place, erect, connect, test and turn over to Client Agency, complete and ready for regular operation, the particular work referred to.

b. "INSTALL" means to join, unite, fasten, link, attach, set up or otherwise connect together before testing and turning over to Client Agency, complete and ready for regular operation, the particular work referred to.

c. "FURNISH" means to supply all materials, labor, equipment, testing apparatus, controls, tests, accessories and all other items customarily required for the proper and complete application for the particular work referred to.

d. "WIRING" means the inclusion of all raceways fittings, conductors, connectors, tape, junction and outlet boxes, connections, splices, and all other items necessary and/or required in connection with such work.

e. "CONDUIT" means the inclusion of all fittings, hangers, supports, sleeves, etc.

f. "AS DIRECTED" means as directed by the Professional or his representative.

g. "CONCEALED" means embedded in masonry or other construction, installed behind wall furring or within double partitions or installed within hung ceilings.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 260500.19

MAINTENANCE MANUALS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION

A. General: Provide maintenance manuals in accordance with the Contract Documents.

1.03 SUBMITTALS

A. Provide three (3) hard copies or (3) digital copies of each manual.

B. Hard copies to be 8-1/2 inches x 11 inches size in hard back 3-ring loose-leaf binders. Use more than one volume if required; do not overfill binders.

C. Digital copies shall be provided on individual flash disk drives (USB type) and attached to a large placard.

D. Submit one (1) copy to Professional. After review and acceptance, assemble other copies.

E. Manuals to be completed and in Client Agency’s hands prior to turning building over to Client Agency and at least 10 days prior to instruction to operating personnel.

PART 2 - PRODUCTS

2.01 MANUFACTURERS' LITERATURE

A. General: Provide manufacturers' literature on all items of equipment and components as regularly published by the respective manufacturers for proper preventative and comprehensive maintenance.

PART 3 - EXECUTION

3.01 PROVIDE MAINTENANCE MANUALS INCLUDING BUT NOT LIMITED TO THE FOLLOWING:

A. Alphabetical list of all system components, with the name, address, and 24-hour phone number of the company responsible for servicing each item during the first year of operation.

B. Operating instructions for complete system including:

1. Normal starting, operating, and shut-down.
2. Emergency procedures for fire or failure of major equipment.

C. Maintenance instructions including:

1. Proper lubricants and lubricating instructions for each piece of equipment, and date when lubricated.
2. This shall be a separate list in addition to manufacturers' data.
3. Necessary cleaning, replacement and/or adjustment schedule.

D. Manufacturers' data on each piece of equipment including:

1. Installation instructions.
2. Drawings and specifications.
3. Parts list, including recommended items to be stocked.
4. Complete wiring diagrams.
5. Marked or changed prints locating all concealed parts and all variations from the original system design.
6. Test and inspection certificates.

END OF SECTION

SECTION 260500.22
EQUIPMENT WIRING

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION

A. General: Provide final connections to equipment and coordinate same in accordance with the Contract Documents.

B. Equipment to receive final connections shall include, but not be limited to the following:

1. Mechanical equipment
2. Appliances
3. Miscellaneous equipment
4. Client Agency furnished equipment
5. Automatic doors and controls

1.03 EXAMINATION OF DOCUMENTS

A. Prior to the submitting of bids, the Contractor shall familiarize himself with all conditions affecting the proposed installation of equipment requiring electrical connections and shall make provisions as to the cost thereof. Failure to comply with the intent of this paragraph shall in no way relieve the Contractor of performing all necessary work required for final electrical connections and equipment.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 MECHANICAL EQUIPMENT

A. All power wiring and connections for all motors including starters, controllers, and breakers as indicated on the drawings and the riser diagrams shall be furnished and installed under this section of the specifications.

B. Motors shall be connected in a neat and skillful manner. Ones delivered with terminal boxes that are inadequate shall be equipped with special boxes that suit the conditions.

C. In general, rigid conduit or tubing shall be used, but motors that require movement or ones that would transmit vibration to conduit shall be wired with liquid tight flexible steel conduit not over 18" long.

D. All motors shall be grounded with a green covered ground wire run inside the conduit and connected to motor frame on one end and to grounding system on the other end.

E. Motors and their starters are only approximately located on the drawings and the Contractor shall allow for the relocation that developed conditions may demand.

F. The location of motors, starters and control equipment and the arrangement to be followed shall be determined on the job jointly by the Contractor whose equipment is involved, this Contractor and the Professional.

G. Starting equipment shall be either wall mounted or free standing, as best suits conditions. If free standing, this Contractor shall make and install a suitable frame of structural steel to accommodate it.

H. Furnish and install one motor snap switch of the proper size for disconnect of each single phase motor indicated on the drawings.

I. All equipment furnished with a variable frequency drive (VFD) shall utilize VFD cable to the motor.

3.02 CONTROL WIRING

A. Control wiring for .2 and .3 equipment will be furnished and installed by .2 and .3 Contractor as Specified in Divisions 22 and 23.

B. All control wiring in Divisions 22 and 23 is the responsibility of the contractor who provides the particular equipment. Control wiring includes the providing of all required motor controls, relays, pilot devices, all related raceway systems, all related conductors and all final connections other than three phase power connections.

C. For single phase equipment provided under .2 and .3 Contract, this Contractor shall provide single phase feeders and make final connection through the control device.

D. All other control wiring required by other Divisions of the Specifications shall be furnished and installed by this Contractor. Unless specifically indicated on the drawings or specified hereinafter to the contrary, all control devices such as starters, pushbuttons, limit switches, etc., are furnished under other Divisions of the Specifications. This Contractor shall receive and store all electrical equipment to be installed by him. Conduit and layout and arrangement of control wiring shall be done by this Contractor.

3.03 EQUIPMENT CONNECTIONS

A. This contractor shall make final connections to all electrical equipment. Coordinate with equipment supplier for size and location of all final connections. Contractor to match receptacle with plugs of equipment supplied by others.

END OF SECTION

SECTION 260500.24

FOOD SERVICE EQUIPMENT

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.03 DESCRIPTION

A. General: Provide final electrical connections and control wiring to kitchen equipment.

B. Related Work Specified Elsewhere

1. Food Service equipment
2. Fire alarm and detection systems

1.04 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and recommendations of the following:

1. Food and Drug Administration
2. NFPA-96

1.05 EXAMINATION OF DOCUMENTS

A. Prior to the submitting of bids, the Contractor shall familiarize himself with all conditions affecting the proposed installation of food service equipment and shall make provisions as to the cost thereof. Failure to comply with the intent of this paragraph shall in no way relieve the Contractor of performing all necessary work required for final connections and control wiring of food service equipment.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.01 INSTALLATION OF FOOD SERVICE EQUIPMENT

A. .4 Contractor to make the final field coordination with food service equipment drawings as to final equipment locations. No extras will be given for kitchen equipment relocations due to field conditions.

3.02 FOOD SERVICE EQUIPMENT CONNECTIONS

A. The .4 Contractor is to furnish the following electrical equipment/devices and make the following connections, but is not limited to:

1. All junction boxes, electrical outlets, stainless steel cover plates and switches not built into food service equipment.
2. All plugs and cords as noted on food service consultant's schedules.
3. Furnish and install shunt-trip branch circuit breakers or shunt-trip main circuit breakers as indicated and disconnect switches for fire control system shut-off of kitchen equipment below hoods or ventilators as shown on the food service consultant's documents or the electrical documents.
4. Disconnect switches or other similar devices as required by code.
5. To provide conduit and wiring, installation of electrical devices furnished by kitchen equipment Contractor and interwire between the following:

a. Remote refrigeration equipment to evaporative coils.

b. Control panels to water-type ventilators and exhaust/supply fans.

c. Kitchen exhaust hoods/ventilators to fire control system and shut-offs.

d. Signal from fire control system to local fire alarm panel with a dedicated zone per fire control system.

B. All outlets and connections shown on electrical kitchen drawings are indicated for kitchen equipment only. Refer to electrical drawing(s) which indicates the general areas for outlets and devices for general purpose use.

C. The electrical kitchen plans indicate outlet type and location, and connection positions and loads. For final rough-in locations, refer to kitchen consultant's dimensioned plans. All dimensions shown are from finished floor and finished walls, unless otherwise noted.

D. Internal electrical work for fabricated food service equipment shall be internally wired and connected by kitchen equipment manufacturer for all kitchen equipment, except as noted. Refer to electrical document for food service equipment which, because of physical size, will be delivered to job-site in two or more pieces. In such case, .4 Contractor shall make final connection(s) to make a single piece of food service equipment.

E. All electrical work for fabricated food service equipment shall be completely wired by kitchen equipment manufacturer (except as noted above), to a junction box or pull box mounted on the equipment in an accessible position. Final connections between equipment, junction or pull boxes to the electrical panelboard (except as noted) to be the responsibility of the .4 Contractor.

END OF SECTION

SECTION 260508

TESTING, ACCEPTANCES, AND CERTIFICATIONS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION

A. General: Complete testing of equipment and systems shall be provided throughout in accordance with the Contract Documents.

1.03 STANDARDS

A. Except as modified by governing codes and by the Contract Documents comply with the latest applicable provisions and the latest recommendations of the following:

1. Industry standards shall apply except as otherwise specified.

1.04 APPLICABLE CODES, STANDARDS AND REFERENCES

A. All inspections and tests shall be in accordance with the following applicable codes and standards except as provided otherwise herein.

1. National Electrical Manufacturer's Association – NEMA
2. American National Standards Institute – ANSI
3. Institute of Electrical and Electronic Engineers – IEEE
4. National Electrical Code – NEC
5. National Fire Protection Association – NFPA
6. American Society for Testing and Materials – ASTM
7. Insulated Power Cable Engineers Association – IPCEA
8. Association of Edison Illuminating Companies – AEIC
9. Occupational Safety and Health Administration – OSHA
10. State and local codes and ordinances
11. Applicable Independent Testing Associations Specifications

B. All inspections and tests shall utilize the following references:

1. Project design specifications
2. Project design drawings
3. Manufacturer's instruction manuals applicable to each particular apparatus.

1.05 SUBMITTALS

A. The test report shall include the following:

1. Summary of project
2. Description of equipment tested
3. Description of test
4. Test results
5. Conclusions and recommendations
6. Appendix, including appropriate test forms
7. List of test equipment used and calibration date
8. Conditions for future access to secured computer database of all Test Data.

B. Furnish three copies of the completed report to the project Professional no later than 30 days after completion of the project, unless directed otherwise.

1.06 SAFETY AND PRECAUTIONS

A. Safety practices shall include, but are not limited to, the following requirements:

1. Occupational Safety and Health Act of 1970 – OSHA 29CFR 1910.269
2. National Fire Protection Association – NFPA 70E
3. Applicable state and local safety operating procedures.

B. All tests shall be performed with apparatus de-energized except where otherwise specified.

C. The engineering service testing group's lead test Professional for the project shall be a designated safety representative and shall be present on the project and supervise testing operations and safety requirements.

D. Power circuits shall have conductors shorted to ground by a hotline grounded device approved for the purpose in accordance with the appropriate test procedures.

E. In all cases, work shall not proceed until the safety representative has determined that it is safe to do so.

F. The engineering service testing group shall have available sufficient protective barriers and warning signs, where necessary, to conduct specified tests safely.

G. The Client Agency's safety procedures shall be reviewed and understood by the engineering service testing group personnel.

PART 2 - PRODUCTS

2.01 GENERAL

A. Provide all labor, premium labor and materials required by shop and field testing as specified in the Contract Documents and as required by the authorities having jurisdiction.

2.02 SYSTEMS

A. The following systems are to be tested, inspected and certified.

1. Wire and Cable (600 Volts and Below)
    a. Inspect all splices and terminations and make mechanically and electrically tight during a fifteen (15) day period immediately prior to final acceptance of the work.
    b. Insulation System – To ensure integrity of the cable insulation system after shipping, site storage, and pulling through conduit an insulation resistance test will reveal insulation deformities and moisture in the cable that otherwise might cause an untimely premature cable failure possibly damaging equipment or personnel. Perform the following on all customer power cables to and from main switchboard. This would include cables from utility transformer to MSB and cables from MSB to all secondary switchboards or distribution panels.
    c. Visually inspect visible portion of cables for observable defects.
    d. Ensure all solid-state devices are disconnected from the system prior to meggering. Typically but not all-inclusive would be Meters, trip units with voltage sensing, and SPD units.
    e. Isolate cables by opening breakers. Meggering thru equipment like motors or transformers will produce erroneous readings.
    f. Perform insulation-resistance tests on each line and load cable, phase-to-phase, phase-to-ground, phase-to-neutral and neutral-to-ground in each conduit. Megger at 1000 VDC for 600 volt cable and 500 VDC for 300 volt cable for one minute.
    g. Insulation resistance shall be above 100 ohms and preferably above one megohm.
    h. Ensure cable termination connections are tight after testing.
2. Motors
    a. Test all motors under load and verify that motor rotation is correct.
3. Fire Alarm Systems

a. All wiring must be inspected and tested to insure that there are not grounds, opens or shorts. The minimum allowable resistance between any two conductors or between conductors and ground is ten (10) megohms as measured with a 500 volt meager after all conduit, conductors, detector bases, etc., have been installed, but before the detector devices are plugged into the bases or end-of-line devices installed.

b. The Contractor must perform all electrical and mechanical tests required by the equipment manufacturer's form. All test and report costs must be in the Contract price. A checkout report is to be prepared by the technician and submitted in triplicate, one copy of which will be registered with the equipment manufacturer. The report is to include, but not be limited to:

1) A complete list of equipment installed and wired.

2) Indication that all equipment is properly installed and functions and conforms with these specifications.

3) Tests of individual zones as applicable.

4) Serial numbers, locations by zone and model number for each installed detector.

5) Voltage (sensitivity) settings for each ionization detector as measured in place.

6) Response time on detectors.

7) Contractor shall submit a certified report indicating the following:

a) Operating all manual stations and all detectors that can be reset.

b) Verifying line supervision of each initiating and indicating circuit.

c) Verifying the operation of each initiating circuit.

d) Verifying the operation of all indicating devices.

e) Verifying the operation of all alarm- initiated functions.

f) Verifying full operation of the F.C.I.P.

4. Switchboard Acceptance Testing For Main Switchboard(s)

a. Examine the Main switchboard(s), including breakers, and accessories for:

1) Doors, panels, and sections for alignment, dents, scratches, fit, and missing hardware

2) Shipped loose and shipped short components.

3) Shipping damage

4) Loose or obviously damaged components.

5) Proper identification.

6) Physical damage from installation.

7) If the unit was placed in temporary storage, verify and record that proper procedures were observed. Remove temporary heater wiring and shipping braces.

b. Inspect

1) Shipping Splits to insure that all bus connections were properly connected and all control wiring splits have been properly terminated.

2) Inspect all grounding connections for cleanliness and alignment.

3) Main Bonding Jumper for proper size and termination (Refer to NEC Article 250, Section 250-102, Equipment Bonding Jumpers).

4) Insulators for evidence of physical damage or contaminated surfaces.

5) Surge Arrester and/or Surge Suppression size, type, installation and connection to determine if they are in accordance with the drawings (Refer to NEC Article 280)

6) Control power & instrument transformers, if applicable.

7) Wiring for damaged insulation, broken leads, tightness of connections, proper crimping, and overall general condition.

c. Verify Structure, Grounding, Cables and Bus Assembly

1) Anchorage (per local codes, wind and seismic considerations).

2) Required area clearances, correct alignment and cleanliness.

3) Verify the grounding electrode conductor is properly sized (in accordance with NEC Article 250, Table 250-66) and terminated.

4) The proper grounding of instruments, panels and connections (Refer to NEC Article 250, Part J, Sections 250-170 through 250-178).

5) That conductors are properly identified (as applicable).

6) Cable termination tightness.

7) That all cables have been properly installed, routed and supported and are clear of energized parts.

8) That conduits and conduit bushings are correctly installed.

9) Tightness of accessible bolted electrical connections, especially shipping splits, by calibrated torque-wrench method in accordance with manufacturers published data.

d. Verify Control and Instrumentation

1) That all VT and CT ratios properly correspond to drawings and that polarity is correct.

2) That shorting screws and bars are removed from CT's and terminal blocks as required.

3) That primary and secondary fuse ratings or circuit breakers match drawings.

4) Meter scaling and type match drawings.

e. Set Meter, Relay, and Breaker Trip settings

1) The meter, protective relay, breaker settings (and PFC choices) must be supplied from a Power System Study performed by the Professional service group prior to commissioning.

2) Calculations and settings are to take into account coordination and protection that might be non-intuitive. i.e., a 5000 amp breaker may be set to a 3000 amp trip point to match a utility primary fuse. While this may not seem right at first, tripping the main first rather than a normally smaller utility transformer may avoid blowing a primary utility fuse, and avoid the resulting single phasing and the downtime of waiting for the utility response. It would be far simpler and faster to reset main and reenergize quickly, not to mention the loss of equipment from single phasing.

3) Set meter, relay, & breaker trip setting per above study.

f. Ductor Testing

1) Inspect shipping splits for mechanical connection assuring adequate surface contact.

2) Ground bonding & shipping splits shall be tested with ductor tester (Digital low ohm resistance meter) to insure connection is a low resistance connection. Test from one fixed bus to adjacent fixed bus through the shipping split connector to measure both connection points.

3) Microhm values shall not vary more than 50% from other phase readings and meet the manufactures published data based on bus size, ampacities and material.

g. Test of the Phase Loss and Undervoltage Relay

1) Test the phase loss relay, either separate or integral to the multimeter, to activate contact.

2) Test the undervoltage relay, either separate or integral to the multimeter, to activate contact.

3) If contact is hooked to the Capacitor trip & Shunt trip combo on main breaker, insure main breaker trips.

4) If contact reports to energy management system, insure energy management system receives loss of phase/voltage signal.

h. Ground Fault Testing

1) Inspect switchboard main bonding jumper for proper size and termination on source side of neutral disconnect link.

2) Inspect Grounding electrode conductor to assure proper size and secure termination to ground bus.

3) Inspect switchboard neutral bus downstream of the neutral disconnect link to verify the absence of ground connections.

4) Set Ground fault setting per calculations in E above.

5) Verify Ground Fault System Performance for correct response of the circuit-interrupting device by secondary (or primary if local inspector requires) ground sensor current injection. Record ground fault pickup current. Verify breaker trips and indicator works.

6) Verify Ground fault does not pick-up at 90% of pickup setting.

7) Record settings, results, and any other notations on the Low Voltage Breaker data form.

PART 3 - EXECUTION

3.01 GENERAL

A. Notify the Professional seven (7) days prior to the testing dates. If the Professional so elects not to witness a specific test a statement of certification must be forwarded to the Professional for his approval.

B. Conduct tests at a time agreeable to the Professional. Provide premium labor as necessary.

C. Products which are found defective or do not pass such tests shall be removed and replaced at the Contractor's expense. Tests shall be repeated.

D. Conduct all test required by the authorities having jurisdiction.

3.02 RESTORATION OF EQUIPMENT AND REPORTS

A. Before Energizing

1. Remove and account for all test equipment, jumper wires, and tools used during testing.

2. Remove and account for safety grounds and tools.

3. Replace all barriers and covers, close all doors, and secure all latches.

4. Remove safety locks and tags.

5. Ensure all adjustable meters, relays and trip devices are properly set in accordance with the coordination study.

6. Apply testing label to equipment

B. Note corrective actions taken, deficiencies, recommendations and any general comments.

C. Finish recording data on test forms, completely filling in the blanks. Enter into electronic database as required in section 1.4.E

D. Turn in 3 copies of report to Professional for approval through e-Builder.

3.03 FOLLOW UP TESTING

A. Included in above cost as part of original project.

B. One month prior to the expiration of the factory warranty schedule & perform a thermal scan of all breaker to cable, breaker, bus connections, cable to panel chassis. Scope is to include main transformer connections, main switchboard, all secondary switchboards, transformers, and panels. Tests are to be done with building normal loaded for 2 hours, not with partial or unloaded condition.

C. Thermal scan temperatures shall be evaluated as follows (based on comparable size or adjacent phases and loaded breakers, bus connections, and terminations)

   1. 1-3 degrees C rise, Investigate as to the cause of temp rise.
   2. 4 – 15 degree C rise, Repair as soon as possible.
   3. 16 or higher degree C rise, Repair immediately.

D. Ensure that all bus and breaker to cable connections are tight.

E. Note corrective actions taken, deficiencies, recommendations and any general comments.

F. Finish recording data on test forms, completely filling in the blanks.

G. Turn in 3 copies of report to Professional for approval.

END OF SECTION

SECTION 260519

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification Section, apply to this Section.

1.03 SUMMARY

A. General: Provide 600 volt wire and cable in accordance with the Contract Documents.

1.04 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Underwriters Laboratory Standard No. UL 467, UL 486c
    a. ASTM
    b. IPECA
2. Terminal Blocks
    a. UL-1059

PART 2 - PRODUCTS

2.01 WIRE AND CABLE

A. General

1. Provide wire with a minimum insulating rating of 600 volts, except for wire used in 50 volts or below applications for control of signal systems use 300 volt minimum or 600 volt where permitted to be incorporated with other wiring systems.

B. Conductor

1. Electrical grade, annealed copper fabricated in accordance with ASTM standards. Minimum size number 12 for branch circuits; number 14 for control wiring.
2. The conductors shown on the drawings are copper, except as noted otherwise.

C. Stranding and Number of Conductors

1. Number 12 and number 10 solid.
2. Cables larger than number 10, stranded in accordance with ASTM Class B stranding designations.
3. Control wires stranded in accordance with ASTM Class B stranding designations.
4. Cables, multi-conductor unless otherwise noted for low tension systems.

D. Insulation

1. Type THWN/THHN insulation suitable for use in wet locations up to 75 degrees Centigrade. Use for lighting, receptacle and motor circuits and for panel and equipment feeders.
2. Type THHN – Flame retardant: Heat-resistant thermoplastic insulation, nylon jacket rated for 90 degrees Centigrade operation. Use for lighting branch circuit wiring installed and passing through the ballast channels of fluorescent fixtures, wiring in metal roof decks in or near roof insulation, in attic or joist spaces, or in raceways exposed to the sun.

3. Type XF – Crosslinked polyolefin insulated heat-resistant wire suitable for 150 degrees Centigrade operation. Use for fixture wiring or any wiring within 3 feet horizontally or 10 feet above any furnace, boiler or similar appliance.

E. Color Coding

1. Provide consistent color coding of all feeders, sub feeders, motor circuits and the likes as follows:

120/208 Volts Code	277/480 Volts Code
Phase A - Black	Phase A - Brown
Phase B - Red	Phase B - Orange
Phase C - Blue	Phase C - Yellow
Neutral - White	Neutral - Gray
Ground - Green	Ground - Green w/Yellow Stripe

2. Color code wiring for control systems installed in conjunction with mechanical and/or miscellaneous equipment in accordance with the wiring diagrams furnished with the equipment. Factory color code wire number 2 and smaller. Wire number 1 and larger may be color coded by color taping of the entire length of the exposed ends.

2.02 CONNECTORS

A. Make connections, splices, taps and joints with solderless devices, mechanically and electrically secure. Protect exposed wires and connecting devices with electrical tape or insulation to provide not less than that of the conductor.

B. Branch Circuit wires (Number 10 and smaller): Use any of the following types of terminals and connecting devices:

1. Hand Applied

a. Coiled tapered, spring wound devices with a conducting corrosion-resistant coating over the spring steel and a plastic cover and skirt providing full insulation for splice and wired ends. Screw connector on by hand.

2. Tool Applied

a. Steel cap, with conduction and corrosion resistant metallic plating, open at both ends, fitted around the twisted ends of the wire and compressed or crimped by means of a special die designed for the purpose. Specifically fitted plastic or rubber insulating cover wrap over each connector.

2.03 ELECTRICAL TAPE

A. Specifically designed for use as insulating tape.

2.04 LUBRICANT

A. Use lubricant only where the possibility of damage to conductors exists. Use only a lubricant approved by the cable manufacturer and one which is inert to cable and raceways.

PART 3 - EXECUTION

3.01 WIRE AND CABLE

A. Provide a complete system of conductors in raceway system. Mount wiring through a specified raceway, regardless of voltage application.

B. Drawings do not indicate size of branch circuit wiring. For branch circuits whose length from panel to furthest outlet exceeds 100 feet for 120-volt circuits, use number 10 or larger.

C. Do not install wire in incomplete conduit runs nor until after the concrete work and plastering is completed and moisture is swabbed from conduits. Eliminate splices wherever possible. Where necessary, splice in readily accessible pull, junction, or outlet.

D. Provide cable supports for all vertical risers where required by code.

E. Flashover or insulation value of joints to be equal to that of the conductor. Provide Underwriters Laboratories listed connectors rated at 600 volts for general use and 1,000 volts for use between ballasts and lamps or gaseous discharge fixtures.

F. Use terminating fittings, connectors, etc., of a type suitable for the specified cable furnished. Make bends in cable at termination prior to installing compression device. Make fittings tight.

G. Extend wire sizing for the entire length of a circuit, feeder, etc. unless specifically noted otherwise.

H. Provide a separate neutral conductor for each branch circuit. In the event a common neutral conductor is used, such as in furniture systems, the circuit breaker in the panelboard must be common trip for each phase that uses one neutral conductor.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification Section, apply to this Section.

1.03 SUMMARY

A. General: Provide a low impedance grounding system in accordance with the Contract Documents.

1.04 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Underwriters Laboratory Standard No. UL 467
2. ANSI C-1 1978

PART 2 - PRODUCTS

2.01 GENERAL

A. Furnish and install an electrical grounding system as indicated on the construction documents and as specified herein.

B. Grounding systems shall be installed in accordance with the requirements of the local authorities, NEC Section 250, and subject to the approval of the Professional.

C. All ground wires and bonding jumpers shall be stranded copper installed in conduit. All ground wires shall be without joints and splices over its entire length.

2.02 GROUNDING SYSTEMS

A. The system neutral shall be grounded at the service entrance only, and kept isolated from grounding systems throughout the building.

B. Each system of continuous metallic piping and ductwork shall be grounded in accordance with the requirements of the NEC Section 250.

C. Metal conduits and portions of metallic piping and duct systems which are isolated by flexible connections, insulated coupling, etc., shall be bonded to the equipment ground with a flexible bonding jumper, or separate grounding conductor.

D. All conduits, metal raceways, boxes, cabinets, etc., installed by this Contractor and all motors and equipment connected shall be properly bonded and grounded.

E. In all feeders and branch circuits install a green colored ground wire to each panel, cabinet, receptacle, motor or piece of control equipment.

F. The green ground wires shall be extended and connected to the ground bus in the panels or equipment enclosure. Neutral wiring system shall not be used for this purpose. Green ground wire shall be connected to all junction or pull boxes through which they pass and to all cabinet and panel enclosures.

G. This ground wire shall be run in same conduit as phase and neutral wires feeding equipment, motor or receptacles and conduit size shall be increased if necessary. This conductor shall be installed whether or not shown on the drawings and shall be sized in accordance with NEC but shall not be smaller than #12 AWG. Motors shall be grounded by a grounding terminal in their connection box. Tie all ground wires together in panels and connect to ground bus in panel cabinet.

H. All electrical equipment including lighting fixtures shall be grounded in the same manner as motors. All equipment shall be solidly grounded to the green covered wire and this Contractor shall furnish grounding lugs as required.

PART 3 - EXECUTION

3.01 GENERAL

A. Grounding connections and splices shall be brazed molded exothermic welded, bolted clamp terminal or pressure-connector type. Bolted connections and pressure-connectors shall be used for connections to removable equipment. Brazed connections shall be made where noted on drawings.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary conditions and Division 1 Specification Section, apply to this Section.

1.03 SUMMARY

A. Equipment shall be installed on hangers and supports as specified in this section of the specifications.

1.04 SUPPORTS

A. Support work in accordance with the best industry practice and the following.

B. Include supporting frames or racks extending from floor slab to ceiling slab for work indicated as being supported from walls where the walls are incapable of supporting the weight. In particular, provide such frames or racks in electric closets.

C. Include supporting frames or racks for equipment, intended for vertical surface mounting, which is required in a free-standing position.

D. Supporting frames or racks shall be of standard angle, standard channel or specialty support system steel members. They shall be rigidly bolted or welded together and adequately braced to form a substantial structure. Racks shall be of ample size to assure a workmanlike arrangement of all equipment mounted on them.

E. Nothing, (including outlet, pull and junction boxes and fittings) shall depend on electric conduits, raceways, or cables for support, except that threaded hub type fittings having a gross volume not in excess of 100 cubic inches may be supported from heavy wall conduit, where the conduit in turn is securely supported from the structure within five inches of the fitting on two opposite sides.

F. Nothing shall rest on, or depend for support on, suspended ceilings media (tiles, lath, plaster, as well as splines, runners, bars and the like in the plane of the ceiling).

G. Provide required supports and hangers for conduit, equipment, etc., so that loading will not exceed allowable loadings of structure.

1.05 FASTENINGS

A. Fasten electric work to building structure in accordance with the best industry practice and the following:

B. As a minimum procedure, where weight applied to the attachment points is 100 pounds or less, fasten to building elements of:

1. Wood – with wood screws.
2. Concrete and solid masonry – with bolts and expansion shields.
3. Hollow Construction – with toggle bolts.
4. Solid metal – with machine screws in tapped holes or with welded studs.
5. Steel decking or subfloor – with fastenings as specified below for applied weights in excess of 100 pounds.

C. As a minimum procedure, where weight applied to the attachment points exceeds 100 pounds, but is 300 pounds or less, conform to the following:

1. At concrete slabs utilize 24" x 24" x 1/2" steel fishplates on top with through bolts. Fishplate assemblies shall be chased in and grouted flush with the tob of slab screen line, where no fill is to be applied.
2. At steel decking or subfloor for all fastenings, utilize through bolts or threaded rods. The tops of bolts or rods shall be set at least one inch below the top fill screen line and grouted in. Suitable washers shall be used under bolt heads or nuts. In cases where the decking or subfloor manufacturer produces specialty hangers to work with his decking or subfloor such hangers shall be utilized.

D. Where weight applied to building attachments points exceeds 300 pounds, coordinate with and obtain approval of Professional and conform to the following:
1. Utilize suitable auxiliary channel or angle iron bridging between building structural steel elements to establish fastening points. Bridging members shall be suitably welded or clamped to building steel. Utilize threaded rods or bolts to attach to bridging members.

E. Floor mounted equipment shall not be held in place solely by its own dead weight. Include floor anchor fastenings in all cases.

F. For items which are shown as being ceiling mounted at locations where fastening to the building construction element above is not possible, provide suitable auxiliary channel or angle iron bridging tying to the building structural elements.

PART 2 – PRODUCTS (Not Used)

PART 3 – EXECUTION (Not Used)

END OF SECTION

SECTION 260533

RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION

A. General: Provide raceways in accordance with the Contract Documents.

1.03 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Rigid Conduit – RMC
    a. UL Standard UL-6
    b. ANSI C80-1
    c. Federal Specification WW-C-581E
2. Electrical Metallic Tubing – EMT
    a. UL Standard UL-797
    b. ANSI C80-3
    c. Federal Specification WW-C-563
3. Flexible Metal Conduit – FMC
    a. UL Standard UL-1
4. LiquidTight Flexible Metal Conduit – LFMC
    a. UL Standard UL-360
5. Rigid Non-Metallic Conduit – RNC
    a. UL Standard UL-651
    b. ANSI Standard C33.91
    c. Federal Specifications GSA-FSS and W-C1094-A
6. Wireways and Auxiliary Gutters
    a. UL Standard UL-870

PART 2 - PRODUCTS

2.01 RACEWAY TYPES

A. Rigid Steel Conduit – RMC

1. Rigid steel conduit heavy wall galvanized.

B. Electric Metallic Tubing – EMT

1. Continuous, seamless tubing galvanized or sheradized on the exterior coated on the interior with a smooth hard finish of lacquer, varnish or enamel.
2. All couplings, connectors, etc., used in conjunction with this raceway which are 2 inch in size and smaller shall be watertight compression type. EMT fittings shall be zinc plated steel. With conduits of 2-1/2 inch in size and larger, set screw type couplings are permitted.

C. Flexible Metal Conduit – FMC

1. Single strip, continuous, flexible interlocked double-wrapped steel, galvanized inside and outside forming smooth internal wiring channel.
2. Maximum length: 6 feet.
3. Each section of raceway must contain a bonding wire bonded at each end and sized as required. Provide connectors with insulating bushings.

D. LiquidTight Flexible Metal Conduit – LFMC
1. Same as flexible steel conduit except with tough, inert watertight plastic outer jacket.
2. Cast malleable iron body and gland nut cadmium plated with one-piece brass grounding bushings which thread to interior of conduit. Spiral molded vinyl sealing ring between gland nut and busing and nylon insulated throat.

E. Rigid Non-Metallic Conduit – RNC
1. Composed of polyvinyl chloride suitable for 90º C.
2. Raceway, fittings and cement must be produced by the same manufacturer who must have had a minimum of ten (10) years experience in manufacturing the products.
3. Materials must have a tensile strength of 7,000 – 7,200 psi and compressive strength of 9,000 psi.
4. All joints shall be solvent cemented in accordance with the recommendations of the manufacturer. Install expansion fittings per NEC.

F. Wireways and Auxiliary Gutters
1. Of sizes and shapes indicated on the Drawings and as required.
2. Provide all necessary elbows, tees, connectors, adaptors, etc.
3. Hinged cover secured with captive screws.
4. Wire retainers not less than 12 inches on center.

G. Duct Banks
1. Provide duct banks as indicated on the Drawings.
2. Reinforce duct banks with steel where such duct banks are positioned beneath roads and parking areas.
3. Concrete to be minimum of 3,000 pounds per square inch.
4. Provide rigid steel raceway across all excavated and backfilled ditches and for a length of 10 feet from building and manhole walls. Pitch conduit away from building at every point where duct bank enters the building or equipment.
5. Support raceways installed in duct banks every 5 feet to assure correct alignment prior to placing concrete.
6. Terminate raceways with flared bells to enable ease of pulling cable and to eliminate stress on the cable. Free bells and raceway terminations of burrs and rough edges.
7. Provide concrete markers at grade where duct banks are stubbed out for future use.
8. Install duct banks not less than 30 inches below grade. Install 6 inch marking ribbon 12 inches below grade.

2.02 OUTLET, JUNCTION AND PULLBOXES

A. Provide zinc-coated or cadmium-plated sheet steel outlet boxes not less than 4 inches octagonal or square, unless otherwise noted. Equip fixture outlet boxes with 3/8 inch no-bolt fixture studs where required. Where fixtures are mounted on or in an accessible type ceiling, provide a junction box and extend flexible conduit to each fixture. Fit outlet boxes in finished ceilings or walls with appropriate covers, set flush with the finished surface. Where more than one switch or device is located at one point, use gang boxes and covers unless otherwise indicated. Sectional switch boxes or utility boxes will not be permitted. Provide Series "GW" (Steel City) tile box, or as accepted, or a 4 inch square box with tile ring in masonry walls which will not be plastered or furred. Where drywall material is utilized, provide plaster ring. Provide outlet boxes of the type and size suitable for the specific application. Where outlet boxes contain two or more 277 volt devices, or where devices occur of different applied voltages, or where normal and emergency devices occur in same box, provide suitable barrier.

B. Construct junction or pullboxes not over 150 cubic inches in size as standard outlet boxes, and those over 150 cubic inches the same as "cabinets" with screw covers of the same gauge metal.

C. Plug any open knockouts not utilized.

D. Provide surface mounted outlet and junction boxes in indoor locations where exposed to moisture and outdoor locations of cast metal with threaded hubs.

PART 3 - EXECUTION

3.01 APPLICATION OF RACEWAYS

A. The following applications must be adhered to except as otherwise required by Code. Raceway not conforming to this listing must be removed by this Contractor and replaced with the specified material at this Contractor's expense.

B. Raceway Types Application

Rigid Conduit RMC	1. Where exposed on outside of building or subjected to exterior temperatures and humidity. 2. Where required by codes. 3. All circuits in excess of 600V.
Electrical Metallic Tubing EMT	Use in every instance except where another material is specified.
Flexible Metal Conduit – FMC	Use in dry areas for connections to lighting fixtures in hung ceilings, connections to equipment installed in removable panels of hung ceilings at all transformer or equipment raceway connections where sound and vibration isolation is required.
LiquidTight Flexible Metal Conduit - LFMC	Use in areas subject to moisture where flexible steel is unacceptable at connections to all motors, and all raised floor areas.
Rigid Non-Metallic Conduit – RNC	1. Schedule 40 – Where raceways are in slab in below grade levels, for raceway duct banks. 2. Schedule 80 – For underground raceways outside of the building which are not encased in concrete
Wireways and Auxiliary Gutters	Where indicated on the drawings and as otherwise specifically approved.

3.02 RACEWAY SYSTEMS IN GENERAL

A. Provide raceways for all wiring systems unless noted otherwise. 277/480 volt wiring must be kept independent of 120/208 volt wiring. Where non-metallic raceways are utilized, provide sizes as required with the grounding conductor considered as an insulated additional conductor. Minimum size 3/4 inch for home runs and 1 inch minimum for power distribution. Wiring of each type and system must be installed in separate raceways.

B. Install capped bushings on raceways as soon as installed and remove only when wires are pulled. Securely tie embedded raceway in place prior to embedment. Raceways installed below or in floor slabs must extend a minimum of 4 inches above the finished slab to the first connector. Lay out the work in advance to avoid excessive concentrations or multiple raceway runs.

C. Locate raceways so that the strength of structural members is unaffected and they do not conflict with the services of other trades. Install 1 inch or larger raceways in or through structural members (beams, slabs, etc.) only when and in the manner accepted by the Professional. Draw up couplings and fittings full and tight. Protect threads from corrosion with one coat zinc chromate after installation.

D. Above Grade – Defined as the area above finished grade for a building exterior and above top surface of any slabs (or other concrete work) on grade for a building interior. Above-grade raceways to comply with the following:

   1. Install raceways concealed except at surface cabinets and for motor and equipment connection in electrical and mechanical rooms. Install a minimum of 6 inches from flues, steam pipes, or other heated lines. Provide flashing and counter-flashing for waterproofing of raceways, outlets, fittings, etc., which penetrate the roof. Route raceways parallel or perpendicular to building lines with right-angle turns and symmetrical bends. Run embedded raceways in a direct line and, where possible, with long sweep bends and offsets. Provide sleeves in forms for new concrete walls, floor slabs and partitions for passage of raceways. Waterproof sleeved raceways where required.

   2. Provide raceway expansion joints for exposed and concealed raceways with necessary bonding conductor at building expansion joints and between buildings or structures and where required to compensate for raceway or building thermal expansion and contraction.

   3. Provide one empty 3/4 inch raceway for each three spare unused poles or spaces of each flush-mounted panelboard. Terminate empty 3/4 inch conduit in a junction box, which after completion, is accessible to facilitate future branch circuit extension.

   4. Provide raceway installation (with appropriate seal-offs, explosion-proof fittings, etc.) in special occupancy area, as required. Provide conduit seal-offs where portions of an interior raceway system pass through walls, ceiling or floors which separate adjacent rooms having substantially different maintained temperatures, as in refrigeration or cold storage rooms.

   5. Protect raceway in earth or fill with two coats of asphalt base paint. Touch up abrasions and wrench marks after conduit is in place.

   6. In lieu of above, protect raceways with a minimum of 20 mil tape approved for the purpose and overlapped a minimum of 1/2 tape width.

   7. Provide drag wire in spare or empty raceways. Tag both ends of wire denoting opposite and termination location with black India ink on flameproof linen tag.

E. Below Grade: Defined as the area below finished grade for a building exterior and below or within the bottom floor slab for a building interior. Below grade raceways to comply to the following.

   1. Project below-grade raceways 2 inches minimum above floor or equipment foundation. Install exterior underground conduits 24 inches minimum below finished grade. Do not penetrate waterproof membranes unless proper seal is provided.

F. No raceway may be installed in a concrete slab.

G. Rigid non-metallic conduit installations shall conform to the following:

1. All joints are to be made by the solvent cementing method using the material recommended by the raceway manufacturer. Fittings, cement and conduit shall be supplied by the same manufacturer.
2. Raceway cutoffs shall be square and made by handsaw or other approved means which does not deform the conduit. Raceway shall be reamed prior to solvent cementing to couplings, adapters, or fittings.
3. Electrical devices which are served by PVC raceways to be grounded by means of ground wire pulled in the raceway.
4. Male box adapters shall be used for all box or raceway fittings to terminate plastic raceways.
5. Where separable terminations are required, they shall be made using PVC threaded adapters with locknuts or bushings. If such terminations must be watertight, "O" rings shall be installed.
6. Bends shall be made by methods that do not deform or damage the conduit. The radii of field bends shall not be less than those established by the NEC.
7. Raceway expansion fittings shall be provided in accordance with NEC. The position of the expansion fitting shall be adjusted proportional to the temperature at installation.
8. Raceway supports shall be installed in such a manner to allow the PVC conduit to slide through the supports as the temperature changes.
9. Elbows must be galvanized rigid steel.
10. Rigid non-metallic conduit is not permitted to be installed within the building.

H. Raceways in hung ceilings shall be run on and secured to slab or primary structural members of ceiling, not to lathing channels or T-bars or other elements which are the direct supports of the ceiling panels. Secure conduit firmly to steel by clips and fittings designed for that purpose. Install as high as possible, but not less than, 1-0" above hung ceilings.

I. Exposed raceways shall be run parallel or at right angles with building lines. Secure raceway clamps or supports to masonry materials by toggle bolts, expansion bolts, or steel inserts. Install raceway on steel construction with approved clamps which do not depend on friction or set-screw pressure alone.

J. Clear raceway of all obstructions and dirt prior to pulling in wires or cables. This shall be done with ball mandrel (diameter approximately 85% of conduit inside diameter) followed by close fitting wire brush and wad of felt or similar material. This assembly may be pulled in together with, but ahead of the cable being installed. All empty raceways shall be similarly cleaned. Clear any raceway which rejects ball mandrel.

K. Support less than 2 inch trade size, vertically run, raceways at intervals no greater than eight feet. Support such raceways, 2 inch trade size or larger, at intervals no greater than 10 feet.

L. Support less than 1 inch trade size horizontally run, raceways at intervals not greater than 7 feet. Support such raceways, 1 inch trade size or larger, at intervals no greater than 10 feet.

3.03 WIREWAY AND AUXILIARY GUTTER

A. Wireways installed in hung ceilings shall be placed such that the cover will hinge upward from the side.

B. A 12 inch clear work space shall be provided from wireway cover when it is in the open position.

3.04 OUTLET, JUNCTION, AND PULLBOXES

A. Provide outlet, junction, and pullboxes as indicated on the Drawings and as required for the complete installation of the various electrical systems, and to facilitate proper pulling of wires and cables. J-boxes and pullboxes shall be sized per NEC minimum.

B. The exact location of outlets and equipment is governed by structural conditions and obstructions or other equipment items. When necessary, relocate outlets so that when fixtures or equipment are installed, they will be symmetrically located according to the room layout and will not interfere with other work or equipment. Verify final location of outlets, panels equipment, etc., with Professional.

C. Back-to-back outlets in the same wall or "thru-wall" type boxes are not permitted. Provide 12 inch (minimum) spacing for outlets shown on opposite sides of a common wall to minimize sound transmission.

3.05 FLOOR BOXES

A. Reference shall be made to other sections of this specification for floor boxes.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Condition and other Division 1 Specification Sections, apply to this Section.

1.03 SUMMARY

A. This Section includes the following:

1. Identification for electrical raceways
2. Identification of power and control cables
3. Identification for branch circuit and feeder conductors
4. Underground-line warning tape
5. Warning labels and signs per N.E.C.
6. Instruction signs
7. Identification labels for distribution equipment, junction boxes, cabinets and miscellaneous equipment.

1.04 SUBMITTALS

A. Product Data: Furnish type of material to be supplied for each electrical identification product indicated.

1.05 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Comply with ANSI A13.1
2. Comply with NFPA 70
3. Comply with 29 CFR 1910.144 and 29 CFR 1910.145
4. Comply with ANSI Z535.4 for safety signs and labels

1.06 COORDINATION

A. Coordinate identification names, abbreviations, colors and features with requirements in the Contract Documents, shop drawings, manufacturer's wiring diagrams and operation and manual and with those required by codes and standards.

PART 2 - PRODUCTS

2.01 POWER RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Raceway Colors for Circuits at 600 V or Less

1. Black letters on an orange field.
2. Fire Alarm Circuits: Red letters on natural field.
3. Legend: Indicate voltage and system or service type.

C. Self-Adhesive Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.02 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils thick by 1 to 2 inches wide.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

2.03 UNDERGROUND-LINE WARNING TAPE

A. Description: Permanent, Bright-Colored, Continuous-Printed, Polyethylene Tape

1. Not less than 6 inches wide by 4 mils thick.
2. Compounded for permanent direct-burial service.
3. Embedded continuous metallic strip or core.
4. Printed legend shall indicate type of underground line.

2.04 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.05 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.06 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: White letters on a dark-gray background. Minimum letter height shall be 3/8 inch.

2.07 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Accessible Raceways 600 V or Less, for Service, Feeder, and Branch Circuits More Than 90A: Identify with orange self-adhesive vinyl label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands.

1. Fire Alarm System: Red

C. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

D. Attach signs and plastic labels with mechanical fasteners appropriate to the location and substrate.

E. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 12 inches below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches overall.

3.02 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power
2. Power

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded service, feeder and branch-circuit conductors.

a. Colors for 208/120-V Circuits

1) Phase A: Black
2) Phase B: Red
3) Phase C: Blue
4) Neutral: White
5) Ground: Green

b. Colors for 480/277-V Circuits

1) Phase A: Brown
2) Phase B: Orange
3) Phase C: Yellow
4) Neutral: White
5) Ground: Green

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

C. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source.

D. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.

2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

E. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.
1. Limit use of underground-line warning tape to direct-buried cables.
2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

F. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install marking tape at flush-mounted panelboards and similar equipment in finished spaces.

G. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.
1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:
a. Power transfer switches.
b. Controls with external control power connections.

H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.
1. Labeling Instructions
a. Indoor Equipment: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide five lines of text.
1) First Line: 1/2-inch letters on the first line stating equipment name.
2) Second Line (if applicable): 3/8-inch letters stating the existing equipment name in parentheses ( ).
3) Third Line: 3/8-inch letters stating voltage/phase.
4) Fourth Line: 3/8-inch letters stating the breaker number, panel name and room number/name (Department's room number) from which the equipment is fed.
5) Fifth Line: 3/8-inch letters stating function and/or equipment which it controls.
2. Equipment to be Labeled
a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Switchboards.

e. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

f. Substations.

g. Emergency system boxes and enclosures.

h. Enclosed switches.

i. Enclosed circuit breakers.

j. Enclosed controllers.

k. Push-button stations.

l. Contactors.

m. Remote-controlled switches, dimmer modules, and control devices.

n. Power-generating units.

END OF SECTION

SECTION 260574

OVERCURRENT PROTECTIVE DEVICE ARC-FLASH STUDY

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. Section Includes

1. Provide a short-circuit, component protection, flash hazard analysis, study for the electrical distribution system from all power sources (normal and emergency) down to the branch circuit overcurrent protective device and equipment. The short circuit, flash hazard study shall be performed by the manufacturer supplying the equipment. Series rated systems are not approved.

1.03 PURPOSE

A. The study shall calculate the available short-circuit current at each point in the electrical distribution system. The overcurrent protective devices shall have an interrupting rating equal to or greater than the available short-circuit current at the point of application.

B. The study shall examine proper protection of electrical system components and utilization equipment such that the equipment has a sufficient short-circuit current rating. If a specific type of overcurrent protective device is required for proper protection of equipment, it shall be noted in the report and reflected in the design of the system.

C. The study shall include a flash hazard analysis for electrical distribution equipment where required per codes and standards. The analysis shall determine the flash protection boundary, incident energy, and required level of personal protective equipment (PPE) for workers at the electrical distribution equipment. The flash protection boundary and incident energy shall be determined based upon a working distance of 18 inches. The electrical distribution equipment shall be field marked with this information in accordance with codes and standards.

D. The studies shall be submitted to the Design Professional prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Professional may be obtained for a preliminary submittal of sufficient study data to ensure that the selection of device ratings and characteristics will be satisfactory.

E. The studies shall include all portions of the electrical distribution system from the normal power source or sources down to and including the smallest adjustable trip circuit breaker in the distribution system. Normal system connections and those which result in maximum fault conditions shall be adequately covered in the study.

F. The firm should be currently involved in high and low-voltage power system evaluation. The study shall be performed, stamped and signed by a registered Professional. Credentials of the individual performing the study and background of the firm shall be submitted to the Professional for approval prior to start of the work. A minimum of five (5) years experience in power system analysis is required for the individual in charge of the project.

G. The firm performing the study should demonstrate capability and experience to provide assistance during start up as required.

1.04 REFERENCES

A. The flash hazard analysis shall be completed in accordance with latest editions of NFPA 70E – Standard for Electrical Safety Requirements for Employee Workplaces and IEEE Standard 1584 – Guide for Performing Arc-Flash Hazard Calculations.

1.05 DATA COLLECTION FOR THE STUDY

A. The Contractor shall provide the required data for preparation of the studies. The Professional performing the system studies shall furnish the Contractor with a listing of the required data immediately after award of the contract.

B. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to release of the equipment for manufacturing.

1.06 SHORT-CIRCUIT PROTECTIVE DEVICE EVALUATION STUDY

A. The short-circuit study shall be performed with the aid of a digital computer program and shall be in accordance with the latest applicable IEEE and ANSI standards.

B. In the short-circuit study, provide calculation methods and assumptions, the base per unit quantities selected, one-line diagrams, source impedance data including power company system characteristics, typical calculations, tabulations of calculation quantities and results, conclusions, and recommendations. Calculate short-circuit interrupting and momentary (when applicable) duties for an assumed 3-phase bolted fault at each supply switchgear lineup, unit substation primary and secondary terminals, low-voltage switchgear lineup, switchboard, motor control center, distribution panelboard, pertinent branch circuit panelboard, and other significant overcurrent protective device locations throughout the system. Provide a ground fault current study for the same system areas, including the associated zero sequence impedance data. Include in tabulations fault impedance, X to R ratios, asymmetry factors, motor fault contribution, short circuit kVA, and symmetrical and asymmetrical fault currents.

C. Include complete fault calculations as specified herein based on contract documents.

D. Submit qualifications of individual(s) who will perform the work for approval prior to commencement of the studies. Provide studies in conjunction with equipment submittals to verify equipment ratings required. Make all additions or changes as required by the reviewer.

E. Contractor shall furnish all data as required by the short-circuit/coordination study vendor. Utilize data for the study obtained by the Contractor from contract documents, including contract addendums issued prior to bid openings.

F. Notify the Professional in writing of circuit protective devices not properly rated for fault conditions.

G. When emergency generator is provided, include phase and ground coordination of the generator protective devices. Show the generator decrement curve and damage curve along with the operating characteristic of the protective devices. Contractor shall obtain the information from the generator manufacturer and include the generator actual impedance value, time constants and current boost data in the study. Do not use typical values for the generator.

1.07 SUBMITTALS

A. The results of the study shall be summarized in report form. Submit 6 copies for review and approval by the design Professional.

B. The results of the study shall include the following:

1. Descriptions, purpose, basis, and scope of study.
2. Fault current calculations including definition of terms and guide for interpretation of computer printout.
3. Tabulations of protective device and equipment ratings versus calculated short-circuit duties, and commentary regarding same.
4. Flash hazard analysis report for electrical distribution equipment.

C. If power company review and approval is required, the results of the study shall be submitted to the power company for review and approval. Approved copies from the power company shall be forwarded to the design Professional.

1.08 SUBMITTALS – CLOSEOUT

A. Submit 6 copies of the final approved study to the electrical design Professional.

PART 2 - PRODUCTS

2.01 REQUIREMENTS

A. The short circuit and flash hazard analysis study shall be completed with the aid of a computer software program where possible.

B. The available short-circuit current, corresponding required interrupting or short-circuit current ratings of components, and flash hazard analysis data, shall be calculated based upon the 3-phase bolted short-circuit, current and phase to ground/neutral short-circuit current at each of the following (if applicable):

1. Utility Service Point.
2. Low-voltage switchgear or switchboards.
3. Distribution panelboards.
4. Branch circuit panelboards.
5. Other significant equipment or utilization equipment.

C. The study shall include the following:

1. Calculation methods and assumptions.
2. One-line diagram (with available short-circuit current and flash hazard data identified).
3. Calculations shall identify:
    a. Available short-circuit currents from all power sources (kVA).
    b. Motor fault contribution.
    c. Component impedance data.
    d. X to R ratio.
    e. Symmetrical and asymmetrical fault current characteristics.
    f. Flash hazard analysis data.
4. Tabulation of all calculation quantities and results.
5. Detailed description of each protective device identifying its type, function, manufacturer, interrupting rating, ampere rating, selected settings, and time-current characteristics.
6. System component characteristic curves or short-circuit current ratings identified and/or plotted up to the maximum symmetrical fault current to which the component is exposed. Include the following where applicable:
    a. Medium voltage equipment characteristics.
    b. Low voltage equipment characteristics.
    c. ICEA conductor damage characteristics.
    d. Transformer characteristics.
    e. Motor and motor circuit equipment characteristics.
    f. Generator and transfer switch (manual or automatic) characteristics.
    g. Other system equipment characteristics.
7. Conclusions regarding interrupting rating for overcurrent protective devices, flash hazard analysis, protection of components, selective coordination, and recommendations and requirements on the same.

2.02 LABELS

A. Arc flash and shock hazard labels shall be provided and installed on all equipment in the report noting the appropriate PPE required. Submit sample label for approval. A sample label format is available from the Professional.

PART 3 - EXECUTION

3.01 EXAMINATION

A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study.

B. Necessary field settings of devices, adjustments, and minor modifications to equipment to accomplish conformance with the approved short-circuit study shall be carried out by the Contractor at no additional cost to the Department.

END OF SECTION

SECTION 26 08 00 – ELECTRICAL SYSTEM COMMISSIONING REQUIREMENTS

PART 1 GENERAL

1.1 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

B. General: This Section specifies Electrical System commissioning requirements, administration, and procedures. See Specification Section 019100 General Commissioning Requirements for general commissioning requirements, administration, and procedures.

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this section.

B. Specification 01 91 00 GENERAL COMMISSIONING REQUIREMENTS

C. All applicable Technical Specification sections.

1.3 REFERENCES

A. See Specification Section 019100 General Commissioning Requirements for a summary of the references.

1.4 ELECTRICAL SYSTEM COMMISSIONING DESCRIPTION

A. Commissioning: Electrical System Commissioning is a systematic process of ensuring that the electrical system has been installed in the prescribed manner to perform with the design intent and that verification of proper installation is documented. The Commissioning Agent shall provide DGS with an unbiased, objective view of the electrical system’s installation and performance. This process does not eliminate nor reduce the responsibility of the Design Professional to provide a complete design or Prime Contractors to provide a finished product. Commissioning is intended to enhance the quality of electrical system installation.

B. Commissioning during the construction phase is intended to achieve the following specific objectives according to the Contract Documents:
   1. Verify electrical system is installed according to the manufacturer’s recommendations and to industry accepted minimum codes and standards.
   2. Verify the installation and operation of all system components, including but not limited to equipment, controls, supports, conduit, wiring, and other transmission components.

C. The Commissioning process shall be a team effort and shall encompass and coordinate the traditionally separate functions of electrical system installation, testing, verification, and performance checkouts.

D. The Commissioning Agent will work closely with the construction team, cooperating and coordinating all commissioning activities with the Prime Contractor, Department's representative, sub-contractors, manufacturers, and equipment suppliers.

E. The commissioning process shall not reduce the responsibility of the Prime Contractor to comply with the Contract Documents.

1.5 ELECTRICAL SYSTEMS TO BE COMMISSIONED

A. The following electrical systems shall be commissioned. All parties associated with the design, installation and/or testing of these systems shall comply with commissioning requirements specified in this section, the individual Division commissioning sections and in the Commissioning Plan.

B. The systems that shall be commissioned in this project include but are not limited to the following:
   1. Power Distribution Systems
   2. Emergency generators
      a. Interface with all other systems to be verified
   3. Lighting and Controls.
   4. Fire Alarm Systems.

1.6 ELECTRICAL SYSTEM COMMISSIONING AND CLOSEOUT SUBMITTALS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the general submittals and processes for reviews.

B. Contractor shall make additional submittals requested by Commissioning Agent for each piece of equipment or system indicated to be commissioned. Incorporate requested submittal information into related operation and maintenance manuals.

1.7 ELECTRICAL SYSTEM COMMISSIONING DOCUMENTATION AND REPORTS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the submittals, reports, and processes.

B. Electrical System Commissioning Plan: A component of the overall Commissioning Plan document, prepared by Commissioning Agent, that outlines the schedule, allocation of resources, and documentation requirements of the electrical system commissioning process, and shall include, but is not limited to the following:
   1. All general requirements and documentation as noted in Specification Section 019100 General Commissioning Requirements.
   2. Description of expected performance for electrical systems and subsystems.
   3. Identification of installed electrical systems and subsystems including design changes that occurred during the construction phase.
   4. Step-by-step procedures for testing electrical systems with descriptions for methods of verifying relevant data, recording the results obtained, and listing parties involved in performing and verifying tests.

5. Witness and verification of all electrical quality assurance tests completed by the Contractor as specified in the contract documents.

1.8 SEQUENCING

A. See Specification Section 019100 General Commissioning Requirements for a summary of the sequencing requirements.

1.9 SCHEDULING

A. See Specification Section 019100 General Commissioning Requirements for a summary of the scheduling requirements.

B. Commissioning of systems shall proceed per the criteria established with activities to be performed on a timely basis. The Commissioning Agent shall be available to respond promptly to avoid construction delays.

C. Prepare schedule indicating anticipated start dates for all major work activities and all verification activities identified in the Commissioning Plan.

D. Schedule seasonal tests of equipment and systems during peak weather conditions to observe full-load performance.

E. Schedule occupancy sensitive tests of equipment and systems during conditions of both minimum and maximum occupancy use.

1.10 OTHER REQUIREMENTS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the commissioning team responsibilities.

B. Commissioning requires support from the Prime Contractor and subcontractors. The commissioning process does not relieve any contractors from their obligations to complete all portions of work in a satisfactory manner.

1.11 COMMISSIONING RESPONSIBILITIES

A. See Specification Section 019100 General Commissioning Requirements for a summary of the commissioning requirements of all parties involved.

B. Equipment or System Installer Commissioning Responsibilities:
   1. Attend commissioning meetings.
   2. Ensure electrical installer performs assigned commissioning responsibilities as specified below.
   3. Provide instructions and demonstrations for DGS's personnel.
   4. Ensure subcontractors perform assigned commissioning responsibilities.
   5. Ensure participation of equipment manufacturers in appropriate startup, testing, and training activities when required by individual equipment specifications.

6. Develop startup and initial checkout plan using manufacturer's startup procedures and functional performance checklists for equipment and systems to be commissioned.
7. During verification check and startup process, execute electrical related portions of checklists for equipment and systems to be commissioned.
8. Perform and document completed startup and system operational checkout procedures, providing copy to Commissioning Agent.
9. Provide manufacturer's representatives to execute starting of equipment. Ensure representatives are available and present during agreed upon schedules and are in attendance for duration to complete tests, adjustments and problem-solving.
10. Coordinate with equipment manufacturers to determine specific requirements to maintain validity of warranties.
11. Provide personnel to assist Commissioning Agent during equipment or system verification checks and functional performance tests.
12. Prior to functional performance tests, review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during tests.
13. Prior to startup, inspect, check, and verify correct and complete installation of equipment and system components for verification checks included in commissioning plan. When deficient or incomplete work is discovered, ensure corrective action is taken and re-check until equipment or system is ready for startup.
14. Provide factory supervised startup services for equipment and systems. Coordinate work with manufacturer and Commissioning Provider.
15. Perform verification checks and startup on equipment and systems as specified.
16. Assist Commissioning Agent in performing functional performance tests on equipment and systems as specified.
17. Perform operation and maintenance training sessions scheduled by Commissioning Agent.
18. Conduct electrical system orientation and inspection.
19. Submit proposed procedures for performing Lighting Controls system point-to-point checks to Commissioning Agent and Design Professional.
20. Inspect, check, and confirm correct installation and operation of electrical system input and output device operation through point-to-point checks.

1.12 COMMISSIONING MEETINGS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the commissioning meeting requirements.

1.13 COORDINATION

A. Notify Commissioning Agent a minimum of three weeks in advance of the following:
   1. Scheduled equipment and system startups.
   2. Scheduled electrical system checkout.

B. Coordinate programming of electrical system with construction and commissioning schedules.

PART 2 PRODUCTS

A. See Specification Section 019100 General Commissioning Requirements for a summary of the Product requirements.

PART 3 EXECUTION

3.1 GENERAL REQUIREMENTS

A. This Section establishes general requirements pertaining to electrical system commissioning of building systems, equipment, and appurtenances. These requirements apply to the Prime Contractors, Subcontractors, Material Supply Vendors, Commissioning Agents, and Design Professionals

B. Commissioning is intended to achieve the following specific objectives of the Contract Documents.
   1. Verify and document proper installation and design parameters of equipment, systems, and integrated systems.
   2. Ensure that operating and maintenance and Commissioning documentation requirements are complete.
   3. Provide DGS with functional buildings and systems that meet the Contract Document and DGS's operational requirements at Substantial Completion.

C. The Prime Contractor shall deliver a successful Commissioning process. It is of primary concern that all operable systems installed in the Project perform in accordance with the Contract Documents and the specified operational requirements. During Commissioning, the Prime Contractor shall systematically demonstrate to the Commissioning Agent, Design Professional, and DGS that the operable systems are properly performing in strict accordance with the Contract Documents and DGS requirements.
   1. Commissioning requires cooperation and involvement of all parties throughout the construction process.
   2. Successful Commissioning requires that installation of all building systems complies with Contract Document requirements and that full operational check-out and necessary adjustments are performed prior to Substantial Completion, with the exception of deferred tests approved in advance.
   3. Commissioning will encompass and coordinate traditionally separate functions of system documentation, Inspection, Pre-functional Checklists and start-up, control system calibration and point-to-point checkout, Testing, Adjusting, and Balancing, Functional Performance Tests, Integrated System Tests, Prime and Sub Contractor demonstration to DGS, and Training of DGS's personnel. This requires assembling all related documentation into one Commissioning Manual.

D. Certify that electrical systems, BAS, sub-systems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents, manufacturer's specifications, DGS standards and specifications, and approved Shop Drawings and submittals.

E. Certify that electrical instrumentation and control systems have been installed and calibrated, that they are operating according to the Contract Documents, DGS standards and specifications, and approved Shop Drawings and submittals, and that pretest set points have been recorded.

F. Set systems, sub-systems, and equipment into operating modes to be tested according to approved test procedures. Modes required to be tested include normal start-up, (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions.).

G. Measure capacities and effectiveness of systems, assemblies, sub-systems, equipment, and components, including operational and control functions to verify compliance with acceptance criteria.

H. Test systems, assemblies, sub-systems, equipment, and components operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and response according to acceptance criteria.

I. Perform tests using design conditions, whenever possible.
   1. Simulated conditions may, with approval of DGS, be imposed using an artificial load when it is impractical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by Commissioning Agent and document simulated conditions and methods of simulation. After tests, return configurations and settings to normal operating conditions.
   2. Commissioning test procedures may direct that set points be altered when simulating conditions is impractical.
   3. Commissioning test procedures may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are impractical.

J. If tests cannot be completed because of a deficiency outside the scope of the electrical system, document the deficiency and report it to DGS. After deficiencies are resolved, reschedule tests.

K. Include seasonal testing. Complete appropriate initial performance tests and documentation and schedule seasonal tests.

L. Coordinate schedule with and perform the commissioning activities at the direction off Commissioning Agent and DGS.

M. Comply with construction checklist requirements, including material verification, installation checks, start-up, and performance tests requirements specified in Sections specifying electrical systems and equipment and the Commissioning Plan.

N. Provide technicians, instrumentation, tools, and equipment to complete and document the following:
   1. Performance tests.
   2. Demonstration of a sample of performance tests.
   3. Commissioning test demonstrations.

3.2 INSTALLATION

A. Place electrical systems and equipment into full operation and continue operation during each working day of commissioning.

3.3 ELECTRICAL SYSTEMS:

A. Witness all of the functional testing to verify correct operation of manual and automatic controls.

B. Review the electrical testing report and verify that the Design Professional has reviewed and accepted the results of the final electrical testing reports.

C. Verify that all system components are labeled with design tag names and nameplates, instructions, arc flash labeling, and other labels that may be required.

D. Witness the correct operation of all lighting controls and control systems.

3.4 FIELD TESTS AND INSPECTIONS

A. Systems Readiness Checklists
   1. The Contractor shall complete Systems Readiness Checklists to verify systems, sub-systems, and equipment installation is complete and systems are ready for Systems Functional Testing.
   2. The Commissioning Agent will prepare Systems Readiness Checklists to be used to document equipment installation. The Contractor shall complete the checklists. Completed checklists shall be uploaded to eBuilder for review.
   3. The Commissioning Agent may spot-check a sample of completed checklists. If the Commissioning Agent determines that the information provided on the checklist is not accurate, the Commissioning Agent will return the marked-up checklist to the Contractor for correction and re-submission. If the Commissioning Agent determines that 10% of completed checklists for similar equipment are not accurate, the Commissioning Agent will select a broader sample of 50% of checklists for review. If the Commissioning Agent determines that another 10% of the broader sample of checklists is also inaccurate, all the checklists for the type of equipment will be returned to the Contractor for correction and re-submission.
   4. Refer to SECTION 019100 GENERAL COMMISSIONING REQUIREMENTS for submittal requirements for System Readiness Checklists, Equipment Startup Reports, and other commissioning documents.

B. Contractors Tests
   1. Contractor tests as required by other sections of Division 23 shall be scheduled and documented. The Commissioning Agent will witness selected Contractor tests. Contractor tests shall be completed prior to scheduling Systems Functional Performance Testing.

C. Systems Functional Performance Testing:
   1. The Commissioning Process includes Systems Functional Performance Testing that is intended to test systems functional performance under steady state conditions, to test system reaction to changes in operating conditions, and system performance under emergency conditions.
   2. The Commissioning Agent will prepare detailed Systems Functional Performance Test procedures for review and approval by Design Professional. The Contractor shall review and comment on the tests prior to approval.
   3. The Contractor shall provide the required labor, materials, and test equipment identified in the test procedure to perform the tests. The Commissioning Agent will direct and document the testing.
   4. See Section 019100 GENERAL COMMISSIONING REQUIREMENTS, for additional details.

D. Occupancy Sensitive Functional Performance Tests:
   1. Test equipment and systems affected by occupancy variations at minimum and peak loads to observe system performance.

2. Participate in testing delayed beyond Final Completion to test performance with actual occupancy conditions.

E. Training of Department Personnel
1. Training of DGS operation and maintenance personnel is required in cooperation with the Design Professional and Commissioning Agent.
2. Provide competent, factory authorized personnel to provide instruction to operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems. The instruction shall be scheduled in coordination with DGS after submission and approval of formal training plans.
3. Refer to Section 019100 GENERAL COMMISSIONING REQUIREMENTS and Division 23 Sections for additional Contractor training requirements.
4. Participate in testing delayed beyond Final Acceptance to test performance at peak seasonal conditions.
5. Participate in initial and alternate peak season test of systems required to demonstrate performance.

END OF SECTION

SECTION 260943

DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SECTION INCLUDES

A. Distributed Digital Lighting Control System: System includes

1. Digital Lighting and Plug Load Controls
2. Emergency Lighting Control.

1.03 RELATED SECTIONS

A. Section 260533 - Raceways and Boxes for Electrical Systems

B. Section 265200 – Solid State Lighting.

1.04 REFERENCES

A. NFPA 70 - National Electrical Code; National Fire Protection Association.

B. NEMA - National Electrical Manufacturers Association

C. FCC emission standards

D. UL - Underwriters Laboratories, Inc. Listings

E. UL 2043 - Standard for Fire Test for Heat and Visible Smoke Release for Discrete Products Installed in Air-Handling Spaces.

F. UL 20 - General Use Switches, Plug Load Controls

G. UL 924 - Standard for Emergency Lighting and Power Equipment

H. ULC - Underwriter Laboratories of Canada Listings

1.05 DESIGN / PERFORMANCE REQUIREMENTS

A. Digital Lighting Management System shall accommodate the square-footage coverage requirements for each area controlled, utilizing room controllers, digital occupancy sensors, switches, daylighting sensors and accessories that suit the required lighting and electrical system parameters.

B. System shall conform to requirements of NFPA 70.

C. System shall comply with FCC emission standards specified in part 15, sub-part J for commercial and residential application.

D. System shall be listed under UL sections 916 and/or 508.

1.06 SUBMITTALS

A. Submit under provisions of Section 013000 - Administrative Requirements.

B. Product Data: Manufacturer's data sheets on each product to be used, including:

1. Catalog sheets and specifications.
2. Ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
3. Storage and handling requirements and recommendations.
4. Installation instructions.

C. Shop Drawings: Wiring diagrams a for the various components of the System specified including:

1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
2. Show location of all devices, including at minimum sensors, load controllers, and switches/dimmers for each area on reflected ceiling plans.
3. Provide room/area details including products and sequence of operation for each room or area. Illustrate typical acceptable room/area connection topologies.
4. Network riser diagram including floor and building level details. Include network cable specification. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

D. Manufacturer's Certificates: Certify products meet or exceed specified requirements.

E. Closeout Submittals:
1. Project Record Documents: Record actual installed locations and settings for lighting control devices.
2. Operation and Maintenance Manual:
a. Include approved Shop Drawings and Product Data.
b. Include Sequence of Operation, identifying operation for each room or space.
c. Include manufacturer's maintenance information.
d. Operation and Maintenance Data: Include detailed information on device programming and setup.
e. Include startup and test reports.

1.07 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing of centralized and distributed lighting control systems with a minimum of 10 years documented experience.

B. Installer Qualifications: Company certified by the manufacturer and specializing in installation of networked lighting control products with minimum three years documented experience.

C. System Components: Demonstrate that individual components have undergone quality control and testing prior to shipping.

1.08 PRE-INSTALLATION MEETINGS

A. Convene minimum two weeks prior to commencing Work of this section. Meeting to be attended by Contractor, Professional, system installer, factory authorized manufacturer's representative, and representative of all trades related to the system installation.

B. Review installation procedures and coordination required with related Work and the following:
1. Confirm the location and mounting of all devices, with special attention to placement of switches, dimmers, and any sensors.
2. Review the specifications for low voltage control wiring and termination.
3. Discuss the functionality and configuration of all products, including sequences of operation, per design requirements.
4. Discuss requirements for integration with other trades.

C. Inspect and make notes of job conditions prior to installation:
1. Record minutes of the conference and provide copies to all parties present.
2. Identify all outstanding issues in writing designating the responsible party for follow-up action and the timetable for completion.
3. Installation shall not begin until all outstanding issues are resolved to the satisfaction of the Professional.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.10 PROJECT CONDITIONS

A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.

B. Do not install equipment until following conditions can be maintained in spaces to receive equipment:

1. Ambient temperature: 32 to 104 degrees F (0 to 40 degrees C).
2. Relative humidity: Maximum 90 percent, non-condensing.

1.11 WARRANTY

A. Products Warranty: Manufacturer shall provide a 5 year limited warranty on products within this installation, except where otherwise noted, and consisting of a one for one device replacement.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of design Manufacturer: Legrand: Wattstopper/Solarfective, which is located at: 2700 Zanker Rd. Suite 168; San Jose, CA 95134; Tel: 408-988-5331; Fax: 408-988-5373; Email:request info (jon.null@legrand.us); Web:https://www.legrand.us/Wattstopper.aspx

B. Substitutions will be considered, however the contractor shall ensure that the sequence of operation as designed are met. The Contractor shall be solely responsible to meet these requirements.

1. Equal acceptable are as follows:
   a. nLight
   b. Acuity Brands Lighting
   c. Or equal as approved by the Professional.

2.02 DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEM

A. System General: Provide a Wattstopper, Provide Digital Lighting Management System (DLM) complete with all necessary enclosures, wiring, and system components to ensure a complete and properly functioning system as indicated on the Drawings and specified herein. If a conflict is identified, between the Drawing and this Specification, contact the Professional for clarification prior to proceeding.

1. Space Control Requirements: Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality as indicated in all spaces except toilet rooms, storerooms, library stacks, or other applications where hands-free operation is desirable and Automatic-ON occupancy sensors are more appropriate. Provide Manual-ON occupancy/vacancy sensors for any enclosed office, conference room, meeting room, open plan system and training room. For spaces with multiple occupants, or where line-of-sight may be obscured, provide ceiling- or corner-mounted sensors and Manual-ON switches.
2. Daylit Areas: Provide daylight-responsive automatic control in all spaces (conditioned or unconditioned) where daylight contribution is available as defined by relevant local building energy code:
   a. All luminaires within code-defined daylight zones shall be controlled separately from luminaires outside of daylit zones.
   b. Daytime setpoints for total ambient illumination (combined daylight and electric light) levels that initiate dimming shall be programmed in compliance with relevant local building energy codes.
   c. Multiple-level switched daylight harvesting controls may be utilized for areas marked on drawings.

d. Provide smooth and continuous daylight dimming for areas marked on drawings. Daylighting control system may be designed to turn off electric lighting when daylight is at or above required lighting levels, only if system functions to turn lamps back on at dimmed level, rather than turning full-on prior to dimming.

3. Conference, meeting, training, auditoriums, and multipurpose rooms shall have controls that allow for independent control of each local control zone. Rooms larger than 300 square feet shall instead have at least four preset lighting scenes unless otherwise specified. Occupancy / vacancy sensors shall be provided to turn off all lighting in the space. Spaces with up to four moveable walls shall include controls that can be reconfigured when the room is partitioned.

B. Equipment Required: Lighting Control and Automation system as defined under this section covers the following equipment.

1. Digital Lighting Management (DLM) local network: Free topology, plug-in wiring system (Cat 5e) for power and data to room devices.

2. Digital Room Controllers: Self-configuring, digitally addressable one, two or three relay plenum-rated controllers for on/off control. Selected models include 0-10 volt or line voltage forward phase control dimming outputs and integral current monitoring capabilities.

3. Digital Occupancy Sensors: Self-configuring, digitally addressable, calibrated occupancy sensors with LCD display and two-way active infrared (IR) communications.

4. Digital Switches: Self-configuring, digitally addressable pushbutton on/off, dimming, and scene switches with two-way active infrared (IR) communications.

5. Digital Daylighting Sensors: Single-zone closed loop, multi-zone open loop and single-zone dual-loop daylighting sensors with two-way active infrared (IR) communications for daylight harvesting using switching, bi-level, tri-level or dimming control.

6. Configuration Tools: Handheld remote for room configuration and relay panel programming provides two way infrared (IR) communications to digital devices and allows complete configuration and reconfiguration of the device / room from up to 30 feet away.

7. Programming and Configuration Software: Optional PC-native application capable of accessing DLM control parameters within a room, for the local network, via a USB adapter, or globally, for many segment networks simultaneously, via BACnet/IP communication.

8. Emergency Lighting Control Unit (ELCU): Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

C. Local Network LMRJ-Series: DLM local network is a free topology lighting control physical connection and communication protocol designed to control a small area of a building.

1. Features of the DLM local network include:

a. Plug n' Go automatic configuration and binding of occupancy sensors, switches and lighting loads to the most energy-efficient sequence of operation based upon the device attached.

b. Simple replacement of any device in the local DLM network with a standard off the shelf unit without requiring significant commissioning, configuration or setup.

c. Push n' Learn configuration to change the automatic configuration, including binding and load parameters without tools, using only the buttons on the digital devices in the local network.

d. Two-way infrared communications for control by handheld remotes, and configuration by a handheld tool including adjusting load parameters, sensor configuration and binding, within a line of sight of up to 30 feet from a sensor, wall switch or IR receiver.

2. Digital room devices connect to the local network using pre-terminated Cat 5e cables with RJ-45 connectors, which provide both data and power to room devices. Systems that utilize RJ-45 patch cords but do not provide serial communication data from individual end devices are not acceptable.
3. If manufacturer's pre-terminated Cat5e cables are not used for the installation each cable must be individually tested and observed by authorized service representative following installation.

2.03 DIGITAL LOAD CONTROLLERS (ROOM AND FIXTURE CONTROLLERS)

A. Digital Load Controllers: Digital controllers for lighting zones and fixtures automatically bind room loads to the connected control devices in the space without commissioning or the use of any tools. Provide controllers to match the room lighting control requirements. Controllers are simple to install, and do not have dip switches/potentiometers, or require special configuration for standard Plug n' Go applications. Control units include the following features

1. Automatic room configuration to the most energy-efficient sequence of operation based upon the devices in the room.
2. Simple replacement using the default automatic configuration capabilities, a room controller may be replaced with an off-the-shelf device.
3. Multiple room controllers connected together in a local network must automatically arbitrate with each other, without requiring any configuration or setup, so that individual load numbers are assigned starting with load 1 to a maximum of 64, assigned based on each controller's device ID's from highest to lowest.
4. Device Status LEDs to indicate:
    a. Data transmission
    b. Device has power
    c. Status for each load
    d. Configuration status
5. Quick installation features including:
    a. Standard junction box mounting
    b. Quick low voltage connections using standard RJ-45 patch cable
6. Based on individual configuration, each load shall be capable of the following behavior on power up following the loss of normal power:
    a. Turn on to 100 percent
    b. Turn off
    c. Turn on to last level
7. Each load be configurable to operate in the following sequences based on occupancy:
    a. Auto-on/Auto-off (Follow on and off)
    b. Manual-on/Auto-off (Follow off only)
8. Polarity of each load output shall be reversible, via digital configuration, so that on is off and off is on.
9. BACnet object information shall be available for the following objects:
    a. Load status
    b. Schedule state, normal or after-hours
    c. Demand Response enable and disable
    d. Room occupancy status
    e. Total room lighting and plug loads watts

f. Electrical current
g. Total watts per controller
h. Total room watts/sq ft.
i. Force on/off all loads

10. UL 2043 plenum rated
11. Manual override and LED indication for each load
12. Zero cross circuitry for each load
13. All digital parameter data programmed into an individual room controller or plug load controller shall be retained in non-volatile FLASH memory within the controller itself. Memory shall have an expected life of no less than 10 years.
14. Dimming Room Controllers shall share the following features:
    a. Each load shall have an independently configurable preset on level for Normal Hours and After Hours events to allow different dimmed levels to be established at the start of both Normal Hours and After Hours events.
    b. Fade rates for dimming loads shall be specific to bound switch buttons, and the load shall maintain a default value for any bound buttons that do not specify a unique value.
    c. The following dimming attributes may be changed or selected using a wireless configuration tool:
        1) Establish preset level for each load from 0-100 percent
        2) Set high and low trim for each load
        3) Initiate lamp burn in for each load of either 0, 12 or 100 hours
    d. Override button for each load provides the following functions:
        1) Press and release for on/off control
        2) Press and hold for dimming control
    e. Each dimming output channel shall have an independently configurable minimum and maximum calibration trim level to set the dimming range to match the true dynamic range of the connected ballast or driver. LED level indicators on bound dimming switches shall utilize this new maximum and minimum trim.
    f. Each dimming output channel shall have an independently configurable minimum and maximum trim level to set the dynamic range of the output within the new 0-100 percent dimming range defined by the minimum and maximum calibration trim.
    g. Calibration and trim levels must be set per output channel. Devices that set calibration or trim levels per controller (as opposed to per load) are not acceptable.
    h. All configuration shall be digital. Devices that set calibration or trim levels per output channel via trim pots or dip-switches are not acceptable.

B. On/Off Room Controllers shall include:
    1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 20A total load
    2. One or two relay configuration
    3. Simple 150 mA switching power supply (Only 4 100 series devices on a Cat 5e local network)
    4. Three RJ-45 DLM local network ports with integral strain relief and dust cover
    5. Wattstopper product numbers: LMRC-101, LMRC-102
C. On/Off/0-10V Dimming KO Mount Room Controllers shall include:
    1. Dual voltage (120/277 VAC, 60 Hz) capable rated for 10A total load
    2. Optional real time current and voltage monitoring (with - M Monitoring option).

3. One or two relays configurations
4. Smart 150 mA switching power supply
5. Two RJ-45 DLM local network ports. Provide molded strain relief ring
6. One dimming output per relay
    a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting
7. Units capable of providing both Class 1 or Class 2 wiring for the 0-10V output
8. Wattstopper product numbers: LMRC-111, LMRC-111-M, LMRC-112, or LMRC-112-M.

D. On/Off/0-10V Dimming Enhanced Room Controllers shall include:
1. Dual voltage (120/277 VAC, 60 Hz) capable or 347 VAC, 60 Hz. 120/277 volt models rated for 20A total load; 347 volt models rated for 15A total load
2. Built in real time current monitoring
3. One, two or three relays configurations
4. Smart 250 mA switching power supply
5. Four RJ-45 DLM local network ports. Provide integral strain relief
6. One dimming output per relay
    a. 0-10V Dimming - Where indicated, one 0-10 volt analog output per relay for control of compatible ballasts and LED drivers. The 0-10 volt output shall automatically open upon loss of power to the Room Controller to assure full light output from the controlled lighting (LMRC-110 series and 210 series).
7. Wattstopper product numbers: LMRC-211, LRMC-212, LRMC-213.

2.04 DIGITAL WALL OR CEILING MOUNTED OCCUPANCY SENSOR

A. Digital Occupancy Sensors shall provide graphic LCD display for digital calibration and electronic documentation. Features include the following:
1. Digital calibration and pushbutton configuration for the following variables:
    a. Sensitivity, 0-100 percent in 10 percent increments
    b. Time delay, 1-30 minutes in 1 minute increments
    c. Test mode, Five second time delay
    d. Detection technology, PIR, Ultrasonic or Dual Technology activation and/or re-activation.
    e. Walk-through mode
2. Load parameters including Auto/Manual-ON, blink warning, and daylight enable/disable when photosensors are included in the DLM local network.
3. Programmable control functionality including:
    a. Each sensor may be programmed to control specific loads within a local network.
    b. Sensor shall be capable of activating one of 16 user-definable lighting scenes.
    c. Adjustable retrigger time period for manual-on loads. Load will retrigger (turn on) automatically within a configurable period of time (default 10 seconds) after turning off.
    d. On dual technology sensors, independently configurable trigger modes are available for both Normal (NH) and After Hours (AH) time periods. The retrigger mode can be programmed to use the following technologies:
    e. Ultrasonic and Passive Infrared

f. Ultrasonic or Passive Infrared

g. Ultrasonic only

h. Passive Infrared only

i. Independently configurable sensitivity settings for passive infrared and ultrasonic technologies (on dual technology sensors) for both Normal (NH) and After Hour (AH) time periods.

4. One or two RJ-45 port(s) for connection to DLM local network.

5. Two-way infrared (IR) transceiver to allow remote programming through handheld commissioning tool and control by remote personal controls.

6. Device Status LEDs, which may be disabled for selected applications, including:

a. PIR detection

b. Ultrasonic detection

c. Configuration mode

d. Load binding

7. Assignment of occupancy sensor to a specific load within the room without wiring or special tools.

8. Manual override of controlled loads.

9. All digital parameter data programmed into an individual occupancy sensor shall be retained in non-volatile FLASH memory within the sensor itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:

1. Detection state

2. Occupancy sensor time delay

3. Occupancy sensor sensitivity, PIR and Ultrasonic

C. Units shall not have any dip switches or potentiometers for field settings.

D. Multiple occupancy sensors may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration will be required.

E. Wattstopper product numbers: LMPX, LMDX, LMPC, LMUC, LMDC

2.05 DIGITAL WALL SWITCHES

A. Low voltage momentary pushbutton switches in 1, 2, 3, 4, 5 and 8 button configuration. Wall switches shall include the following features:

1. Two-way infrared (IR) transceiver for use with personal and configuration remote controls.

2. Removable buttons for field replacement with engraved buttons and/or alternate color buttons. Button replacement may be completed without removing the switch from the wall.

3. Configuration LED on each switch that blinks to indicate data transmission.

4. Load/Scene Status LED on each switch button with the following characteristics:

a. Bi-level LED

b. Dim locator level indicates power to switch

c. Bright status level indicates that load or scene is active

d. Dimming switches shall include seven bi-level LEDs to indicate load levels using 14 steps.

5. Programmable control functionality including:

a. Button priority may be configured to any BACnet priority level, from 1-16, corresponding to networked operation allowing local actions to utilize life safety priority

b. Scene patterns may be saved to any button other than dimming rockers. Once set, buttons may be digitally locked to prevent overwriting of the preset levels.

6. All digital parameter data programmed into an individual wall switch shall be retained in non-volatile FLASH memory within the wall switch itself. Memory shall have an expected life of no less than 10 years.

B. BACnet object information shall be available for the following objects:

1. Button state
2. Switch lock control
3. Switch lock status

C. Two RJ-45 ports for connection to DLM local network.

D. Multiple digital wall switches may be installed in a room by simply connecting them to the free topology DLM local network. No additional configuration shall be required to achieve multi-way switching.

E. Load and Scene button function may be reconfigured for individual buttons from Load to Scene, and vice versa.

1. Individual button function may be configured to Toggle, On only or Off only.
2. Individual scenes may be locked to prevent unauthorized change.
3. Fade Up and Fade Down times for individual scenes may be adjusted from 0 seconds to 18 hours.
4. Ramp rate may be adjusted for each dimmer switch.
5. Switch buttons may be bound to any load on any load controller or relay panel and are not load type dependent; each button may be bound to multiple loads.
6. Wattstopper product numbers: LMSW-101, LMSW-102, LMSW-103, LMSW-104, LMSW-105, LMSW-108, LMDM-101. Available in white, light almond, ivory, grey, red and black; compatible with wall plates with decorator opening.

2.06 DIGITAL DAYLIGHTING SENSORS

A. Digital daylighting sensors shall work with load controllers and relay panels to provide automatic switching, bi-level, or tri-level or dimming daylight harvesting capabilities for any load type connected to the controller or panel. Daylighting sensors shall be interchangeable without the need for rewiring.

1. Closed loop sensors measure the ambient light in the space and control a single lighting zone.
2. Open loop sensors measure incoming daylight in the space, and are capable of controlling up to three lighting zones.
3. Dual loop sensors measure both ambient and incoming daylight in the space to insure that proper light levels are maintained as changes to reflective materials are made in a single zone.

B. Digital daylighting sensors shall include the following features:

1. Sensor's internal photodiode shall only measure lightwaves within the visible spectrum. The photodiode's spectral response curve shall closely match the entire photopic curve. Photodiode shall not measure energy in either the ultraviolet or infrared spectrums. Photocell shall have a sensitivity of less than 5 percent for any wavelengths less than 400 nanometers or greater than 700 nanometers.
2. Sensor light level range shall be from 1-6,553 foot-candles (fc).
3. Capability of ON/OFF, bi-level or tri-level switching, or dimming, for each controlled zone, depending on the selection of load controller(s) and load binding to controller(s).

4. For switching daylight harvesting, the photosensor shall provide a field-selectable deadband, or a separation, between the "ON Setpoint" and the "OFF Setpoint" that will prevent the lights from cycling excessively after they turn off.
5. For dimming daylight harvesting, the photosensor shall provide the option, when the daylight contribution is sufficient, of turning lights off or dimming lights to a field-selectable minimum level.
6. Photosensors shall have a digital, independently configurable fade rate for both increasing and decreasing light level in units of percent per second.
7. Photosensors shall provide adjustable cut-off time. Cut-off time is defined by the number of selected minutes the load is at the minimum output before the load turns off. Selectable range between 0-240 minutes including option to never cut-off.
8. Integral infrared (IR) transceiver for configuration and/or commissioning with a handheld configuration tool, to transmit detected light level to wireless configuration tool, and for communication with personal remote controls.
9. Configuration LED status light on device that blinks to indicate data transmission.
10. Status LED indicates test mode, override mode and load binding.
11. Recessed switch on device to turn controlled load(s) ON and OFF.
12. BACnet object information shall be available for the following daylighting sensor objects, based on the specific photocell's settings:
    a. Light level
    b. Day and night setpoints
    c. Off time delay
    d. On and off setpoints
    e. Up to three zone setpoints
    f. Operating mode - on/off, bi-level, tri-level or dimming
13. One RJ-45 port for connection to DLM local network.
14. A choice of accessories to accommodate multiple mounting methods and building materials. Photosensors may be mounted on a ceiling tile, skylight light well, suspended lighting fixture or backbox. Standard tube photosensors accommodate mounting materials from 0-0.62 inch thick (LMLS-400, LMLS-500). Extended tube photosensors accommodate mounting materials from 0.62 to 1.25 inches thick (LMLS-400-L, LMLS-500-L). Mounting brackets are compatible with J boxes (LMLS-MB1) and wall mounting (LMLS-MB2). LMLS-600 photosensor to be mounted on included bracket below skylight well.
15. Any load or group of loads in the room can be assigned to a daylighting zone
16. Each load within a daylighting zone can be individually enabled or disabled for discrete control (load independence).
17. All digital parameter data programmed into a photosensor shall be retained in non-volatile FLASH memory within the photosensor itself. Memory shall have an expected life of no less than 10 years.

C. Open loop digital photosensors shall include the following additional features:
1. An internal photodiode that measures light in a 60-degree angle (cutting off the unwanted light from the interior of the room).
2. Automatically establishes application-specific setpoints following manual calibration using a wireless configuration tool or a PC with appropriate software. For switching operation, an adequate deadband between the ON and OFF setpoints for each zone shall prevent the lights from cycling; for dimming operation, a proportional control algorithm shall maintain the design lighting level in each zone.

3. Each of the three discrete daylight zones can include any non overlapping group of loads in the room.
4. Wattstopper Product Number: LMLS-500, LMLS-500-L.

2.07 HANDHELD CONFIGURATION TOOLS

A. Provide a wireless configuration tool to facilitate customization of DLM local networks using two-way infrared communications, and/or PC software that connects to each local network via a USB interface.

B. Features and functionality of the wireless configuration tool shall include but not be limited to:
1. Two-way infrared (IR) communication with DLM IR-enabled devices within a range of approximately 30 feet.
2. High visibility organic LED (OLED) display, pushbutton user interface and menu-driven operation.
3. Must be able to read and modify parameters for load controllers and relay panels, occupancy sensors, wall switches, daylighting sensors, network bridges, and identify DLM devices by type and serial number.
4. Save up to eight occupancy sensor setting profiles, and apply profiles to selected sensors.
5. Temporarily adjust light level of any load(s) on the local network, and incorporate those levels in scene setting. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
6. Adjust or fine-tune daylighting settings established during auto-configuration, and input light level data to complete configuration of open loop daylighting controls.
7. Set room mode for testing of Normal Hours (NH) and After Hours (AH) parameter settings.
8. Verify status of building level network devices.

C. Wattstopper Product Numbers: Handheld LMCT-100

2.08 PROGRAMMING, CONFIGURATION AND DOCUMENTATION SOFTWARE

A. PC-native application for optional programming of detailed technician-level parameter information for all DLM products, including all parameters not accessible via BACnet and the handled IR configuration tool. Software must be capable of accessing room-level parameter information locally within the room when connected via the optional LMCI-100 USB programming adapter, or globally for many segment networks simultaneously utilizing standard BACnet/IP communication.

B. Additional parameters exposed through this method include but are not limited to:
1. Occupancy sensor detection LED disable for performance and other aesthetic spaces where blinking LEDs present a distraction.
2. Six occupancy sensor action behaviors for each controlled load, separately configurable for normal hours and after hours modes. Modes include: No Action, Follow Off Only, Follow On Only, Follow On and Off, Follow On Only with Override Time Delay, Follow Off Only with Blink Warn Grace Time, Follow On and Off with Blink Warn Grace Time.
3. Separate fade time adjustments per load for both normal and after hours from 0 - 4 hours.
4. Configurable occupancy sensor re-trigger grace period from 0 - 4 minutes separate for both normal hours and after hours.
5. Separate normal hours and after hours per-load button mode with modes including: Do nothing, on only, off only, on and off.
6. Load control polarity reversal so that on events turn loads off and vice versa.
7. Per-load DR (demand response) shed level in units of percent.
8. Load output pulse mode in increments of 1second.

9. Fade trip point for each load for normal hours and after hours that establishes the dimmer command level at which a switched load closes its relay to allow for staggered On of switched loads in response to a dimmer.

C. Generation of reports at the whole file, partial file, or room level. Reports include but are not limited to:

1. Device list report: All devices in a project listed by type.
2. Load binding report: All load controller bindings showing interaction with sensors, switches, and daylighting.
3. BACnet points report: Per room Device ID report of the valid BACnet points for a given site's BOM.
4. Room summary report: Device manifest for each room, aggregated by common BOM, showing basic sequence of operations.
5. Device parameter report: Per-room lists of all configured parameters accessible via hand held IR programmer for use with O&M documentation.
6. Scene report: All project scene pattern values not left at defaults (i.e. 1 = all loads 100 percent, 2 = all loads 75 percent, 3 = all loads 50 percent, 4 = all loads 25 percent, 5-16 = same as scene 1).
7. Occupancy sensor report: Basic settings including time delay and sensitivities for all occupancy sensors.

D. Network-wide programming of parameter data in a spreadsheet-like programming environment including but not limited to the following operations:

1. Set, copy/paste an entire project site of sensor time delays.
2. Set, copy/paste an entire project site of sensor sensitivity settings.
3. Search based on room name and text labels.
4. Filter by product type (i.e. LMRC-212) to allow parameter set by product.
5. Filter by parameter value to search for product with specific configurations.

E. Network-wide firmware upgrading remotely via the BACnet/IP network.

1. Mass firmware update of entire rooms.
2. Mass firmware update of specifically selected rooms or areas.
3. Mass firmware upgrade of specific products

F. Wattstopper Product Number: LMCS-100, LMCI-100

2.09 EMERGENCY LIGHTING CONTROL DEVICES

A. Emergency Lighting Control Unit - A UL 924 listed device that monitors a switched circuit providing normal lighting to an area. The unit provides normal ON/OFF control of emergency lighting along with the normal lighting. Upon normal power failure the emergency lighting circuit will close, forcing the emergency lighting ON until normal power is restored. Features include:

1. 120/277 volts, 50/60 Hz, 20 amp ballast rating
2. Push to test button
3. Auxiliary contact for remote test or fire alarm system interface

B. Wattstopper Product Numbers: ELCU-100, ELCU-200.

PART 3 - EXECUTION

3.01 PREPARATION

A. Do not begin installation until measurements have been verified and work areas have been properly prepared.

B. If preparation is the responsibility of another installer, notify Professional of unsatisfactory preparation before proceeding.

C. Verify that required pre-installation meeting specified in Part 1 of this specification has been completed, recorded meeting minutes have been distributed and all outstanding issues noted have been resolved prior to the start of installation.

3.02 INSTALLATION

A. Install system in accordance with the approved system shop drawings and manufacturer's instructions.

B. Install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors.

1. If pre-terminated cable is not used for room/area wiring, each field-terminated cable shall be tested following installation and testing results submitted to the Manufacturer's Representative for approval prior to proceeding with the Work.
2. If fixtures have internal DLM Control Modules, ensure that they are also connected with Cat 5e cable.
3. Install all room to room network devices using manufacturer-supplied LM-MSTP network wire or wireless devices. Network wire substitution is not permitted and may result in loss of product warranty.
4. Low voltage wiring topology must comply with manufacturer's specifications.
5. Route network wiring as indicated on the Drawings as closely as possible. Document final wiring location, routing and topology on as built drawings.

C. All line voltage connections shall be tagged to indicate circuit and switched legs.

D. Test all devices to ensure proper communication.

E. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings. Adjust time delay so that controlled area remains lighted while occupied.

F. Provide written or computer-generated documentation on the configuration of the system including room by room description including:

1. Sensor parameters, time delays, sensitivities, and daylighting setpoints.
2. Sequence of operation, (e.g. manual ON, Auto OFF. etc.)
3. Load Parameters (e.g. blink warning, etc.)

G. Post start-up tuning - Adjust sensor time delays and sensitivities to meet the Client Agency's requirements 30 days from beneficial occupancy. Provide a detailed report to the Professional / Client Agency of post start-up activity.

H. Tighten all panel Class I conductors from both circuit breaker and to loads to torque ratings as marked on enclosure UL label.

I. All Class II cabling shall enter enclosures from within low-voltage wiring areas and shall remain within those areas. No Class I conductors shall enter a low-voltage area.

J. Run separate neutrals for any phase dimmed branch load circuit. Different types of dimming loads shall have separate neutral.

K. Verify all non-panel-based lighting loads to be free from short circuits prior to connection to room controllers.

L. Remote Access for Network Systems: If "REMOTE ACCESS AND ENHANCED WARRANTY FOR NETWORKED SYSTEMS" is specified in Part 1 of this specification, ensure Segment Manager enclosure is installed in a location with good to excellent cellular phone coverage based on building orientation and geographic location, and mount magnetic antenna for the modem. For cases where alternate mounting locations are not available and a stronger cellular signal is needed, the manufacturer shall offer additional antenna options to improve signal quality. Verify final mounting location with Professional and Client Agency prior to proceeding with the Work.

M. Install equipment level and plumb and according to manufacturer's written instructions.

N. Mount lighting control devices according to manufacturer's written instructions and requirements.

O. Mounting heights indicated are to bottom of unit for suspended devices and to center of unit for wall-mounted devices.

P. Wall sensor/switches shall be mounted at standard wall switch mounting height, unless otherwise noted.

Q. Install wiring between sensing and control devices according to manufacturer's written instructions and as specified in Section 260519 "Low Voltage Electrical Power Conductors and Cables" for low-voltage connections.

R. Wiring Method: Install all wiring in raceway as specified in Section 260533 "Raceways and Boxes for Electrical Systems".

S. Bundle, train, and support wiring in enclosures.

T. Ground equipment.

U. Connections: Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Notify Professional and Manufacturer in writing a minimum of 3 weeks prior to system start-up and testing.

B. Tests and Inspections: Manufacturer's service representative shall perform the following inspections and prepare reports.

1. Verify Class I and II wiring connections are terminated properly by validating system performance.
2. Set IP addresses and other network settings of system front end hardware per facilities IT instructions.
3. Verify / complete task programming for all switches, dimmers, time clocks, and sensors.
4. Verify that the control of each space complies with the Sequence of Operation.
5. Correct any system issues and retest.

C. Provide a report in table format with drawings, or using a software file that can be opened in the manufacturer's system software including each room or space that has lighting control installed. Indicate the following:

1. Date of test or inspection.
2. Loads per space, or Fixture Address identification.
3. Quantity and Type of each device installed
4. Reports providing each device's settings.

D. Schedule visual and mechanical inspections and electrical tests with at least seven day's advance notice.

E. Inspect control components for defects and physical damage, testing laboratory labeling, and nameplate compliance with the Contract Documents.

F. Check tightness of electrical connections with torque wrench calibrated within previous six months. Use manufacturer's recommended torque values.

G. Electrical Tests: Use particular caution when testing devices containing solid-state components. Perform the following according to manufacturer's written instructions:

1. Continuity tests of circuits.

2. Operational Tests: Set and operate devices to demonstrate their functions and capabilities in a methodical sequence that cues and reproduces actual operating functions.

    a. Include testing of devices under conditions that simulate actual operational conditions. Record control settings, operations, cues, and functional observations.

H. Correct deficiencies, make necessary adjustment, and retest. Verify that specified requirements are met.

I. Test Labeling: After satisfactory completion of tests and inspections, apply a label to tested components indicating test results, date, and responsible agency and representative.

J. Record defective materials and workmanship and unsatisfactory test results. Record repairs and adjustments.

3.04 DEMONSTRATION AND TRAINING

A. Before Substantial Completion, arrange and provide a one-day Client Agency instruction period to designated Client Agency personnel with a factory-authorized service representative. Set-up, starting of the lighting control system and Client Agency instruction includes:

1. Confirmation of entire system operation and communication to each device.
2. Confirmation of operation of individual relays, switches, and sensors.
3. Confirmation of system Programming, photocell settings, override settings, etc.
4. Provide training to cover installation, programming, operation, serving, adjusting, preventative maintenance and troubleshooting of the lighting control system.
5. Training Aid: Use the approved final version of maintenance manuals as a training aid.
6. Training to be scheduled with Client Agency, through Professional, with at least seven days' advance notice.

3.05 CLEANING

A. Cleaning: Clean equipment and devices internally and externally using methods and materials recommended by manufacturers, and repair damaged finishes.

3.06 ON-SITE ASSISTANCE

A. Occupancy Adjustments at no additional cost within one year of date of Substantial Completion. Provide up to two Project site visits, when requested, to make program changes, and adjust controls to suit actual conditions.

3.07 PRODUCT SUPPORT AND SERVICE

A. Factory telephone support shall be available at no cost to the Department following acceptance. Factory assistance shall consist of assistance in solving application issues pertaining to the control equipment.

END OF SECTION

SECTION 262213

DRY-TYPE DISTRIBUTION TRANSFORMERS (1500 KVA AND BELOW)]

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The Contractor shall furnish and install single-phase and three-phase general purpose individually mounted dry-type transformers of the two-windings type, self-cooled as specified herein, and as shown on the contract drawings.

1.03 REFERENCES

A. The transformers and all components shall be designed, manufactured and tested in accordance with the latest applicable standards of ANSI, NEMA and UL.

B. Transformers shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

1.04 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Professional:

1. Outline dimensions and weights
2. Transformer ratings included:
    a. kVA
    b. Primary and secondary voltage
    c. Taps
    d. Basic impulse level (BIL) for equipment over 600 volts
    e. Design impedance
    f. Insulation class and temperature rise
    g. Sound level
3. Product data sheets

1.05 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes.

1. Final as-built drawings and information for items listed in Paragraph 1.3, and shall incorporate all changes made during the manufacturing process
2. Connection diagrams
3. Installation information

1.06 QUALIFICATIONS

A. The manufacturer of the dry-type distribution transformers shall be the same as the manufacturer of the other major electrical distribution equipment on the project.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer shall be a participant in the UL Data Acceptance Program (DAP) under the Client Test Data Program (CTDP) certification to ensure UL test methodologies and record traceability complies with the requirements of ISO 17025.

D. Transformer must bear the UL Energy Efficiency Verification Mark to confirm that the unit meets the requirements of 10 CFR Part 431.

E. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years.

1.07 REGULATORY REQUIREMENTS

A. All transformers shall be UL listed and bear the UL label.

1.08 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped, and shall include instruction leaflets and instruction bulletins for the complete assembly and each major component.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Eaton/Cutler-Hammer products

B. Square D

C. General Electric

D. Siemens

E. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 RATINGS

A. The kVA and voltage ratings shall be as indicated on the Drawings.

B. Transformers shall be designed for continuous operation at rated kVA, for 24 hours a day, 365 days a year operation, with normal life expectancy as defined in ANSI C57.96.

C. Transformer shall meet the requirements of the most current version of federal law 10 CFR Part 431 "Energy Efficiency Program for Certain Commercial and Industrial Equipment".

D. Transformers efficiency shall be measured according to federal law 10 CFR Part 431.

E. Transformer sound levels shall not exceed the following ANSI and NEMA levels for self-cooled ratings:

Equivalent Winding kVA Range	Self-Cooled Ventilated		Self-Cooled Sealed
	K-Factor = 1 K-Factor = 4 K-Factor = 9	K-Factor = 13 K-Factor = 20	
3.00 and Below	40	40	45
3.01 to 9.00	40	40	45
9.01 to 15.00	45	45	50
15.01 to 30.00	45	45	50
30.01 to 50.00	45	48	50
50.01 to 75.00	50	53	55
75.01 to 112.50	50	53	55
112.51 to 150.00	50	53	55
150.01 to 225.00	55	58	57
225.01 to 300.00	55	58	57

Equivalent Winding kVA Range	Self-Cooled Ventilated		Self-Cooled Sealed
	K-Factor = 1 K-Factor = 4 K-Factor = 9	K-Factor = 13 K-Factor = 20	
300.01 to 500.00	60	63	59
500.01 to 700.00	62	65	61
700.01 to 1000.00	64	67	63
Greater than 1000	Consult Factory	Consult Factory	Consult Factory

2.03 CONSTRUCTION – GENERAL PURPOSE TRANSFORMERS

A. Insulation Systems

1. Transformer insulation system shall be as follows:

   a. Less than 15 kVA: 180 degrees C insulation system with 115 degree C rise, encapsulated design; 15 kVA and above: minimum of 200 degree C insulation system with 150 degree C rise, ventilated design.

2. Required performance shall be obtained without exceeding the above indicated .temperature rise in a 40 degrees C maximum ambient, and a 24-hour average ambient of 30 degrees C.

3. All insulation materials shall be flame-retardant and shall not support combustion as defined in ASTM Standard Test Method D635.

B. Core and Coil Assemblies

1. Transformer core shall be constructed with high-grade, non-aging, silicon steel with high magnetic permeability, and low hysteresis and eddy current losses. Maximum magnetic flux densities shall be substantially below the saturation point. The transformer core volume shall allow efficient transformer operation at 10% above the nominal tap voltage. The core laminations shall be tightly clamped and compressed. Coils shall be wound of electrical grade copper with continuous wound construction.

2. On three-phase units rated 15 kVA and the core and coil assembly shall be completely encapsulated in a proportioned mixture of epoxy or resin and aggregate to provide a moisture proof, shock-resistant seal. The core and coil encapsulation system shall minimize the sound level.

3. On three-phase units rated 15 kVA and above the coils assembly shall be impregnated with non-hydroscopic, thermosetting varnish and cured to reduce hot spots and seal out moisture; the core shall be coated with HAPs (Hazardous Air Pollutants) free water reducible electrical varnish to give good corrosion resistance. The assembly shall be installed on vibration-absorbing pads.

4. Terminals shall be welded to the leads of the coils for better conductivity, less maintenance, and lower risk of hot spots. Terminals shall not be spot welded or bolted to the coil leads.

C. Taps

1. Three-phase transformers rated 15 through 300 kVA shall be provided with six 2-1/2% taps, two above and four below rated primary voltage. Three-phase transformers rated greater than 300 kVA shall be provided with manufacturer's standard taps for that rating.

2. All single-phase transformers, and three-phase transformers rated below 15 kVA and above 500 kVA, shall be provided with the manufacturer's standard tap configuration.

D. Electrostatic Shielding

1. Provide shielded isolation transformers with an electrostatic shield consisting of a single turn of aluminum placed between the primary and secondary winding and grounded to the housing of the transformer.
    a. Electrostatic shield shall provide primary to secondary winding capacitance between 24 and 18 picofarads over the range of 100 Hz to 20 kHz.

2.04 WIRING/TERMINATIONS

A. Recommended external cable shall be rated 90 degrees C sized at 75 degrees C ampacity) for encapsulated and 75 degrees C for ventilated designs. Connectors should be selected on the basis of the type and cable size used to wire the specific transformer.

2.05 ENCLOSURE

A. The enclosure shall be made of heavy-gauge steel. All transformers shall be equipped with a wiring compartment suitable for conduit entry and large enough to allow convenient wiring. The maximum temperature of the enclosure shall not exceed 90 degrees C. The core of the transformer shall be grounded to the enclosure.

B. On three-phase units rated 15 kVA and below and single-phase units rated 15 kVA and below the enclosure construction shall be encapsulated, totally enclosed, non-ventilated, NEMA 3R, with lifting provisions.

C. On three-phase units rated 15 kVA and above and single-phase units rated 15 kVA and above the enclosure construction shall be ventilated, NEMA 2, drip-proof, with lifting provisions. All ventilation openings shall be protected against falling dirt. On outdoor units, provide weathershields over ventilated openings.

D. Ventilated type transformers that meet 10 CFR Part 431 efficiency requirements, with a core size of 150 kVA or less, shall be suitable for installation with 2-inch clearance from a wall or other obstruction behind the transformer enclosure.

2.06 FINISH

A. Steel enclosures shall be finished with ANSI 61 color, weather-resistant enamel.

PART 3 - EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.
    1. Ratio tests at the rated voltage connection and at all tap connections.
    2. Polarity and phase relation tests on the rated voltage connection.
    3. Applied potential tests.
    4. Induced potential test.
    5. No-load and excitation current at rated voltage on the rated voltage connection.

3.02 INSTALLATION

A. Transformers shall be floor mounted except where indicated on the Drawings to be suspended or wall mounted.

B. Suspended transformers shall be mounted on hanger rods with a spring isolator in each rod.

C. Floor mounted transformers shall be mounted on 4 inch high concrete housekeeping pads. Provide neoprene pads between transformer legs and housekeeping pad and anchor transformer to floor.

D. Provide grounding electrode conductor from transformer secondary neutral to nearest effectively grounded building structural steel.

E. Conduit connected to transformers shall be flexible metal conduit, 24 inches minimum length, 60 inches maximum length.

3.03 FIELD ADJUSTMENTS

A. Adjust taps to deliver appropriate secondary voltage.

3.04 FIELD TESTING

A. Measure primary and secondary voltages for proper tap settings.

END OF SECTION

SECTION 262413

SWITCHBOARDS - LOW VOLTAGE

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The Contractor shall furnish and install, where indicated, a free-standing, dead-front type low voltage distribution switchboard, utilizing group mounted circuit protective devices as specified herein, and as shown on the contract drawings.

1.03 RELATED SECTIONS

A. Section 264313 – Surge Protective Devices

1.04 REFERENCES

A. The low voltage distribution switchboards and all components shall be designed, manufactured and tested in accordance with the latest applicable following standards:

1. NEMA PB-2
2. UL Standard 891

1.05 SUBMITTALS – FOR REVIEW/APPROVAL

A. The following information shall be submitted to the Professional:

1. Master drawing index
2. Front view elevation
3. Floor plan
4. Top view
5. Single line
6. Schematic diagram
7. Nameplate schedule
8. Component list
9. Conduit entry/exit locations
10. Assembly ratings including:
    a. Short-circuit rating
    b. Voltage
    c. Continuous current
11. Major component ratings including:
    a. Voltage
    b. Continuous current
    c. Interrupting ratings
12. Cable terminal sizes
13. Product data sheets

1.06 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Paragraph 1.4, and shall

incorporate all changes made during the manufacturing process

2. Wiring diagrams
3. Certified production test reports
4. Installation information

1.07 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

1.08 REGULATORY REQUIREMENTS

A. The low-voltage switchboard shall be UL labeled.

1.09 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of these instructions shall be included with the equipment at time of shipment.

1.10 OPERATION AND MAINTENANCE MANUALS

A. Equipment operation and maintenance manuals shall be provided with each assembly shipped and shall include instruction leaflets, instruction bulletins and renewal parts lists where applicable, for the complete assembly and each major component.

1.11 PRE-INSTALLATION MEETING

A. The Contractor shall hold a Pre-Installation meeting for equipment included in this specification section. The meeting shall include the contractor, vendor, Professional, Bureau of Construction and Client Agency representatives. The meeting shall be held after a normal job conference. The Pre-Installation checklist form is located in e-builder in the Z Standard Training & Documentation: Documents \ 03 – Construction – Training and Guidance Documents \ 03 – Role Based Training and Guidance Documents \Contractors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Eaton/Cutler-Hammer products

B. General Electric

C. Square 'D'

D. Siemens

1. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety.

2.02 RATINGS

A. The assembly shall be rated to withstand mechanical forces exerted during short-circuit conditions when connected directly to a power source having available fault current of the amperes symmetrical at rated voltage as shown on the drawings.

B. Voltage rating to be as indicated on the drawings.

2.03 CONSTRUCTION

A. Switchboard shall consist of the required number of vertical sections bolted together to form a rigid assembly. The sides and rear shall be covered with removable bolt-on covers. All edges of front covers or hinged front panels shall be formed. Provide adequate ventilation within the enclosure.

B. All sections of the switchboard shall be front and rear aligned with depth as shown on drawings. All protective devices shall be group mounted.

C. The assembly shall be front accessible only. Protective devices shall be group mounted.

D. The switchboard shall be equal to Cutler-Hammer type Pow-R-Line C utilizing the components herein specified and as shown on the drawings.

E. The switchboard shall be suitable for use as service entrance equipment and be labeled in accordance with UL requirements.

2.04 BUS

A. All bus bars shall be silver-plated copper. Main horizontal bus bars shall be mounted with all three phases arranged in the same vertical plane. Bus sizing shall be based on NEMA standard temperature rise criteria of 65 degrees C over a 40 degrees C ambient.

B. Provide a full capacity neutral bus where a neutral bus is indicated on the drawings.

C. A copper ground bus (minimum 1/4 x 2 inch) shall be furnished firmly secured to each vertical section structure and shall extend the entire length of the switchboard.

D. All hardware used on conductors shall be high-tensile strength and zinc-plated. All bus joints shall be provided with conical spring-type washers.

2.05 WIRING/TERMINATIONS

A. Small wiring, necessary fuse blocks and terminal blocks within the switchboard shall be furnished as required. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

B. Mechanical-type terminals shall be provided for all line and load terminations suitable for copper or aluminum cable rated for 75 degrees C of the size as indicated on the drawings.

C. Lugs shall be provided in the incoming line section for connection of the main grounding conductor. Additional lugs for connection of other grounding conductors shall be provided as indicated on the drawings.

D. All control wire shall be type SIS, bundled and secured with nylon ties. Insulated locking spade terminals shall be provided for all control connections, except where saddle type terminals are provided integral to a device. All current transformer secondary leads shall first be connected to conveniently accessible short-circuit terminal blocks before connecting to any other device. All groups of control wires leaving the switchboard shall be provided with terminal blocks with suitable numbering strips. Provide wire markers at each end of all control wiring.

2.06 TRIP UNITS – MOLDED CASE CIRCUIT BREAKERS – 1200 A AND BELOW

A. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tripping characteristics and shall be Cutler – Hammer or approved equal.

B. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.

C. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.

D. Circuit breakers 100-ampere frame and below shall be Cutler-Hammer with thermal-magnetic trip units and inverse time-current characteristics.

E. Circuit breakers 125-ampere through 1200-ampere frame shall be Cutler-Hammer with microprocessor-based Digitrip RMS 310 sensing trip units.

F. Ground fault protection shall be provided where indicated and as required by Article 230.95 of the N.E.C.

G. All circuit breakers frame sizes rated 1,200 amp or larger shall be provided with arc energy

reduction. Circuit breaker Cutler Hammer, or approved equal shall be provided with microcessor-based digitrip RMS 310 sensing trip units, arc energy reducing switch with local status indicator. Furnish a nameplate on the breaker to read "Circuit Breaker Provided with Arc Energy Maintenance Reduction Switch."

2.07 SWITCHBOARD METER

A. Where indicated on the drawings, provide a microprocessor based multifunction power and energy meter. Meter shall be equal to Eaton type PXM 2250 or approved equal. Meter shall be UL rated. Meter shall support a three element wye system. Meter shall provide true rms measurements of voltage, phase to neutral and phase to phase, current, per phaseand neutral. Meter shall be digital readout. The PSM 2250 shall provide volts, AMPS, KW, KVAR< PF, KVA, frequency, KWH, KVAH, KVARH, and IKYZ pulse output.

1. The PXM shall be supplied with three (3) current transformers sized as required. Potential transformers shall be self-included and fused for up to 600 volts with potential connections suitable for 3-phase, 460.
2. The PXM control power shall be capable of being supplied from the monitored incoming AC line.

2.08 BOLTED PRESSURE SWITCHES

A. Protective devices shall be Pringle bolted pressure contact-type manufactured by Eaton and shall be UL listed.

B. Fusible switches shall be furnished with Class L fuse clips. Switch contact interrupting capacity shall be twelve (12) times the continuous rating of the switch.

C. Fuse access door shall be mechanically interlocked with the operating handle and shall have provisions for padlocking the switch in the open position.

D. The switch shall utilize a stored energy deadfront mechanism compressed and released by the operating handle, to provide quick positive switching action independent of the speed of the operating handle.

E. Switches shall be manually operated unless electrically tripped as shown on the drawings. Electrically tripped switches shall be designed to be closed only after the opening spring has been charged, ready for electrical opening by solenoid or manual opening by the mechanical pushbutton.

F. Contractor to provide Class L fuses as shown on the drawings.

G. Supply electrically-tripped switch(es) with the following accessories where indicated on the drawing:

1. Ground fault protection including test panel
2. Single-phase protection to open the switch(es) upon loss of any phase from the source
3. Blown fuse protection to open the switch upon blowing of one or more of the fuses, or with detection only: Protection with lights on when tripped

2.09 QUICK-MAKE/QUICK-BREAK FUSIBLE SWITCHES

A. Protective devices shall be quick-make/quick-break fusible switches as manufactured by Eaton type FDP. Fusible switches 30 amperes through 600 amperes frames shall be furnished with rejection Class "R" or "J" type fuse clips unless otherwise scheduled. Fusible switches 800 amperes through 1200 amperes specified in Paragraph 2.8 shall be furnished with Class L fuse clips. Switches shall incorporate safety cover interlocks to prevent opening the cover with the switch in the ON position or prevent placing the switch in the ON position with the cover open. Provide defeater for authorized personnel. Handles shall have provisions for padlocking and shall clearly indicate the ON or OFF position. Front cover doors shall be padlockable in the closed position.

2.10 ENCLOSURES

A. NEMA 1 Enclosure

2.11 NAMEPLATES

A. Engraved nameplates, mounted on the face of the assembly, shall be furnished for all main and feeder circuits as indicated on the drawings. Nameplates shall be laminated plastic, black characters on white background. Characters shall be 3/16-inch high, minimum. Nameplates shall give item designation and circuit number as well as frame ampere size and appropriate trip rating. Furnish master nameplate giving switchboard designation, voltage ampere rating, short-circuit rating, manufacturer's name, general order number, and item number.

B. Control components mounted within the assembly, such as fuse blocks, relays, pushbuttons, switches, etc., shall be suitably marked for identification corresponding to appropriate designations on manufacturer's wiring diagrams.

2.12 FINISH

A. All exterior and interior steel surfaces of the switchboard shall be properly cleaned and provided with a rust-inhibiting phosphatized coating. Color and finish of the switchboard shall be ANSI 61 light gray.

2.13 SURGE PROTECTIVE DEVICES

A. Provide surge protective devices as specified in Section 264313.

PART 3 - EXECUTION

3.01 FACTORY TESTING

A. The following standard factory tests shall be performed on the equipment provided under this section. All tests shall be in accordance with the latest version of ANSI and NEMA standards.

1. The switchboard shall be completely assembled, wired, adjusted, and tested at the factory. After assembly, the complete switchboard will be tested for operation under simulated service conditions to ensure the accuracy of the wiring and the functioning of all equipment. The main circuits shall be given a dielectric test of 2200 volts for one (1) minute between live parts and ground, and between opposite polarities. The wiring and control circuits shall be given a dielectric test of 1500 volts for one (1) minute between live parts and ground

B. The manufacturer shall provide three (3) certified copies of factory test reports.

3.02 MANUFACTURER'S CERTIFICATION

A. A certified test report of all standard production tests shall be available to the Professional upon request.

3.03 INSTALLATION

A. The Contractors shall install all equipment per the manufacturer's instructions, contract drawings and National Electrical Code.

B. The assembly shall be provided with adequate lifting means and shall be capable of being moved into installation position and bolted directly to Contractor supplied floor sills to be set level in concrete per manufacturer's recommendations. All necessary hardware to secure the assembly in place shall be provided by the Contractor. Contractor to install switchboard on a 4" concrete pad reinforced with #6 mesh.

3.04 FIELD ADJUSTMENTS

A. The Contractor shall perform field adjustments of the protective devices as required to place the equipment in final operating condition. The settings shall be in accordance with the approved short-circuit study, protective device evaluation study and protective device coordination study.

B. Necessary field settings of devices, adjustments and minor modifications to equipment to accomplish conformance with an approved short circuit and protective device coordination study shall be carried out by the Contractor at no additional cost to the Department.

3.05 TRAINING

A. The Contractor shall provide a training session for up to five (5) Client Agency's representatives

for 1 normal workdays at a job site location determined by the Client Agency.

B. A manufacturer's qualified representative shall conduct the training session. The training program shall consist of instruction on operation of the assembly, circuit breakers, fused switches, and major components within the assembly.

END OF SECTION

SECTION 262416
PANELBOARDS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION

A. General: Provide panelboards in accordance with the Contract Documents.

1.03 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. Panelboards
    a. UL Standards #67.
    b. UL Standard 50 Cabinet and Boxes
    c. Federal Standard W-P-115.
    d. NEMA Standard PB-1
    e. Circuit Breakers – Type 1, Class 1.

1.04 SUBMITTALS

A. Submittals will be furnished. Submittals failing to meet the following criteria will be returned without a review or acceptance.

B. With each panelboard drawing the following is required:

1. Show main devices and lug sizes; branch circuit device sizes and arrangement; bus ampacities; withstandability and short circuit rating; dimensions and construction; gutter and backbox dimensions; nameplate and legend; protective coating; and all pertinent details of panel, enclosure, cover, and method of securing cover and lock.

1.05 QUALITY ASSURANCE

A. Each panelboard as a complete and finished product shall receive a single integrated equipment rating by the manufacturer. The integrated equipment short circuit wiring shall certify that all equipment is capable of withstanding the thermal and magnetic stress of a fault equal to the value specified on the Drawings. Such rating shall be established by actual tests by the manufacturer on similar equipment. This certification shall be permanently affixed to each panelboard. Test data shall be submitted to the Professional at time of submission of Acceptance Drawings.

1.06 PRE-INSTALLATION MEETING

A. The Contractor shall hold a Pre-Installation meeting for equipment included in this specification section. The meeting shall include the contractor, vendor, Professional, Bureau of Construction and Client Agency representatives. The meeting shall be held after a normal job conference. The Pre-Installation checklist form is located in e-builder in the Z Standard Training & Documentation: Documents \ 03 – Construction – Training and Guidance Documents \ 03 – Role Based Training and Guidance Documents \Contractors.

PART 2 - PRODUCTS

2.01 APPROVED MANUFACTURERS

A. Eaton

B. Square D

C. General Electric

D. Siemens

E. 277/480 volts circuit breaker type panelboards are to be equal to Eaton Pow-R – Line 2.

F. 120/240 volts circuit breaker type panelboards are to be equal to Eaton Pow-R Line 1.

G. Breaker distribution panelboards are to be equal to Eaton Pow-R-Line-4B.

2.02 PANELBOARDS IN GENERAL

A. Provide panelboards consisting of an assembly of branch circuit switching and protective devices (circuit breakers, switch and fuse units, or combination thereof) mounted inside a dead front enclosure. Provide the number and size of these branch circuit devices as indicated by the circuiting, on the drawings, and in the schedules.

B. Provide the following modifications and additional equipment as shown on the Drawings:

1. Main circuit breakers.
2. Shunt trip circuit breakers.
3. Sub-feed switches.
4. Panelboard integral mounted relays and contactors.
5. Feed through lugs and/or bus.
6. Ground fault interrupting circuit breakers.

C. Interiors

1. Rigid removable assembly of copper bus bars and interchangeable bolted branch circuit devices.
2. Bus bars drilled to permit branch circuit devices of all sizes and number of poles to be interchangeable and installed in any spare space of sufficient size, without disturbing adjacent units; without removing main bus or branch circuit connectors and without machining, drilling, or tapping in the field.
3. Arrange bus in sequence or distributed phasing so that multipole circuit breaker can replace any group of single circuit breakers of the same size.
4. Provide copper neutral bus in each panelboard.
5. Provide copper ground bus in each panelboard.

D. Enclosure

1. Code gauge steel box galvanized.
2. Provide a bolt-on ground connector to inside of enclosure.
3. Flush mounted in finished areas and where indicated. Surface mount elsewhere.

E. Front

1. Doors must be provided on all lighting and power distribution panels. On switch and fuse panelboards, doors for overcurrent devices are not to be provided.
2. Heavy code gauge steel as required to maintain panel face flat.
3. Hold front closed with trim clamps.
4. Factory finished in medium gray enamel or two coats of air-drying lacquer over a rust inhibitor.
5. Provide directory for total number of poles.
6. Provide approved lock. All panels keyed alike. Furnish 4 sets of matching keys to the Client Agency.
7. Welded angle rest at the bottom of the door to facilitate cover installation.
8. Doors over 48" in height shall have auxiliary fasteners at top and bottom of door in

addition to lock and catch.

9. Door-in-door construction.

F. Terminal lugs

1. Bolted type, labeled for either copper or aluminum conductors.
2. Locate main lugs properly at top or bottom, depending where main feeder enters.

G. Electrical Ratings

1. Panelboards are to be rated 120/208 or 277/480 volts 3 phase, 4 wire, full neutral with ampacities as indicated on the Drawings (unless otherwise noted).
2. Short circuit withstand ratings shall be as indicated on the Drawings. Panelboards shall be fully rated. Series rated not acceptable.
3. Where indicated, provide panelboards having a "service entrance" Type UL label with neutrals factory bonded to frame or enclosure.

H. Circuit Breaker Devices

1. Plastic molded case. Completely sealed enclosure. Toggle type operating handle. Trip ampere rating and ON/OFF indication clearly visible.
2. Thermal-magnetic trip-free, trip-indicating, quick-make, quick-break, with inverse time delay characteristics. Single-handle and common tripping multipole breakers.
3. Silver alloy contacts with auxiliary arc-quenching devices.
4. Panelboard must be of the type which will accept the field installation of shunt trip devices of 60 amperes or less on the branch devices.
5. Interrupting capacities shall be as indicated on the Drawings. In general, 120/208 volt devices shall be not less than (10,000 AIC). And 277/480 not less than (14,000 AIC).
6. Bolted type terminals UL listed for either aluminum or copper 75 degrees C cables.
7. Provide main breakers in panels served from transformers.
8. Locate next to each breaker or space unit an individual number.
9. Circuit breakers serving kitchen equipment beneath cooking hoods shall include a shunt trip coil.
10. Panelboard shall accept circuit breakers from 15 ampere to 100 ampere.

I. Life Safety Circuit Breakers

1. For all main and sub-feed circuit breakers for the life safety distribution system, the circuit breakers shall be provided with electronic trip unit with LSI settings. This is required for selective coordination. Branch circuit breakers in panelboards may be thermal magnetic trip.

J. Ground Fault Interrupters

1. Ground fault interrupter branch circuit breakers shall be as indicated in panel schedules. Circuit breakers shall be circuit interrupting which will operate manually for normal switching functions and automatically under overload, short circuit, and 0.005 amp line-to-ground fault conditions. The operation mechanism shall be entirely trip-free so that contact cannot be held closed against an abnormal overcurrent, short circuit, or ground fault condition. The device shall be bolt-on type with insulated case construction and shall be interchangeable with standard 1 P breakers utilized in the panelboard.

2.03 DISTRIBUTION PANELBOARDS

A. Distribution panelboards with bolt-on devices shall have interrupting ratings as specified herein or indicated on the drawings. Panelboards shall be fully rated. Panelboards shall be Eaton type Pow-R-Line 4B.

B. Where indicated, provide circuit breakers UL listed for application at 80% of their continuous

ampere rating in their intended enclosure.

C. Provide shunt trips, bell alarms, and auxiliary switches as shown on the contract drawings.

D. Trip Units for Molded Case Circuit Breakers – 1200 A and Below

1. Protective devices shall be molded case circuit breakers with inverse time and instantaneous tipping characteristics and shall be Eaton or approved equal.
2. Circuit breakers shall be operated by a toggle-type handle and shall have a quick-make, quick-break over-center switching mechanism that is mechanically trip-free. Automatic tripping of the breaker shall be clearly indicated by the handle position. Contacts shall be nonwelding silver alloy and arc extinction shall be accomplished by means of DE-ION arc chutes. A push-to-trip button on the front of the circuit breaker shall provide a local manual means to exercise the trip mechanism.
3. Circuit breakers shall have a minimum symmetrical interrupting capacity as indicated on the drawings.
4. Circuit breakers 225-ampere frame and below shall have thermal-magnetic trip units and inverse time-current characteristics.
5. Circuit breakers 250-ampere through 1200-ampere frame shall have microprocessor-based rms sensing trip units.
6. Ground fault protection shall be provided where indicated.

E. Enclosure

1. Enclosures shall be at lest 20 inches wide made from galvanized steel. Provide minimum gutter space in accordance with the National Electrical Code. Where feeder cables supplying the mains of a panel are carried through its box to supply other electrical equipment, the box shall be sized to include the additional required wiring space. At least four interior mounting studs with adjustable nuts shall be provided.
2. Enclosures shall be provided with blank ends.

F. Nameplates

1. Provide an engraved nameplate for each panel section.

2.04 SURGE PROTECTIVE DEVICES

A. Provide surge protective devices as specified in Section 264313.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Mount panel 4 feet to panel center but with maximum height of 6 feet 6 inches to handle of topmost switching device.

B. Mount surface type panels a minimum of 1 inch off wall on channels.

C. Connect feed-through panels to main feeder by insulated parallel gutter taps. Full-size tap for two panels on a common feeder. Increase cabinet width to accommodate gutter tap.

D. Where flush mounted, the fire integrity of the wall in which it is installed must be maintained.

E. Neatly arrange branch circuit wires and tie together in each gutter with Thomas & Betts nylon "Ty-Raps", or approved equal at minimum 4 inch intervals.

F. Plug all knockouts removed and not utilized.

3.02 TOUCH UP AND CLEANING

A. Vacuum all backboxes clean of debris after installation and prior to final payment.

B. Touch up scratch marks, etc. with matching paint.

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTIONS

A. General: Provide wiring devices in accordance with the Contract Documents.

1.03 QUALITY ASSURANCE

A. Switches and receptacles shall be of the same manufacturer.

B. Reference shall be made to the drawings for additional wiring devices not noted in this section of the specifications.

C. Manufacturer shall have a minimum of ten (10) years experience in the manufacture of wiring devices similar to those specified on this project.

D. Manufacturer shall have ISO-9002 certification.

1.04 STANDARDS

A. Switches: Federal Specifications WS-896E, NEMA WD-1, and UL 20.

B. Receptacles: Federal Specification W-C-596, NEMA WD-1, NEMA WD-6, and UL 498.

C. Ground Fault Circuit Interrupter Receptacles: UL 943 Class A.

1.05 SUBMITTALS

A. Product Data: For each type of products.

B. Shop Drawings: List and description of materials and the method for receptacle identification.

1.06 COLORS

A. Device and coverplate (thermostatic) colors connected to the normal power system shall be as selected by Professional unless otherwise indicated on the architectural drawings:

B. Switches and receptacles connected to the emergency power system shall be red.

C. Isolated ground receptacles shall be orange as specified below with orange triangle on face.

PART 2 - PRODUCTS

2.01 ACCEPTABLE MANUFACTURERS

A. Catalog numbers shall not be used to determine colors of devices and coverplates. Catalog numbers are used to establish minimum acceptable standard.

B. Switches and Receptacles: Hubbell or equal, by Cooper Wiring Devices, Leviton, and Pass & Seymour.

C. Floor Boxes and Fittings

1. Poke through type: Hubbell or equal.
2. Recessed flush floor box type: Hubbell or equal.

2.02 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.
3. Receive Client Agency approval.

D. Devices for Client Agency-Furnished Equipment:
1. Receptacles: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.03 SWITCHES

A. General
1. Switches shall be of the type indicated on the Drawings.
2. Switches shall be commercial specification grade, quiet type, 20A, 120/277V, 1 HP rated at 120V, 2HP rated at 277V, back and side wired, silent handle operation.
3. Switch with pilot light shall be specified for applications where the load to be controlled is not in sight. Pilot light shall be long life, LED type and shall be on when the load is off.

B. Lighting Switches
1. Toggle Handle Type
a. Single pole: Hubbell: HBL1221.
b. 3-way: Hubbell: HBL1223.
c. 4-way: Hubbell: HBL1224.
d. Double pole: Hubbell: HBL1222.

C. Single-Pole, Double Throw, Momentary Contact Switches
1. Toggle handle type, center off: Hubbell: HBL1557.
2. Key operated, center off: Hubbell: HBL1557L.

D. Weatherproof Switches
1. Weatherproof handle/coverplate: Hubbell: HBL1795.

2.04 RECEPTACLES

A. General
1. Receptacles shall be of the type indicated on the Drawings.
2. Receptacles shall be heavy duty 20A specification grade, 125V, grounding type, back and side wired.

B. Receptacles
1. Single, 20A: Hubbell: HBL5361.
2. Duplex, 20A: Hubbell: HBL5362.

C. Tamper Resistant Receptacles
1. Duplex, 20A: Hubbell: HBL5362TR.

D. Isolated Ground Receptacles
1. Duplex, 20A: Hubbell IG5362.

E. Ground Fault Circuit Interrupter Receptacles
1. Duplex, 20A: Hubbell: HBLGF20LA.
2. Duplex 20A: Hubbell Tamper Resistant: HBLGFTR20.

F. Special purpose receptacles: Rating as indicated on the Drawings.

G. Weatherproof Receptacles and Cover

1. Exterior weatherproof outlet shall be Hubbell. While in use, cast aluminum, 1 gang vertical, GFCI receptacle Catalog #WP26M or approved equal.

2.05 FLOOR BOXES AND FITTINGS

A. General

1. Provide floor boxes and fittings of the types, ratings, and configurations as shown on the Drawings. Complete with all fittings, wiring devices with tile or carpet assembly.
2. Floor boxes and fittings shall be suitable for the fire rating and thickness of the floor.
3. Combination power/telecom outlets shall have barrier to separate power and telecom wiring.

B. Fire Rated Poke Through Assembly

1. Fire rated insert, junction box, and service fitting. Combination power/telecom outlets shall have barrier to separate power and telecom wiring. Carpet flange shall be diecast aluminum, painted or plated finish as selected by Professional, Department.
2. Comply with UL 514 scrub water exclusion requirements.

2.06 SERVICE POLES

A. Description:

1. Provide service poles of the types and configurations as shown on the drawings – complete with all fittings, wiring, devices, etc.
2. Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.
3. Poles: Nominal 2.5-inch-square cross section, with height adequate to extend from floor to at least 6 inches above ceiling, and with separate channels for power wiring and voice and data communication cabling.
4. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.

2.07 WALL PLATES

A. Single and combination types to match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: 0.035-inch-thick, satin-finished stainless steel 302/304, 0.03-inch thick.
3. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations".

PART 3 - EXECUTION

3.01 INSTALLATION

A. General

1. The exact location of wiring devices shall be determined by location of equipment and as detailed on the Architectural Drawings. Prior to installation the Client Agency has the right to have the devices relocated 25'-0" at no cost.
2. Devices mounted above counters shall be 2 inches above the top of the backsplash to the bottom of the coverplate.

B. Switches

1. Mount switches vertically with the ON position on top.
2. Mount switches on the strike side of doors, unless otherwise detailed on the drawings.

C. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

D. Conductors:
1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
4. Existing Conductors:
   a. Cut back and pigtail, or replace all damaged conductors.
   b. Straighten conductors that remain and remove corrosion and foreign matter.
   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

E. Device Installation:
1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

F. Receptacle Orientation:
1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

G. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

3.02 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.03 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Perform the following tests and inspections:

1. Test Instruments: Use instruments that comply with UL 1436.
2. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

D. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.
2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.
3. Ground Impedance: Values of up to 2 ohms are acceptable.
4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.
5. Using the test plug, verify that the device and its outlet box are securely mounted.
6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

E. Wiring device will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

END OF SECTION

SECTION 262813

FUSES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION

A. General: Provide fuses in accordance with the Contract Documents.

1.03 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. UL Standard #198

1.04 SUBMITTALS

A. Provide a complete set of shop drawings to include let-thru curves for each type of fuse, a schedule of spare fuse cabinets with a listing of fuses provided within each spare fuse cabinet, and dimensioned drawings of each spare fuse cabinet by type and size.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Mains, Feeders and Branch Circuits

1. General
    a. All fuses shall be labeled as UL Class L or UL Class R, current limiting and rated for up to 200,000 amperes. Time delay Class R fuses shall be so labeled.
2. Main Service and all Feeder Circuits
    a. Fuses over 600 amperes shall be UL Class L. Fuses up to 600 amperes shall be UL Class RK1. If fuses directly feed motors or transformers, they shall be UL RK1, labeled Time-delay.
3. Branch Circuits
    a. Feeding circuit breaker panels shall be UL Class RK1.
    b. Feeding motor circuits shall be UL Class RK1 labeled as Time-delay.
4. All fuses shall be so selected as to provide a selectivity coordinated system.
5. All fuses shall be of the same manufacturer.
6. All fuses to be of the Class R type.

B. Spares: Upon completion of the building, the contractor shall provide the Client Agency with spare fuses as indicated below:

1. 10 percent (minimum of 3) of each type and rating of installed fuses shall be supplied as spares.
2. Spare fuse cabinets shall be provided to store the above spares.
3. Spare fuse cabinets shall be provided as a minimum in the following locations:
    a. Each main switchgear room.
    b. Each major mechanical equipment room.

C. Manufacturers

1. Littelfuse, Bussmann, Gould-Shawmut.

PART 3 - EXECUTION

3.01 GENERAL

A. Fuses shall not be installed until equipment is ready to be energized.

B. All fuses shall be provided by the Contractor.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION

A. Provide enclosed fusible disconnect switches in accordance with the Contract Documents.

1.03 STANDARDS

A. Except as modified by governing codes and by the Contract Documents, comply with the latest applicable provisions and latest recommendations of the following:

1. UL Standards #98
2. NEMA KS-1

1.04 SUBMITTALS

A. Submit manufacturers' data for all disconnect switches and circuit breakers.

PART 2 - PRODUCTS

2.01 ENCLOSED SWITCHES

A. Enclosed switches shall be fused heavy-duty, single-throw knife switch with quick-make, quick-break mechanism, capable of full load operations. Meet NEMA and U.S. Government specifications for Class A switches. Install fused switches unless otherwise noted.

B. Provide with contact arc-quenching devices, such as magnetic blowouts or snuffing plates. Provide self-aligning switchblades with silver alloy contact areas and designed so that arcing upon making and breaking does not occur on the final contact surfaces. Provide with high-pressure, spring-loaded contact. Mount switch parts on high-grade insulating base. All safety switches shall be fused unless otherwise noted.

C. Enclosure: NEMA 1 with hinged door, and defeatable interlock when switch is in "On" position and can be positively padlocked in "on" and "off" positions. Utilize NEMA 3R (rain-tight) enclosure for exterior installations. NEMA 3R enclosures must be galvanized.

D. Size fusing and number of poles as shown or as required. Where fused, the devices must be provided with UL listed rejection feature to reject all but Class R fuses. Provide horsepower rated switch to match motor load if no size is shown. Use 3 pole plus solid neutral switches on four wire circuits and 3 pole switches on all other circuits unless otherwise noted.

E. Lugs must be UL listed for aluminum and/or copper conductors and be front removable.

F. Manufacturer to be the same as that for transformers, switchgear, etc.

G. Acceptable manufacturers: Square D, Cutler-Hammer, General Electric or Siemens.

2.02 TOGGLE TYPE MANUAL CONTROL SWITCHES

A. Provide switches that operate at their full rating with fluorescent, tungsten, and resistance loads – and at 80% of their rated capacity with motor loads.

B. Switches to be heavy duty and have:

1. Arc-resisting bodies.
2. Slow make-and-break mechanisms.
3. Silver alloy contact buttons.
4. Side or back wiring with up to No. 10 AWG solid conductors.

C. Acceptable manufacturers: Square D Class 2510, 11, or 12; General Electric Type RB and Siemens Class MMS with enclosure.

2.03 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250 Type A.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Kitchen and Wash-Down Area: NEMA 250, Type 4X, stainless steel.
4. Other Wet or Damp, Indoor Locations: NEMA 250, Type 4.

PART 3 - EXECUTION

3.01 APPLICATIONS

A. Each piece of equipment utilizing multi-phase power shall be supplied with a safety-type disconnect switch.

B. Each piece of equipment utilizing single-phase power and protected at over 30 amperes shall be supplied with a safety-type disconnect switch.

C. Motor disconnects other than mentioned above may utilize a toggle type manual control switch properly sized and rated for the equipment it disconnects.

D. Factory installed fused disconnect switches may be used to satisfy the above requirements with the Professional's prior approval.

3.02 MOUNTING

A. Switches or circuit breakers less than 100 pounds may be mounted on the wall. Equipment over 100 pounds shall be mounted on a rack that extends from floor to ceiling. Do not mount switches or circuit breakers to equipment housing.

END OF SECTION

SECTION 263600

TRANSFER SWITCHES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, weights, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Dimensioned plans, elevations, sections, and details showing minimum clearances, conductor entry provisions, gutter space, installed features and devices, and material lists for each switch specified.

C. Qualification Data: For manufacturer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For each type of product to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 1 Section "Operation and Maintenance Data," include the following:

1. Features and operating sequences, both automatic and manual.
2. List of all factory settings of relays; provide relay-setting and calibration instructions, including software, where applicable.

1.04 QUALITY ASSURANCE

A. Manufacturer Qualifications: Maintain a service center capable of providing training, parts, and emergency maintenance repairs within a response period of less than eight hours from time of notification.

B. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NEMA ICS 1.

E. Comply with NFPA 70.

F. Comply with NFPA 99.

G. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.05 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of automatic transfer switches that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 5 years from date of final payment.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Contactor Transfer Switches:
    a. Cummins Power Generation- OTPC (Basis of design).
    b. ASCO
    c. Or equal as approved by the Professional

2.02 GENERAL TRANSFER-SWITCH PRODUCT REQUIREMENTS

A. Indicated Current Ratings: Apply as defined in UL 1008 for continuous loading and total system transfer, including tungsten filament lamp loads not exceeding 30 percent of switch ampere rating, unless otherwise indicated.

B. Tested Fault-Current Closing and Withstand Ratings: Adequate for duty imposed by protective devices at installation locations in Project under the fault conditions indicated, based on testing according to UL 1008.

1. Where transfer switch includes internal fault-current protection, rating of switch and trip unit combination shall exceed indicated fault-current value at installation location.

C. Solid-State Controls: Repetitive accuracy of all settings shall be plus or minus 2 percent or better over an operating temperature range of minus 20 to plus 70 deg C.

D. Resistance to Damage by Voltage Transients: Components shall meet or exceed voltage-surge withstand capability requirements when tested according to IEEE C62.41. Components shall meet or exceed voltage-impulse withstand test of NEMA ICS 1.

E. Electrical Operation: Accomplish by a nonfused, momentarily energized solenoid or electric-motor-operated mechanism, mechanically and electrically interlocked in both directions.

F. Switch Characteristics: Designed for continuous-duty repetitive transfer of full-rated current between active power sources.

1. Limitation: Switches using molded-case switches or circuit breakers or insulated-case circuit-breaker components are not acceptable.
2. Switch Action: Double throw; mechanically held in both directions.
3. Contacts: Silver composition or silver alloy for load-current switching. Conventional automatic transfer-switch units, rated 225 A and higher, shall have separate arcing contacts.

G. Neutral Switching. Provide Switch Neutral 4 Pole where indicated on drawings.

H. Factory Wiring: Train and bundle factory wiring and label, consistent with Shop Drawings, either by color-code or by numbered or lettered wire and cable tape markers at terminations. Color-coding and wire and cable tape markers are specified in Division 26 Section "Electrical Identification."

1. Designated Terminals: Pressure type, suitable for types and sizes of field wiring indicated.
2. Power-Terminal Arrangement and Field-Wiring Space: Suitable for top, side, or bottom entrance of feeder conductors as indicated.
3. Control Wiring: Equipped with lugs suitable for connection to terminal strips.

I. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508, unless otherwise indicated.

2.03 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

C. Signal-Before-Transfer Contacts: A set of normally open/normally closed dry contacts operates in advance of retransfer to normal source. Interval is adjustable from 1 to 30 seconds.

D. Motor Disconnect and Timing Relay: Controls designate starters so they disconnect motors before transfer and reconnect them selectively at an adjustable time interval after transfer. Control connection to motor starters is through wiring external to automatic transfer switch. Time delay for reconnecting individual motor loads is adjustable between 1 and 60 seconds, and settings are as indicated. Relay contacts handling motor-control circuit inrush and seal currents are rated for actual currents to be encountered.

E. Programmed Neutral Switch Position: Switch operator has a programmed neutral position arranged to provide a midpoint between the two working switch positions, with an intentional, time-controlled pause at midpoint during transfer. Pause is adjustable from 0.5 to 30 seconds minimum and factory set for 0.5 second, unless otherwise indicated. Time delay occurs for both transfer directions. Pause is disabled unless both sources are live.

F. Automatic Transfer-Switch Features:

1. Undervoltage Sensing for Each Phase of Normal Source: Sense low phase-to-ground voltage on each phase. Pickup voltage shall be adjustable from 85 to 100 percent of nominal, and dropout voltage is adjustable from 75 to 98 percent of pickup value. Factory set for pickup at 90 percent and dropout at 85 percent.
2. Adjustable Time Delay: For override of normal-source voltage sensing to delay transfer and engine start signals. Adjustable from zero to six seconds, and factory set for one second.
3. Voltage/Frequency Lockout Relay: Prevent premature transfer to generator. Pickup voltage shall be adjustable from 85 to 100 percent of nominal. Factory set for pickup at 90 percent. Pickup frequency shall be adjustable from 90 to 100 percent of nominal. Factory set for pickup at 95 percent.
4. Time Delay for Retransfer to Normal Source: Adjustable from 0 to 30 minutes, and factory set for 10 minutes to automatically defeat delay on loss of voltage or sustained undervoltage of emergency source, provided normal supply has been restored.
5. Test Switch: Simulate normal-source failure.
6. Switch-Position Pilot Lights: Indicate source to which load is connected.
7. Source-Available Indicating Lights: Supervise sources via transfer-switch normal- and emergency-source sensing circuits.
    a. Normal Power Supervision: Green light with nameplate engraved "Normal Source Available."
    b. Emergency Power Supervision: Red light with nameplate engraved "Emergency Source Available."
8. Unassigned Auxiliary Contacts: Two normally open, single-pole, double-throw contacts for each switch position, rated 10 A at 240-V ac.
9. Transfer Override Switch: Overrides automatic retransfer control so automatic transfer switch will remain connected to emergency power source regardless of condition of normal source. Pilot light indicates override status.
10. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
11. Engine Shutdown Contacts: Instantaneous; shall initiate shutdown sequence at remote engine-generator controls after retransfer of load to normal source.

12. Engine-Generator Exerciser: Solid-state, programmable-time switch starts engine generator and transfers load to it from normal source for a preset time, then retransfers and shuts down engine after a preset cool-down period. Initiates exercise cycle at preset intervals adjustable from 7 to 30 days. Running periods are adjustable from 10 to 30 minutes. Factory settings are for 7-day exercise cycle, 20-minute running period, and 5-minute cool-down period. Exerciser features include the following:
    a. Exerciser Transfer Selector Switch: Permits selection of exercise with and without load transfer.
    b. Push-button programming control with digital display of settings.
    c. Integral battery operation of time switch when normal control power is not available.

G. Comply with requirements for Level 1 equipment according to NFPA 110.

H. Interconnection with Automatic Transfer Switches: Factory-installed copper bus bars; plated at connection points and braced for the indicated available short-circuit current.

2.04 SOURCE QUALITY CONTROL

A. Factory test and inspect components, assembled switches, and associated equipment. Ensure proper operation. Check transfer time and voltage, frequency, and time-delay settings for compliance with specified requirements. Perform dielectric strength test complying with NEMA ICS 1.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Design each fastener and support to carry load indicated by seismic requirements and according to seismic-restraint details. See Division 26 Section "Electrical Supports and Seismic Restraints."

B. Switch to be wall mounted. Seismic Certified.

C. Identify components according to Division 26 Section "Electrical Identification."

D. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.02 CONNECTIONS

A. Ground equipment according to Division 26 Section "Grounding and Bonding."

B. Connect wiring according to Division 26 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installation, including connections, and to assist in testing.
2. After installing equipment and after electrical circuitry has been energized, test for compliance with requirements.
3. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
4. Measure insulation resistance phase-to-phase and phase-to-ground with insulation-resistance tester. Include external annunciation and control circuits. Use test voltages and procedure recommended by manufacturer. Comply with manufacturer's specified minimum resistance.
    a. Check for electrical continuity of circuits and for short circuits.

b. Inspect for physical damage, proper installation and connection, and integrity of barriers, covers, and safety features.

c. Verify that manual transfer warnings are properly placed.

d. Perform manual transfer operation.

5. After energizing circuits, demonstrate interlocking sequence and operational function for each switch at least three times.

a. Simulate power failures of normal source to automatic transfer switches and of emergency source with normal source available.

b. Simulate loss of phase-to-ground voltage for each phase of normal source.

c. Verify time-delay settings.

d. Verify pickup and dropout voltages by data readout or inspection of control settings.

e. Test bypass/isolation unit functional modes and related automatic transfer-switch operations.

f. Perform contact-resistance test across main contacts and correct values exceeding 500 microhms and values for 1 pole deviating by more than 50 percent from other poles.

g. Verify proper sequence and correct timing of automatic engine starting, transfer time delay, retransfer time delay on restoration of normal power, and engine cool-down and shutdown.

C. Coordinate tests with tests of generator and run them concurrently.

D. Remove and replace malfunctioning units and retest as specified above.

E. Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each switch. Remove all access panels so joints and connections are accessible to portable scanner.

1. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each switch 11 months after date of Substantial Completion.

2. Instrument: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

3. Record of Infrared Scanning: Prepare a certified report that identifies switches checked and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Client Agency's maintenance personnel to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 1 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 264313

SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. The Contractor shall furnish and install the Surge Protective Device (SPD) equipment having the electrical characteristics, ratings, and modifications as specified herein and as shown on the contract drawings. To maximize performance and reliability and to obtain the lowest possible let-through voltages, the ac surge protection shall be integrated into electrical distribution equipment such as switchboards and panelboards. Refer to related sections for surge requirements in:

1.03 RELATED SECTIONS

A. Section 262416 – Panelboards

B. Section 262413 – Switchboards – Low Voltage

1.04 REFERENCES

A. SPD units and all components shall be designed, manufactured, and tested in accordance with the latest applicable UL standard (ANSI/UL 1449 3rd Edition).

1.05 SUBMITTALS – For Review/Approval

A. The following information shall be submitted to the Professional:

1. Provide verification that the SPD complies with the required ANSI/UL 1449 3rd Edition listing by Underwriters Laboratories (UL) or other Nationally Recognized Testing Laboratory (NRTL). Compliance may be in the form of a file number that can be verified on UL's website or on any other NRTL's website, as long as the website contains the following information at a minimum: model number, SPD Type, system voltage, phases, modes of protection, Voltage Protection Rating (VPR), and Nominal Discharge Current (I_n).
2. For sidemount mounting applications (SPD mounted external to electrical assembly), electrical/mechanical drawings showing unit dimensions, weights, installation instruction details, and wiring configuration.

B. Where applicable the following additional information shall be submitted to the Professional:

1. Descriptive bulletins
2. Product sheets

1.06 SUBMITTALS – FOR CONSTRUCTION

A. The following information shall be submitted for record purposes:

1. Final as-built drawings and information for items listed in Section 1.4 and shall incorporate all changes made during the manufacturing process.

1.07 QUALIFICATIONS

A. The manufacturer of the assembly shall be the manufacturer of the major components within the assembly.

B. For the equipment specified herein, the manufacturer shall be ISO 9001 or 9002 certified.

C. The manufacturer of this equipment shall have produced similar electrical equipment for a minimum period of five (5) years. When requested by the Professional, an acceptable list of installations with similar equipment shall be provided demonstrating compliance with this requirement.

D. The SPD shall be compliant with the Restriction of Hazardous Substances (RoHS) Directive 2002/95/EC.

1.08 DELIVERY, STORAGE AND HANDLING

A. Equipment shall be handled and stored in accordance with manufacturer's instructions. One (1) copy of manufacturer's instructions shall be included with the equipment at time of shipment.

1.09 OPERATION AND MAINTENANCE MANUALS

A. Operation and maintenance manuals shall be provided with each SPD shipped.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Eaton Cutler-Hammer

B. Square D

C. ABB

D. The listing of specific manufacturers above does not imply acceptance of their products that do not meet the specified ratings, features, and functions. Manufacturers listed above are not relieved from meeting these specifications in their entirety. Products in compliance with the specification and manufactured by others not named will be considered only if pre-approved by the Professional ten (10) days prior to bid date.

2.02 VOLTAGE SURGE SUPPRESSION – GENERAL

A. Electrical Requirements

1. Unit Operating Voltage – Refer to drawings for operating voltage and unit configuration.
2. Maximum Continuous Operating Voltage (MCOV) – The MCOV shall not be less than 115% of the nominal system operating voltage.
3. The suppression system shall incorporate thermally protected metal-oxide varistors (MOVs) as the core surge suppression component for the service entrance and all other distribution levels. The system shall not utilize silicon avalanche diodes, selenium cells, air gaps, or other components that may crowbar the system voltage leading to system upset or create any environmental hazards.
4. Protection Modes – The SPD must protect all modes of the electrical system being utilized. The required protection modes are indicated by bullets in the following table:

	Protection Modes			
Configuration	L-N	L-G	L-L	N-G
Wye	●	●	●	●
Delta	N/A	●	●	N/A
Single Split Phase	●	●	●	●
High Leg Delta	●	●	●	●

5. Nominal Discharge Current (I_n) – All SPDs applied to the distribution system shall have a 20kA I_n rating regardless of their SPD Type (includes Types 1 and 2) or operating voltage. SPDs having an I_n less than 20kA shall be rejected.
6. ANSI/UL 1449 3rd Edition Voltage Protection Rating (VPR) – The maximum ANSI/UL 1449 3rd Edition VPR for the device shall not exceed the following:

MODES	208Y/120	480Y/277

L-N; L-G; N-G	700	1200
L-L	1200	2000

B. SPD Design

1. Maintenance Free Design – The SPD shall be maintenance free and shall not require any user intervention throughout its life. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.
2. Balanced Suppression Platform – The surge current shall be equally distributed to all MOV components to ensure equal stressing and maximum performance. The surge suppression platform must provide equal impedance paths to each matched MOV. Designs incorporating replaceable SPD modules shall not be accepted.
3. Electrical Noise Filter – Each unit shall include a high-performance EMI/RFI noise rejection filter. Noise attenuation for electric line noise shall be up to 50 dB from 10 kHz to 100 MHz using the MIL-STD-220A insertion loss test method. Products unable able to meet this specification shall not be accepted.
4. Internal Connections – No plug-in component modules or printed circuit boards shall be used as surge current conductors. All internal components shall be soldered, hardwired with connections utilizing low impedance conductors.
5. Monitoring Diagnostics – Each SPD shall provide the following integral monitoring options:
    a. Protection Status Indicators - Each unit shall have a green / red solid-state indicator light that reports the status of the protection on each phase.
        1) For wye configured units, the indicator lights must report the status of all protection elements and circuitry in the L-N and L-G modes. Wye configured units shall also contain an additional green / red solid-state indicator light that reports the status of the protection elements and circuitry in the N-G mode. SPDs that indicate only the status of the L-N and L-G modes shall not be accepted.
        2) For delta configured units, the indicator lights must report the status of all protection elements and circuitry in the L-G and L-L modes.
        3) The absence of a green light and the presence of a red light shall indicate that damage has occurred on the respective phase or mode. All protection status indicators must indicate the actual status of the protection on each phase or mode. If power is removed from any one phase, the indicator lights must continue to indicate the status of the protection on all other phases and protection modes. Diagnostics packages that simply indicate whether power is present on a particular phase shall not be accepted.
    b. Remote Status Monitor – The SPD must include Form C dry contacts (one NO and one NC) for remote annunciation of its status. Both the NO and NC contacts shall change state under any fault condition.
    c. Audible Alarm and Silence Button – The SPD shall contain an audible alarm that will be activated under any fault condition. There shall also be an audible alarm silence button used to silence the audible alarm after it has been activated.
6. Overcurrent Protection
    a. The unit shall contain thermally protected MOVs. These thermally protected MOVs shall have a thermal protection element packaged together with the MOV in order to achieve overcurrent protection of the MOV. The thermal protection element shall disconnect the MOV(s) from the system in a fail-safe manner should a condition occur that would cause them to enter a thermal runaway condition.

7. Fully Integrated Component Design – All of the SPD's components and diagnostics shall be contained within one discrete assembly. SPDs or individual SPD modules that must be ganged together in order to achieve higher surge current ratings or other functionality shall not be accepted.

8. Safety Requirements

   a. The SPD shall minimize potential arc flash hazards by containing no user serviceable / replaceable parts and shall be maintenance free. SPDs containing items such as replaceable modules, replaceable fuses, or replaceable batteries shall not be accepted. SPDs requiring any maintenance of any sort such as periodic tightening of connections shall not be accepted. SPDs requiring user intervention to test the unit via a diagnostic test kit or similar device shall not be accepted.

   b. SPDs designed to interface with the electrical assembly via conductors shall require no user contact with the inside of the unit. Such units shall have any required conductors be factory installed.

   c. Sidemount SPDs shall be factory sealed in order to prevent access to the inside of the unit. Sidemount SPDs shall have factory installed phase, neutral, ground and remote status contact conductors factory installed and shall have a pigtail of conductors protruding outside of the enclosure for field installation.

2.03 SYSTEM APPLICATION

A. The SPD applications covered under this section include distribution and branch panel locations and switchboard assemblies as indicated on drawings. All SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C, B, and A environments.

B. Surge Current Capacity – The minimum surge current capacity the device is capable of withstanding shall be as shown in the following table:

Minimum surge current capacity based on ANSI / IEEE C62.41 location category			
CATEGORY	Application	Per Phase	Per Mode
C	Service Entrance Locations (Switchboards, Main Entrance)	250 kA	125 kA
A	Branch Locations (Panelboards)	120 kA	60 kA

C. SPD Type - All SPDs installed on the load side of the service entrance disconnect shall be Type 1 or Type 2 SPDs.

2.04 LIGHTING AND DISTRIBUTION PANELBOARD REQUIREMENTS

A. The SPD application covered under this section includes lighting and distribution panelboards. The SPD units shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category B environments.

1. The SPD shall not limit the use of through-feed lugs, sub-feed lugs, and sub-feed breaker options.

2. SPDs shall be installed immediately following the load side of the main breaker. SPDs installed in main lug only panelboards shall be installed immediately following the incoming main lugs.

3. The panelboard shall be capable of re-energizing upon removal of the SPD.

4. The SPD shall be interfaced to the panelboard via a direct bus bar connection.

5. The SPD where noted on drawings or in schedules shall be included and mounted within the panelboard by the manufacturer of the panelboard.

6. The SPD shall be of the same manufacturer as the panelboard.

7. The complete panelboard including the SPD shall be UL67 listed.

B. Switchboard Requirements

1. The SPD application covered under this section is for switchboard locations. Service entrance located SPDs shall be tested and demonstrate suitability for application within ANSI/IEEE C62.41 Category C environments.
2. The SPD shall be of the same manufacturer as the switchboard.
3. The SPD shall be factory installed inside the switchboard at the assembly point by the original equipment manufacturer
4. Locate the SPD on the load side of the main disconnect device, as close as possible to the phase conductors and the ground/neutral bar.
5. The SPD shall be connected through a disconnect (30A circuit breaker). The disconnect shall be located in immediate proximity to the SPD. Connection shall be made via bus, conductors, or other connections originating in the SPD and shall be kept as short as possible.
6. The SPD where noted on drawings or in schedules shall be integral to switchboard as a factory standardized design.
7. All monitoring and diagnostic features shall be visible from the front of the equipment.

2.05 ENCLOSURES

A. All enclosed equipment shall have NEMA 1 general purpose enclosures, unless otherwise noted. Provide enclosures suitable for locations as indicated on the drawings and as described below:

1. NEMA 1 – Constructed of a polymer (units integrated within electrical assemblies) or steel (sidemount units only), intended for indoor use to provide a degree of protection to personal access to hazardous parts and provide a degree of protection against the ingress of solid foreign objects (falling dirt).

PART 3 - EXECUTION

3.01 EXAMINATION (Not Used)

3.02 FACTORY TESTING

A. Standard factory tests shall be performed on the equipment under this section. All tests shall be in accordance with the latest version of NEMA and UL standards.

3.03 INSTALLATION

A. The Contractor shall install all equipment per the manufacturer's recommendations and the contract drawings.

3.04 WARRANTY

A. The manufacturer shall provide a full ten (10) year warranty from the date of shipment against any SPD part failure when installed in compliance with manufacturer's written instructions and any applicable national or local code.

END OF SECTION

SECTION 265200
SOLID STATE LIGHTING

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 DESCRIPTION

A. Section includes, but is not necessarily limited to, the furnishing and installation of solid state lighting (SSL) Luminaires (herein referred to as Luminaires) applied to the illumination of interior and exterior spaces. Luminaires shall be listed in accordance with national recognized testing laboratories (NETLs) approved by the United States Department of Labor, Occupational Safety and Health Administration (OSHA).

1.03 RELATED DOCUMENTS

A. Specification Section 260943 – "Distributed Digital Lighting Control System".

1.04 DEFINITIONS AND STANDARDS

A. The terms and standards used or referenced herein are defined as follows:

ANSI-C78.377	American National Standard for Electric Lamps – Specifications for the Chromacity of Solid State Lighting (SSL) Products.
ANSI-C82.11	American National Standard for Lamp Ballasts – High Frequency Fluorescent Lamp Ballasts.
ANSI-C82.SSL1	SSL Drivers (in ANSI development)
CALiPER	Commercially Available LED Product Evaluation and Reporting 'A' US DOE program for the testing and monitoring of commercially available LED Luminaires and lights.
CCT	Correlated Color Temperature: Visible light characteristic of comparing a light source to a theoretical, heated black body radiator; measured in Kelvin.
Cd	Candela: Unit of measurement of light intensity.
Chromaticity	The property of color of light.
fc	foot-candle. Unit of illuminance.
IEC-EN-61000-6-3	International Electrotechnical Commission – Electromagnetic Compatibility (EMC) Generic Standards – Emission Standard for residential, commercial and light-industrial environments.
IEEE C62.41.1	IEEE Guide on the Surge Environment in Low-Voltage (1000V and less) AC Power Circuits.
IEEE C62.41.2	IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000V and less) AC Power Circuits.
IES-LM-79-08	Illuminating Engineering Society – Approved Methods: Electrical and Photometric Measurements of Solid-State Lighting Products.
IES-LM-80-08	Illuminating Engineering Society – Approved Methods: Measuring Lumen Maintenance of LED Light Sources.
IES LM-82-12	Illuminating Engineering Society – Approved Methods: Characterization of LED Light Engines and LED Lamps for Electrical and Photometric Properties as a Function of Temperature.
IES-TM-21	Method for determining an LED luminaire or integral replacement lamp's expected operating life, based on initial performance data collected per IES-LM-80.
L80	The extrapolated life in hours of the luminaire when the luminous output depreciates 20 percent from initial values.
LED	Light Emitting Diode.
METS	Material Engineering and Testing Services of the Translab.
NEMA	National Electrical Manufacturers Association.
NVLAP	National Voluntary Laboratory Accreditation Program. A program under the US DOE to accredit independent testing laboratories to qualify.

Power Factor	The ratio of the real power component to the total (complex) power component.
Rated power	Power consumption that the luminaire was designed and tested for at ambient temperature.
SPD	Surge Protection Device. A subsystem or component(s) that can protect the unit against short duration voltage and current surges.
SSL	Solid-State Lighting.
THD	Total Harmonic Distortion. The amount of higher frequency power on the power line.

B. Except as herein specified or as indicted on the Drawings, the work of this section shall comply with the following:
   1. ANSI-UL Standards
      a. 924 – Emergency Lighting and Power Equipment
      b. C78.377 – Chromacity of Solid State Lighting (SSL) Products
      c. C82.11 – High Frequency Fluorescent Lamp Ballasts
      d. C82.SSL1 – SSL Drivers
   2. IEC
      a. EN-61000-6-3 – EMC Emission Standards
   3. NFPA
      a. 70-NEC
      b. 101-Life Safety
   4. Standards as listed and referenced in this Specification.

C. All LED Luminaires shall have a CRI of at least 80, an estimated life of at least 50,000 hours at 70% lumen maintenance, and shall include a minimum 5-year warranty on the entire luminaire including the driver. The luminaire and LEDs shall have been tested in accordance with LM-79 and LM-80.

1.05 FIXTURE SCHEDULE

A. Once Bids and Shop Drawings are approved, all lighting is to be ordered according to construction schedule and lead times. The Contractor is then to inform the Professional immediately, in writing, the date when equipment orders are completed and delivery scheduled.

1.06 SUBMITTALS

A. Submit shop drawings and manufacturers' data for the following items in accordance with the conditions of the contract and as specified below.
   1. Shop drawings shall be submitted with product datasheets that include the following information:
      a. General device descriptions
      b. Dimensions
      c. Wiring details
      d. Nomenclature
      e. Operating temperature range
      f. System efficacy
      g. Rated life
      h. Rated output
      i. Input wattage
      j. Inrush current
      k. THD
      l. Power factor
      m. Warranty
      n. CCT
      o. The rated life
      p. Lumen output

         This information shall be provided for the actual lumen package and driver combination specified. Provide information regarding the effects of temperature on the rated life and lumen output. If applicable, the submittal shall also include the US Department of Energy Lighting Facts label.

2. Major luminaires and special luminaires shall show full size cross sections. Indicate finished dimensions, metal thicknesses, and materials.
3. Show mounting details, including hung ceiling construction.
4. Shop drawings shall include a complete listing of all luminaires on a single sheet. This listing shall contain the luminaire type, manufacturer's catalog number, applied voltage, and wattage.
5. Submit manufacturer's fixtures and accessories Shop Drawings and data in booklet form, including rough-in dimensions, instructions for installation and maintenance.

1.07 WARRANTY

A. The manufacturer shall provide a warranty against loss of performance and defects in materials, finishes, and workmanship for the Luminaires and all components for a minimum period of 5 years. Replacement Luminaires shall be provided promptly after receipt of Luminaires that have failed at no cost to the customer. All warranty documentation shall be provided to customer prior to random sample testing.

B. Failure of the LED light source shall be defined as failure or negligible output of 10% or more individual LEDs within the LED array, bar, etc.

1.08 PROTECTION

A. Protect lighting fixtures and work against dirt, water or mechanical damage before, during, and after installation. Damage to fixtures prior to final acceptance shall be repaired or replaced at no cost to the Department.

PART 2 - PRODUCTS

2.01 MATERIALS AND FIXTURES

A. General
1. Provide all lighting fixtures in accordance with Lighting Fixture Schedule and as indicated and required on Drawings.
2. Fixture catalog numbers only indicate type and style. Provide each fixture complete with proper fixture trim, levelers, mounting brackets, flanges, plaster rings, glassware and accessories for complete installation as required for type of ceiling and room finish schedules.
3. All plastic diffusers used in lighting fixtures shall be manufactured of 100 percent virgin acrylic plastic, polycarbonate, or as otherwise noted.
4. Provide approved fireproof enclosures UL rated (UL 0529) where recessed in fire rated ceilings.
5. Provide gaskets as required to prevent light spill between frames and ceilings.
6. Provide "wet" labels on all fixtures installed outdoors or in moist areas.
7. Provide continuity of ground on all fixtures used as raceways and mounted end to end.
8. All metal parts to be chemically treated with a rust resistant phosphatized solution, internal components and reflecting surfaces to have a factor of minimum 90%.
9. Provide luminaires, completely factory-assembled and wired and equipped with necessary light sources, drivers, wiring, shielding, reflectors, channels, lenses, etc., and deliver to job ready for installation.
10. Luminaire Reflector Care: Luminaires with Alzak reflectors shall be installed with Mylar cover over reflectors. Cover shall be UL listed for temporary lighting. Upon completion of work, remove Mylar cover with white glove and blow clean reflectors.
11. Finish: Porcelain or baked enamel finish matte white on interiors with minimum test reflectance of 90% matte white finish or as specified in visible exterior. Thoroughly clean base metal and bonderize after fabrication.
12. Where utilized as raceway, luminaires shall be suitable for use as raceways. Provide feed through splice boxes where necessary. Wiring shall be rated for 90 degrees Centigrade.

B. Luminaires
1. Each luminaire shall consist of an assembly that utilizes LEDs as the light source. In addition, a complete luminaire shall consist of a housing, LED array, and electronic driver (power supply). If required, components such as the LED array and driver shall be modular and replaceable without removing the luminaire.
2. Each luminaire shall be rated for a minimum operational life as specified on lighting fixture schedule or per basis of design luminaire, as defined by IES LM-80 and TM-21.
3. Each luminaire shall be designed to operate at an average operating temperature of 25°C.

a. The typical operating temperature range shall be -10°C to +25°C, unless otherwise specified on lighting fixture schedule and Drawings.
b. Some parameters and tests (such as IESNA standard LM-80-08) shall be conducted at different ambient temperatures.

4. Each luminaire shall meet all parameters of this specification throughout the minimum operational life when operated within the rated temperature range.
5. The individual LEDs shall be connected such that a catastrophic loss or the failure of one LED will not result in the loss of the entire luminaire.
6. Each luminaire shall be listed with a nationally recognized testing laboratory (including but not limited to UL, CSA, ETL) under UL 1598 and UL 8750, or an equivalent standard from a recognized testing laboratory.

C. LEDs
1. The light source of the luminaires shall consist of LED arrays or bars. If required, the LED arrays or bars shall be removeable.
2. The LEDs shall be either white or RGB, according to the light fixture schedule and Drawings. For luminaires specified with white light, it is not acceptable to provide RGB LEDs mixed to produce white light.
3. Refer to the light fixture schedule and Drawings for the specified correlated color temperature (CCT) of each luminaire.
4. Individual LEDs shall be binned by manufacturer to comply with ANSI C78.377.
5. The LEDs shall be manufactured by Cree, Philips, Toshiba, Osram, Samsung, or Nichia, unless otherwise noted.

D. Drivers
1. The driver or power supply for the luminaire shall be modular and replaceable.
2. The rated life of the driver shall match the rated life of the LEDs and luminaire.
3. In general, the drive current rating of the driver shall be minimized, while still maintaining the required lumen output, to improve luminaire efficiency and life.
4. The driver shall meet the emission standards of IEC EN-61000-6-3 at a minimum. For healthcare or other applications with EMI sensitive equipment, provide drivers that meet more stringent standards as required.

E. Exit Lighting
1. Exit lighting system shall be as indicated on Drawings.
2. Equipment shall be complete with LED light sources.
3. Where indicated as such, provide battery pack and charger with self-diagnostics for illumination under power failure conditions.
4. Equipment shall meet BOCA, OSHA, NFPA and NEC illumination standards.

F. Emergency Lighting
1. Provide GTD or GTD20A transfer devices suitable for use with solid-state lighting (Bodine or approved equal manufacturer) as indicated on drawings, light fixture schedule, and lighting control schedule.

2.02 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Division 26 Section "Hangers and Supports for Electrical Systems" for channel and angle-iron supports and nonmetallic channel and angle supports.
B. Single-Stem Hangers: ½ inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as fixture.
C. Twin-Stem Hangers: Two, ½ inch steel tubes with single canopy designed to mount a single fixture. Finish same as fixture.

PART 3 - TECHNICAL REQUIREMENTS

3.01 ELECTRICAL

A. Power Consumption: Maximum power consumption allowed for the luminaire shall be per basis of design light fixture listed on lighting fixture schedule.
B. Operation Voltage
1. The luminaire shall operate from a 60 HZ ±3 HZ AC line over a voltage ranging from 110 VAC to 277 VAC as specified on the drawings. The fluctuations of line voltage shall have no visible effect on the luminous output.
2. The standard operating voltages are as shown on drawings.

C. Current: The inrush current for the luminaire shall be published on the luminaire data sheet and shall be less than that of the basis of design fixture listed on the light fixture schedule.

D. Power Factor: The luminaire shall have a power factor of 0.90% or greater at all standard operating voltages.
E. THD: Total harmonic distortion (current and voltage) induced into an AC power line by a luminaire shall not exceed 20 percent at any standard input voltage. The luminaire shall comply with ANSI C82.11, or equivalent ANSI LED Standard C82.SSL1.
F. Surge Suppression: The luminaire shall include surge protection to withstand high repetition noise and other interference.
    1. The surge protection which may reside within the driver shall protect the luminaire from damage and failure for transient voltages and currents as defined in ANSI/IEEE C64.41 for Location Category A Low. Where failure does not mean a momentary loss of light during the transient event.
    2. Surge protection performance shall be tested per the procedures in ANSI/IEEE C62.45 based on ANSI/IEEE C62.41 definitions for standard and optional waveforms for Location Category A-Low
G. Operational Performance: The LED circuitry shall prevent perceptible flicker to the unaided eye over the voltage range specified above.
H. RF Interference: The luminaire and associated on-board circuitry must meet Class A emission limits referred in IEC EN-61000-6-3 and Federal Communications Commission (FCC) Title 47, Subpart B, Section 15 regulations concerning the emission of electronic noise.
I. Dimming: Where dimming is specified on the drawings, the luminaire shall be capable of continuous dimming without perceivable flicker over a range of 100% to 5% of rated lumen output. Dimming shall be controlled by a 0-10V signal, unless otherwise noted or specified.
    1. Dimming switches and other control system components shall be compatible with the LED driver type – constant current reduction (CCR) or pulse-width modulation (PWM). The device(s) shall be rated to accommodate full load, as well as inrush current and repetitive peak currents.
    2. The luminaire and dimming controls shall produce a smooth change in lumen output, without any visible flicker.
    3. The luminaire shall be capable of dimming without any visible change in CCT and color rendition.
J. Multi-Level Control: Where specified on drawings, the luminaire shall be provided with multiple power supplies, multi-level power supply, or other similar means to facilitate multi-level control of luminaire.
K. Temperature Range: The luminaire shall have the capability of operating and maintaining rated lumen output and rated life within the temperature range specified on the lighting fixture schedule and Drawings, or within that of the basis of design luminaire if no temperature range is specifically listed.
L. Lumen Output and Performance
    1. The luminaire shall maintain the lumen output specified on the lighting fixture schedule and Drawings, or that of the basis of design luminaire if no minimum lumen output is specifically listed.
    2. The lumen output shall be maintained regardless of ambient temperature fluctuations, within the rated temperature range. The luminaire data sheets shall specify any effect or variation on lumen output from temperature.
    3. The luminaire shall be capable of continuously monitoring system performance to allow for constant lumen management/compensation, if specified in lighting fixture schedule, Drawings, or basis of design luminaire.
    4. The luminaire shall provide a total system efficacy that meets or exceeds that of the basis of design luminaire listed on the light fixture schedule and Drawings.
M. Rated Life: The luminaire shall have a rated life that meets or exceeds that listed on the lighting fixture schedule and Drawings, or that of the basis of design luminaire if no rated life is specifically listed.

3.02 PHOTOMETRIC REQUIREMENTS

A. Light Output
    1. The minimum initial lumen output of the luminaire exiting the luminaire in the 0-90 degree zone - as measured by IESNA Standard LM-79-08 shall be as specified in the lighting fixture schedule and Drawings, or that of the basis of design luminaire if no lumen output is specifically listed.

2. The lumen output shall not decrease by more than 30% over the minimum operational life (or L70 shall be at least the minimum number of hours specified).
3. The measurements shall be calibrated to standard photopic calibrations.

B. Light Color/Quality
1. Corrected Color temperature (CCT) range shall be correlated to chromaticity as defined by the absolute (X,Y) coordinates on the 2-D CIE chromaticity chart.
2. The color rendition index (CRI) shall be 80 or greater for interior applications, and 70 or greater for exterior applications.

3.03 THERMAL MANAGEMENT

A. The thermal management (of the heat generated by the LEDs) shall be of sufficient capacity to assure proper operation of the luminaire over the expected useful life.
1. The LED manufacturer's maximum junction temperature for the expected life shall not be exceeded at the average operating ambient.
2. The LED manufacturer's maximum junction temperature for the catastrophic failure shall not be exceeded at the maximum operating ambient.
3. The luminaire shall have an UL IC rating, if applicable.

B. The Driver manufacturer's maximum case temperature shall not be exceeded at the maximum operating ambient. Thermal management shall be passive by design.
1. The use of fans or other mechanical devices shall not be allowed.

3.04 PHYSICAL AND MECHANICAL REQUIREMENTS

A. The luminaire shall be a single, self-contained device, not requiring on-site assembly for installation. The power supply for the luminaire shall be integral to the unit, unless otherwise specified.

B. The assembly and manufacturing process for the SSL luminaire shall be designed to assure all internal components are adequately supported to withstand mechanical shock and vibration.

C. The optical assembly of the luminaire shall be constructed so that individual LED images shall not be visible to the occupant.

D. The electronics/power supply enclosure shall be internal to the SSL luminaire and be accessible per UL requirements.

E. The circuit board and power supply shall be contained inside the luminaire.

F. Electrical connections between normal power, driver and LED boards must be modular utilizing a snap fit connector. All electrical components must be easily accessible after installation from the room side and all electrical components must to be able to be replaced without removing the fixture from the ceiling.

G. For LED retrofit lamps, the weight of the unit shall be in compliance with weight ratings of the lamp sockets/bases.

3.05 MATERIALS

A. Housings shall be fabricated from material indicated on lighting fixture schedule.

B. If applicable, refractor or lens shall be made from UV inhibited high impact plastic (such as acrylic or polycarbonate) or heat and impact resistant glass.

C. If applicable, polymeric materials of enclosures containing either the power supply or electronic components of the luminaire shall be made of UL94VO flame retardant materials. The lenses of the luminaire are excluded from this requirement.

3.06 LUMINAIRE IDENTIFICATION

A. Each luminaire shall have the manufacturer's name, trademark, model number, serial number, date of manufacture (month-year), and lot number as identification permanently marked inside the each unit and the outside of each packaging box.

B. The following operating characteristics shall be permanently marked inside each unit: rated voltage and rated power in Watts and Volt-Ampere.

3.07 QUALITY ASSURANCE

A. The luminaires shall be manufactured in accordance with a manufacturer quality assurance (QA) program. The QA program shall include two types of quality assurance: (1) design quality assurance and (2) production quality assurance. The production quality assurance shall include statistically controlled routine tests to ensure minimum performance levels of the modules built to meet this specification, and a documented process of how problems are to be resolved.

B. QA process and test results documentation shall be kept on file for a minimum period of seven years.

C. LED luminaire designs not satisfying design qualification testing and the production quality assurance testing performance requirements described below shall not be labeled, advertised, or sold as conforming to this specification.

D. Design Qualification Testing

1. Design Qualification Testing shall be performed by a National Voluntary Laboratory Accreditation Program (NVLAP) testing facility. Such testing may be performed by the manufacturer or an independent testing lab hired by the manufacturer on new luminaire designs, and when a major design change has been implemented on an existing design. A major design change is defined as a design change (electrical or physical) which changes any of the performance characteristics of the luminaire, results in a different circuit configuration for the power supply, or changes the layout of the individual LED's in the module.
2. A quantity of two units for each design shall be submitted for Design Qualification Testing.
3. Product submittals shall be accompanied by product specification sheets or other documentation that includes the designed parameters as detailed in this specification. These parameters include (but not limited to):
4. Maximum power in Watts
5. Maximum Designed Junction Temperature
6. L70 in hours, when extrapolated for the average operating temperature
7. Product submittals shall be accompanied by performance data that is derived in accordance with appropriate IESNA testing standards and tested in a laboratory that is NVLAP accredited for Energy Efficient Lighting Products.
8. Product submittals shall be accompanied by a test report showing surge protection performance as tested per the definitions and procedures in ANSI/IEEE C62.41 1991
9. Thermal testing data and reporting shall be provided based in the sensor input as defined below:
    a. Temperature sensors shall me mounted on the LED solder pads as close to the LED as possible.
10. Burn-In: Before any customer design qualification testing is performed, the sample Luminaires shall be energized for a minimum of 24 hours, at 100 percent on-time duty cycle, at a temperature of +70°F (+21°C).
11. Any failure of the luminaire, which renders the unit non-compliant with the specification after burn-in, shall be cause for rejection.
12. The luminaire shall be tested as described herein.
    a. Luminaire performance shall be judged against the specified minimum illuminance in the specified pattern for a particular application.
    b. The luminaire lighting performance shall be adjusted (depreciated) for the minimum life expectancy.
        1) The performance shall be adjusted (depreciated) by using the LED manufacturer's data or the data from the IESNA Standard LM-80-08 test report, which ever one results in a higher level of lumen depreciation.
    c. The luminaire may be determined to be compliant photometrically, if:
        1) The initial minimum illuminance level is achieved in 100% of the area of the specified lighting pattern, and
        2) The depreciated minimum illuminance is maintained in at least 95% of the area of the specified lighting pattern, and
        3) The minimum length of the depreciated iso-footcandle curve is equal or greater than the length of the specified iso-footcandle curve.

3.08 QUALITY ASSURANCE TESTING (RANDOM SAMPLE TESTING)

A. Random sample testing may be performed on all shipments.

B. Testing shall be completed within 30 days.

C. All parameters of the specification may be tested on the shipment sample.

PART 4 - EXECUTION

4.01 INSPECTION AND PREPARATION

A. General

1. Install outlets, surface mounted, recessed or semi-recessed fixtures to maintain the alignment, spacings, layout and general arrangements indicated in the Drawings. Obtain approval of Professional for all changes in layout required to avoid interferences with other trades.
2. Install one light fixture of each type and mounting for approval of Client Agency and Professional prior to mounting all light fixtures.

B. Coordination
1. Work incorporating with ceiling trades in locating and framing recessed fixtures in acoustical tile pattern or grid system to conform to layout.
2. Inform affected trades of the location and framing details necessary for the installation of flush fixtures and deliver all framing rings of these fixtures that become a part of the ceiling construction.
3. Before equipment is ordered, electrical contractor to review luminaire and ceiling mechanical compatibility in each area and verify luminaire on the drawings. Contractor shall be responsible for all fixture quantities, lengths and clearances required and shall inform the Client Agency of the job conditions at variance with the fixture(s) specified or detailed which affect installation or location. (All stages of installation.)
4. Mechanical and electrical contractors are to review and coordinate lighting locations in relationship to mechanical systems to minimize conflicts prior to installation.
5. This contractor is responsible for coordinating the characteristics and the U.L. labeling of the luminaires and their components with the ambient conditions, which will exist when the luminaires are installed. No extra compensation will be permitted for failure to coordinate the luminaires with their ambient conditions.

C. Mounting and Supports
1. Install luminaires in mechanical and unfinished areas after ductwork and piping installation.
2. Where luminaires are surface mounted, they shall be labeled for such and a minimum of one-half (1/2) inch air space and shall be maintained between top of luminaire and mounting surface by an approved means.
3. Pendant mounted units shall comply with the following:
   a. Where luminaires are mounted in a continuous row, luminaires, eight feet in length shall have stems placed within 2'-0" of end of fixture. Stems shall be spaced symmetrically. A fixture, four feet or three feet in length, placed in a row, shall have a stem connected to center luminaire.
   b. Individual luminaires, four feet in length, shall have two stems placed approximately 3 inches from each end.
   c. Individual luminaire, three feet in length, shall have dual stems and a single canopy.
   d. Each stem shall have a brass or steel swivel or other self-aligning device of type approved by the Professional.
4. Where luminaires are mounted on surface-mounted outlet boxes in surface mounted conduit runs, this Contractor shall furnish and install a luminaire canopy sufficiently deep to permit exposed conduits to pass through. Canopy shall have proper openings cut by luminaire manufacturer through which conduits may pass. Submit sample of canopy for approval before installation.
5. Prior to final payment, this contractor shall clean all luminaires and replace any burned out LED modules. He shall also touch up all scratch marks, etc. in an approved manner.
6. Provide a minimum of two support points for all surface, pendant or recessed mounted luminaires. The supports shall be tied to the building structural system. The support points shall be totally independent of the ceiling system.
7. Recessed luminaires to be installed in metal panel or acoustic modular ceilings shall be modified as required to fit into openings in ceiling construction. Shop Drawings showing details shall be submitted for approval.
8. All luminaires in hung ceilings are to be installed with earthquake clips.

D. Emergency Systems Raceway and Hook-up
1. Circuit wiring for the emergency systems shall be installed in separate raceway and kept entirely independent of all other wiring and equipment.

4.02 ADJUSTING AND CLEANING

A. At project completion, before final approval:

1. Aim adjustable fixtures as directed by Professional and observe and adjust at night as required.
2. Clean interior of all fixtures, all lenses and LED modules.

END OF SECTION

SECTION 269500

LOCAL SOUND/AV SYSTEMS

PART 1 – LOCAL SOUND/AV SYSTEMS

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.03 SUMMARY

A. Provide labor and materials required to design, procure, deliver, install, test, train, commission, program and place into operation the audio and video systems as called for in the contract documents, and according to applicable codes and regulations.

B. Furnish and install all labor, materials, apparatus, and appliances essential to the complete functioning of the systems described and/or indicated herein, or which may be reasonably implied as essential whether mentioned in the Contract Drawings and Specifications or not.

C. Division 27 contractor shall furnish all Audio-Visual products indicated in specifications, drawings and schedules, unless noted otherwise. Products include but are not limited to:

1. Microphones.
2. Preamplifiers/Mixers.
3. Power Amplifiers.
4. Cabinets.
5. Speakers.
6. Wiring.
7. Microphone Outlets.
8. Hardware
9. DSP

D. Work Provided By Others (0.4 Contractor under Division 26).

1. The scope of work provided by electrical contractor includes but not limited to: furnishing and installation of conduits, back boxes and all miscellaneous hardware (whether specified or not) (e.g. nuts, bolts, tie wraps, fasteners, etc.) for all audio and video systems in locations shown on Professional drawings and/or called for whether in specifications, or Contractor other documents specifying the scope of work.
2. Contractor shall provide dedicated power outlets at locations shown on the Professional’s drawings.

1.04 SYSTEM DESCRIPTION

A. General: The Local AV Systems shall be a complete system for amplifying sound signals from microphones and distributing them to loudspeakers at various locations. This system shall provide high fidelity and highly intelligible sound to all seating within the room it serves.

B. Functional Performance: Components and system features, and functions shall include, but are not limited to, the following:

1. FM wireless amplification for Hearing Assistance.
2. Multiple Sources Mixing: Mixing of sources for sound amplification between various

microphones and inputs.

3. High-Quality Sound Reproduction: Freedom from noises such as pops, clicks, hiss and hum at all loudspeakers at all times during operation of the system, including standby mode with inputs off. Freedom from distortion and non-uniform coverage of amplified sound.
4. Audio Visual reproduction and routing.
5. USB Conferencing

C. Provide Complete AV Systems as follows:

1. Banquet Room AV
2. Cafeteria AV

D. Quality Control

1. Speakers shall be installed using standard industry techniques and hardware.
2. Efforts shall be taken to eliminate any acoustic coupling between the building structure and the speakers.
3. Mounting hardware shall be designed and installed with consideration of the manufacturer's specifications.

1.05 SUBMITTALS

A. General: Submit all product data and/or shop drawings bound in a single, soft-cover binder. Incomplete submittals, i.e., missing speakers, volume controls, cable, racks, single-line risers, Contractor's stamp, etc. will be returned to the sender without any action being taken. The local sound system submittal shall comply with the following:

1. Complete schedule of ALL equipment and materials that are to be furnished for the work.
2. Typewritten cover page that includes the Contractors' and Suppliers' name, addresses, and telephone numbers, and the name of the Project.
3. Organized and physically divided into sections for each group of items, i.e., separate sections for sound equipment, accessories, single-line riser, etc.
4. Clearly identify each item by highlight marker or arrow to define that specific component, all associated characteristics, and all hardware.

B. Product Data for each type of product specified.

C. Shop Drawings detailing local sound systems including, but not limited to, the following:

1. Console layouts.
2. Control panels.
3. If the loudspeakers submitted are different than the loudspeakers specified, these calculations shall show how this difference effects the operation and performance of the system.
4. A complete list, comparing equipment submitted, verses equipment specified, showing any differences between the two.
5. A statement from the factory-authorized distributor of the equipment stating which factory-authorized distributor will certify the installation as meeting the factory standards and be the purveyor of maintenance under the factory warranty.
6. Failure to include this letter will be cause for the submission to be rejected.

D. Wiring diagrams detailing wiring for power, signal, and control systems and differentiating clearly between manufacturer-installed and field-installed wiring. Identify terminals to facilitate installation, operation, and maintenance.

E. Product certificates signed by equipment manufacturers certifying that their products comply with specified requirements.

F. Manufacturer certificates signed by manufacturer certifying that manufacturers comply with

requirements specified under the “Quality Control” article. Upon request, submit evidence of manufacturing experience.

G. Report of field tests and observations, including record of final tap settings of speaker line matching transformers and signal ground-resistance measurement certified by Installer.

H. Maintenance data for system to include in the operation and maintenance manual specified in Division 1.

1.06 QUALITY CONTROL

A. Installer Qualifications: Engage an experienced Installer who is an authorized representative of the system manufacturers to perform work of this section. Contractor must have industry certified staff (CTS, CTS-I)

B. Manufacturer Qualifications: Engage a firm experienced in manufacturing public address and music systems complying with the requirements of these Specifications and experienced with at least 5 projects of similar size and scope that have been in operation for 3 years or more.

C. Listing and Labeling: Provide products specified in this Section that are listed and labeled.

1. The Terms “Listed and Labeled”: As defined in the National Electrical Code, Article 100.

D. Comply with NFPA 70.

E. EIA Compliance: Comply with the following Electronics Industries Association Standards:

1. Sound Systems, EIA-160.
2. Loudspeaker, Dynamic Magnetic Structures, and Impedance, EIA-299-A.
3. Racks, Panels, and Associated Equipment, EIA-310-A.
4. Amplifiers for Sound Equipment, SE-101-A.
5. Speakers for Sound Equipment, SE-103.
6. Microphones for Sound Equipment, SE-105.

F. Comply with UL 50.

1.07 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in factory containers. Store in clean, dry space in original containers. Protect products from fumes and construction traffic. Handle carefully to avoid damage.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. General: All published specifications of the manufacturer listed below shall be deemed as being a part of this specification Section, and shall have the same force and effect as if written herewith in full. In order to guarantee the Using Agency of all factory warranties, all equipment shall be obtained from a local factory authorized vendor/distributor for the job site geographic location. Vendor shall be prepared to prove this, at the request of the Professional.

1. The intent is to establish a standard of quality, function and/or features. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard set forth in these specifications.
2. The functions and features specified are vital to the operation of this facility, therefore, inclusion in the list of acceptable manufacturers does not release the contractor from strict compliance with the requirements of this specification.

B. Available Manufacturers: The manufacturers and their associated catalog numbers herein specified constitute the material and desired operating features that are to be furnished. Subject to compliance with requirements, other manufacturers offering similar products may be incorporated in the Work as approved by Professional.

2.02 SYSTEM REQUIREMENTS

A. General: Provide complete and fully functional local AV systems using materials and equipment

of types, sizes, ratings, and performances as indicated in drawings, schedules, and specifications. Use materials and equipment that comply with referenced standards and manufacturers' standard design and construction in accordance with published product information.

B. Coordinate the features of materials and equipment to form an integrated system. Match components and interconnections for optimum performance of specified functions.

C. Configurable Custom Programming

1. The Systems Contractor shall provide system Touchpanel and Control system programming incorporating all the below functions, including but not limited to:

a. System Startup: Step the user though a simple intuitive user interface.

b. Audio Controls

1) Preset recall of the Digital Audio Processor.

2) Audio level controls.

c. Video Controls

1) Audio and video source matrix routing.

2) AV source audio controls.

3) Video Camera

4) Video camera pan/tilt/zoom and preset recall control.

2.03 EQUIPMENT, MATERIALS AND SYSTEM SPECIFICS

A. Banquet Room AV System

1. Provide AV System functionality as indicated on drawing detail AV-01

2. Provide all the following products including but not limited to:

QUANTITY	PART NUMBER	MANUFACTURER	DESCRIPTION
			Banquet Room AV
			MAIN RACK AND EQUIPMENT
1	SR-46-28	Middle Atlantic	SR SERIES RACK, SR-46-28
1	DWR-RR46	Middle Atlantic	RACKRAIL, 10-32, 46 RU, DWR/EWR SERIES
1	VFD-46	Middle Atlantic	Vented Front Door
1	MPR-6A	Middle Atlantic	Raceway
1	RLM-20A	Middle Atlantic	Remote Power Module
4	M-20A	Middle Atlantic	Power Module
5	MPR-SS	Middle Atlantic	MPR SURGE SUPPRESSOR
6	MPR-BL2A	Middle Atlantic	MPR BLANK COVER, 2"
1	T-80x6	Middle Atlantic	Power Tail 80"
1	PD-2415SC-NS	Middle Atlantic	SLIM POWER STRIP, 24 OUTLET, 15A
2	UD3	Middle Atlantic	UTILITY DRAWER, 3 RU
1	RLB-KIT16	Lowell	16" Rackmount Light Bars.
1	KIT-WB-300VB-RM	Wattbox	WattBox® IP Power Conditioner with OvrC and Rack Mount Kit | 5 Controlled Outlets
1	WB-OVRC-UPS-1100-1	Wattbox	WattBox® UPS Battery Pack for IP Power Conditioners | 1100 VA
1	SM-2-A	Telex	Listening System includes: one ST-300 17 Channel Base Transmitter, four SR-50 with Rack Mount.
1	UA844+SWB	Shure	Wideband Antenna DA w/ Cascade Output.

3	ULXD4Q=G50	Shure	Quad Digital Wireless Receiver with internal power supply, 1/2 Wave Antenna. (Coordinate
1	AT-OME-PS62	Atlona	6×2 Matrix Presentation Switcher with USB
1	CP3	Crestron	3-Series® Compact Control System
1	DN-700CB	Denon	Network CD/Media Bluetooth® Player
1	DN-500BDMKII	Denon	Blu-ray, DVD & CD/SD/USB Player.
1	AM-200	Crestron	AirMedia® Presentation System 200
1	DGS-1210-52MP	DLInk	48-PORT GB POE SWITCH 4 SFP SLOTS
1	CORE 110f	QSC	Unified Core with 24 local audio I/O channels, 128x128 total network I/O channels with 8x8 Software-based Dante license included
1	SL-DAN-32-P	QSC	Q-SYS Software-based Dante 32x32 Channel License, Perpetual
1	PX5	Yamaha	2 Channel DSP Amplifier 800W + 800W (4Ω)
2	NXAMP4x2MK2	NEXO	NEXO AMP, POWER AMPLIFIER/ CONTROLLER 4X2500W
2	NXDT104Mk2	NEXO	NEXO, DANTE CARD FOR NXAMP - MK 2
1	Lot	Misc	Misc Rack Hardware, Blanks, Screws, Etc
			CONTROL ROOM/ MIX DESK EQUIPMENT
1	QL5	Yamaha	Digital Console 24 faders + 2 Master faders. 64 mono + 8 Stereo mixable channels.
1	HPH-MT5	Yamaha	Monitor headphones, 51Ω, sensitivity 100 dB/mW, frequency response 20Hz-20kHz, 40mm driver.
1	MDV-DSK	Middle Atlantic	2 RACKBAY STRAIGHT DESK, MDV SERIES
1	MDV-R12	Middle Atlantic	12 SPACE SIDE BAY RACK, MDV SERIES
1	MDV-OB4	Middle Atlantic	OVERBRIDGE FOR MDV-R12, MDV SERIES
1	UD3	Middle Atlantic	UTILITY DRAWER, 3 RU
1	KIT-UPS-IPVM12-1100	Wattbox	WattBox® IP UPS Kit - 12 Controllable Outlets | 1100 VA
1	TS-770-B-S	Crestron	7 in. Touch Screen, Black Smooth
1	ADP-DAO-AU-0X2	Audinate	Dante AVIO 2-Channel XLR Analog Output Adapter
1	DGS-1210-10P	DLInk	8-PORT GB POE SWITCH 2 SFP SLOTS
			LOUDSPEAKERS
16	16 AD-C	16 AD-C4	16 AD-C4T-WH QSC
			SYSTEM ANTENNAS
1	DFIN1-BLK	RF Venue	Wireless Microphone Antenna.
1	HGA-1	Telex	Assisted Listening Antenna
1	9U1-R610-US00	Rukus	R610 XX Unleashed 11ac indoor AP 3x3:3
1	Lot	Misc	RG8 Cable for ALS and Wireless Mic Antennas
			AV WALL PLATES
1	TSW-770-B-S	Crestron	7 in. Touch Screen, Black Smooth
2	AT-HDVS-210U-TX-WP	Atlona	Single Gang HDMI and USB-C Wall Transmitter
1	39874	C2G	HDMI® and USB Pass Through Single Gang Wall Plate - Brushed Aluminum
1	DR-H2.0-15M	FSR	Next Gen 4k Digital Ribbon Cables
1	39935	C2G	50ft USB-A Male to Female Active Extension Cable- Plenum, CMP-Rated

1	Custom	Proco	Provide all required Custom Microphone – Dante – Monitor – Network Wall Plate and Panels on System Drawing. (Qty.as needed)
			WIRELESS MICROPHONE TRANSMITTERS AND MISC EQUIPMENT
12	ULXD1	Shure	Digital Wireless Bodypack Transmitter with Miniature 4-Pin Connector
2	ULXD2/SM58	Shure	Handheld Transmitter with SM58® Microphone
12	MX153T/O-TQG	Shure	Omnidirectional Earset Headworn Microphone, Tan, TA4F connector
2	WL183	Shure	Microflex® Omnidirectional Lavalier Microphone
4	RE92H	EV	Premium hanging choir cardioid condenser microphone with in-line preamp, XLR-type connector, 25ft cable.
2	SM57-LC	Shure	Handheld Cardioid Dynamic Microphone
2	SM58S	Shure	Cardioid Dynamic, On-Off Switch Microphone
1	545SD-LC	Shure	Cardioid Dynamic, Vocal or Instrument, On/Off Switch, Microphone Clip
1	PC DESKTOP-18	EV	Freestanding gooseneck multi-pattern condenser mic. Mic on/off switch, mic status LED. 18-inch goosen
4	RE92HW	EV	Premium hanging choir cardioid condenser microphone with in-line preamp, XLR-type connector, 25ft cable. Whi
4	MB8455	Audix	84-inch carbon fiber boom with M1255B microphone, clutch assembly and cable
4	26045.500.55	K&M	Stackable Microphone Stand
10	21075.500.55	K&M	Microphone Stand w/ telescopic boom arm
4	DB1	RHC	PROCO PASSIVE DIRECT BOX
1	AV1A	Proco	Audio/Video Interface Unit
1	LTIGLBLOX	Rapco	Converts consumer grade equipment (laptop computers, MP3 players, CD players) to a mic level balanced output. (No
4	AQ-5-Blk	Proco	AmeriQuad XLR-M - XLR-F 5’ BLACK
10	AQ-25-Blk	Proco	AmeriQuad XLR-M - XLR-F 25’ BLACK
6	AQ-50-Blk	Proco	AmeriQuad XLR-M - XLR-F 50’ BLACK. (Approved Alternate Manufacture Whirlwind MKQ Canare Audio
26	SR-50-A	Telex	Single frequency personal receiver with belt clip - requires two AA batteries
26	SEB-1	Telex	Single earbud with cord sets.
9	NL-4S	Telex	Inductive neckloop
			PROJECTOR & SCREEN
2	PT-MZ10KLBU	Panasonic	10,000 Lumens, LCD, WUXGA Resolution (1,920 x 1,200), Laser, 4K Signal Input, Information Monitor, No Lens, Black
2	ET-EMT700	Panasonic	2.10 – 4.14:1 Zoom lens for PT-MZ16K/MZ13K/MZ10K LCD laser projectors (Field Verify)
2	WMA2S	Chief	Heavy Duty Dual Stud Wall Projector Mount
2	CMS003	Chief	3" Connect Fixed Extension Column (Black)
6	VCMU	Chief	HD Universal Projector Mount.

2	14148	Dalite	Tensioned Professional Electrol 16:9, 135X240 (275 Diag) HD Prog 1.1 120V (Verify Black Drop)
2	40973	Dalite	Single Motor Low Voltage Control System
2	ACSP-2002-VTE	Lowell	2-STAGE COMPACT SURGE DEVICE, 2 OUTLET

B. Cafeteria AV

1. Provide AV System functionality as indicated on drawing detail AV-02
2. Provide all the following products including but not limited to:

QUANTITY	PART NUMBER	MANUFACTURER	DESCRIPTION
			Cafeteria Sound
			RACK EQUIPMENT (LOCATED IN Banquet Room RACK)
1	ULXD4	Shure	Single Digital Wireless Receiver with PS41US Power Supply
1	AT-UHD-CLSO-824	Atlona	4K/UHD 8×2 Multi-Format Matrix Switcher
1	PD-815R-PL	Middle Atlantic	Rackmount Power, 8 Outlet, 15A, Basic Surge Protection
1	AM-200	Crestron	AirMedia® Presentation System 200
1	SM-2-C	Telex	Listening System includes: one ST-300 17 Channel Base Transmitter, four SR-50 with Rack Mount.
1	Lot	Misc	Misc Rack Hardware, Blanks, Screws, Etc
			LOUDSPEAKERS
16	AD-C4T-WH	QSC	4.5" Two-way ceiling speaker, 70/100V transformer with 16Ω bypass, 150° conical
			SYSTEM ANTENNAS
1	DFIN1-BLK	RF Venue	Wireless Microphone Antenna.
1	HGA-1	Telex	Assisted Listening Antenna
			AV WALL PLATES
1	AT-HDVS-210U-TX-WP	Atlona	Single Gang HDMI and USB-C Wall Transmitter
1	WPE101	RHC	1 GANG MIC 1 & 2 W/2 XLRF
1	unD6IO-BT	QSC	4x2 Channel 2 Gang US, Dante/AES67 Wall Plate w/Bluetooth, RCA, 3.5 mm I/O, PoE (white and black faceplates included).
1	TSC-55w-G2	QSC	Q-SYS 5.5” PoE Touch Screen Controller for In-Wall Mounting
			DISPLAYS
2	TH-75CQ1	Panasonic	75" 4K UHD, 450 cd/m2, ATSC/NTSC/QAM Tuner
2	AM95	Premier	Dual Arm Swingout Mount for Flat Panel Displays up to 95 lbs. Dual Stud - Black
2	AT-UHD-EX-100CE-RX	Atlona	4K/UHD HDMI Over 100 M HDBaseT TX/RX with Ethernet, Control, and PoE
			MICROPHONE AND ADDITIONAL EQUIPMENT
1	ULXD2/B58	Shure	Handheld Transmitter with BETA 58A® Microphone

1	26045.500.55	K&M	Stackable Microphone Stand
1	SM58S	Shure	Cardioid Dynamic, On-Off Switch Microphone
1	NM1-25	RHC	25' Mic Cable
16	SR-50-C	Telex	Single frequency personal receiver with belt clip - requires two AA batteries
16	SEB-1	Telex	Single earbud with cord sets.
5	NL-4S	Telex	Inductive neckloop
1	Lot	Misc	Misc Hardware

PART 3 – EXECUTION

3.01 EXAMINATION

A. Examine conditions, with the Installer present, for compliance with requirements and other conditions affecting the performance of the Local Sound System work.

B. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install equipment to comply with manufacturer's written instructions.

B. Wiring Method: Install wiring in raceway except within consoles, desks, and counters. Conceal raceway and wiring except in unfinished spaces.

C. Wiring Within Enclosures: Provide adequate length of conductors. Bundle, lace, and train the conductors to terminal points with no excess. Provide and use lacing bars.

D. Control Circuit Wiring: Provide number of conductors as recommended by system manufacturer for control functions indicated.

E. Splices, Taps, and Terminations: Make splices, taps, and terminations on numbered terminal strips in junction, pull, and outlet boxes, terminal cabinets, and equipment enclosures.

F. Impedance and Level Matching: Carefully match input and output impedances and signal levels at audio signal interfaces. Provide matching networks where required.

G. Provide physical isolation from each other for microphone, line-level, speaker, and power wiring. Run in separate raceways or provide 12-inch minimum separation where exposed or in same enclosure. Provide additional physical separation as recommended by equipment manufacturer.

H. Microphone Outlets: Install as flows, except as otherwise indicated:

1. Wall Outlets: Flush mounted

I. Conductor Sizing: Except as otherwise indicated, size speaker circuit conductors from racks to loudspeaker outlets not smaller than No. 12 AWG and conductors from microphone receptacles to amplifiers not smaller than No. 22 AWG.

J. All microphone cable shall be shielded and routed in a separate raceway from loudspeaker cables.

K. Identification of Conductors and Cables: Switches, connectors, jacks, receptacles, cable and cable terminations shall be clearly, logically and permanently marked. Use color coding of conductors and apply wire and cable marking tape to designate wires and cables so all media are identified in coordination with system wiring diagrams.

L. Line Matching Transformer Connections: Make initial connections using tap settings indicated on the Drawings.

M. Equalization: Set as flat as possible and adjust only to eliminate unwanted reflections between the speakers and the room surfaces. Upon completion of the equalization, record the settings and permanently attach the record of these settings to the inside of the cabinet.

3.03 GROUNDING

A. Connect equipment-grounding connections for intercommunication systems as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent

and effective grounds.

B. Ground cable shield and equipment to eliminate shock hazard and to minimize ground loops, common mode returns, noise pickup, cross talk, and other impairments.

1. All speaker cable shielding shall be grounded at the amplifier only. A separate #6 copper ground lead shall be run from the control rack to the ground wire at the AC entrance cable.

C. Signal Ground Terminal: Locate at main equipment rack or cabinet. Isolate from power system and equipment grounding.

1. Provide 5-ohm ground at main equipment location. Measure, record, and report ground resistance.

3.04 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the testing and adjustment of the system.

B. Testing Procedure: Conform to the following:

1. Schedule tests a minimum of 7 days in advance of performance.

2. Report: Submit a written record of test results.

3. Operational Test: Perform operational system test to verify conformance of system to these Specifications. Perform tests that include originating program and page material at microphone outlets, preamplifier program inputs, and other inputs. Verify proper volume levels and freedom from noise and distortion.

4. Signal-to-Noise Ratio Test: Measure the ratio of signal to noise of the complete system at normal gain settings, using the following procedure:

a. Disconnect a microphone at the connector or jack closest to it and replace it in the circuit with a signal generator using a 1000-Hz signal. Replace all other microphones at the corresponding connectors with dummy loads, each equal in impedance to the microphone it replaces. Measure the ratio of signal to noise.

b. Repeat the test for each separately controlled zone of loudspeakers.

c. The minimum acceptance ratio is 50 dB.

5. Distortion Test: Measure distortion at normal gain settings and rated power. Feed signals at frequencies of 50, 200, 400, 1000, 3000, 8000, and 12,000 Hz into each preamp channel and measure the distortion in the amplifier output. The maximum acceptable distortion at any frequency is 3 percent total harmonics.

6. Acoustic Coverage Test: Feed pink noise into the system using octaves centered at 500 and 4000 Hz. Use a sound-level meter with octave band filters to measure the level at 5 locations in each zone. For spaces with seated audiences, the maximum permissible variation in level is plus or minus 2 dB. In addition, the levels between locations in the same zone and between locations in adjacent zones must not vary more than plus or minus 3 dB.

7. Power Output Test: Measure the electrical power output of each power amplifier at normal gain setting at 50, 1000, and 12,000 Hz. The maximum variation in power output at these frequencies must not exceed plus or minus 1 dB.

8. Ground Test: Measure ground resistance at local sound system signal ground terminal using method specified in Division 16 Section "Grounding". Submit report of measurement.

C. Inspection: Verify that units and controls are properly labeled, and interconnecting wires and terminals are identified.

D. Retesting: Rectify deficiencies indicated by tests and observations. Include revising tap settings of speaker line matching transformers where necessary to optimize volume and uniformity of sound levels. Completely retest work affected by such deficiencies at the Contractor's expense. Verify by the system tests that the total system meets the Specifications and complies with

applicable standards. Provide a written record of all retest results.

3.05 CLEANING

A. Prior to final acceptance, clean system components and protect from damage and deterioration.

3.06 DEMONSTRATION

A. Demonstration and Training: Obtain and pay for the services of a factory-authorized service representative to demonstrate the system in all operating modes and functions and to train ’s maintenance personnel.

B. Schedule training with Using Agency with at least 7 days advance notice.

C. Train Using Agency’s maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, service, and preventative maintenance. Provide a minimum of 3 hours training.

D. Training Aid: Use the approved operation and maintenance manual as an instructional aid. Refer to Division 1 Section “Contract Closeout”. Provide copies of pertinent excerpts from the manual for use in the instruction.

3.07 ON-SITE ASSISTANCE

A. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound levels, resetting matching transformer taps, adjusting controls, and investigating possible need for any system revisions required to meet actual occupancy conditions. Provide up to 3 visits to the site for this purpose.

END OF SECTION

SECTION 270500

COMMUNICATIONS DOCUMENTATION

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. This Section includes identification of network materials, equipment, and *installations in accordance with the ANSI/TIA/EIA 606A guidelines*. It includes requirements for network identification components including but not limited to the following:

1. Identification labeling for cables, and conductors.
2. Operational instruction signs.
3. Equipment labels and signs.

B. Refer to Division-1 General Requirements Section, "Identification Systems" for equipment and system nameplates, and performance data; not work of this section.

C. Refer to other Division 26 sections for additional specific network identification associated with specific items.

1.03 SUBMITTALS

A. General: Submit the following in accordance with Conditions of Contract and Division 1 Specification Sections.

B. Product Data: Manufacturer's data for each type of product specified.

C. Schedule of identification nomenclature to be used for identification signs and labels.

D. Samples of each color, lettering style, and other graphic representation required for identification materials; samples of labels and signs.

1.04 QUALITY ASSURANCE

A. Manufacturers: Firms regularly engaged in manufacture of network identification products of types required, whose products have been in satisfactory use in similar service for not less than 3 years.

B. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing network identification work similar to that required for this project.

C. NEC Compliance: Comply with NEC as applicable to installation of identifying labels and markers for wiring and equipment.

D. UL Compliance: Comply with applicable requirements of UL Std 969, "Marking and Labeling Systems", pertaining to network identification systems.

E. ANSI Compliance: Comply with applicable requirements of ANSI Std A13.1 "Scheme for the Identification of Piping Systems", with regard to type and size of lettering for raceway and cable labels.

F. NEMA Compliance: Comply with applicable requirements of NEMA Std No's. WC-1 and WC-2 pertaining to identification of power and control conductors.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following (for each type marker):

Alarm Supply Co., Inc.

Brady, W.H. Co.
Calpico Inc.
Cole-Flex Corp.
Direct Safety Co.
George-Ingraham Corp.
Griffolyn Co.
Ideal Industries, Inc.
LEM Products, Inc.
Markal Company
National Band and Tag Co.
Panduit Corp.
Radar Engineers Div.; EPIC Corp.
Seton Name Plate Co.
Tesa Corp.
Or equivalent as approved by the Professional

2.02 COMMUNICATION IDENTIFICATION PRODUCTS

A. Cable/Conductor Identification Bands:

1. General: Provide manufacturer's standard aluminum wrap-around cable/conductor markers, of size required for proper application, and numbered to show circuit identification.

B Equipment Labels

1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thickness indicated, engraved with engraver's standard letter style of the sizes and wording indicated, black face and white core plies (letter color) except as otherwise indicated, punched for mechanical fastening.
2. Thickness: 1/16", for units up to 20 sq. in. or 8" length; 1/8" for larger units.

C. Lettering and Graphics

1. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

D Fasteners for Plastic-Laminated and Metal Signs

E. Self-tapping stainless steel screws or number 10/32 stainless steel machine screws with nuts and flat and lock washers.

1. Exception: Where specifically approved contact type permanent adhesive may be used in areas where screws cannot or should not penetrate substrate.

PART 3 - EXECUTION

3.01 GENERAL

A Cabling Nomenclature

1. See Drawings for details on nomenclature of cables, outlets, and termination fields.
2. Identify cable plant following ANSI TIA/EIA-606A Standard for Administration.

B. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

C. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

D. Install identification devices as indicated, in accordance with manufacturer's written instructions and requirements of NEC.

E. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

F. Regulations: Comply with governing regulations and requests of governing authorities for the identification of electrical work.

3.02 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used on shop drawings, contract documents, and similar previously established identification for project's electrical work.

3.03 OPERATION SIGNS

A. Provide instruction signs with approved legend where instructions or explanations are needed for system or equipment operation.

3.04 INSTALLATION

A. Provide equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes computer systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each computer system component.

B. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION

SECTION 271116

COMMUNICATIONS RACKS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. SCOPE

1. This section includes the minimum product and installation requirements for the equipment and cabling infrastructure in Telecommunication Spaces and Communication Rooms.
2. Communications racks and cabinets are floor-mounted structures that hold active network equipment and cable distribution systems. Installation of communications racks and cabinets requires design approval of the floor layout. Compliance to codes and standards is required for construction, grounding and bonding, and cable deployment.
3. Minimum composition requirements and installation methods for the following:
    a. Floor Mounted Racks/Distribution Frames
    b. Back Boards
    c. Rack Mounted Shelves

1.03 QUALITY ASSURANCE

A. All cable and equipment shall be installed in a neat and workmanlike manner. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Client Agency. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where “approved equal” is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Strictly adhere to all Building Industry Consulting Service International (BICSI), Electronic Industries Alliance (EIA) and Telecommunications Industry Association (TIA) recommended installation practices when installing communications/data cabling.

C. PRODUCT SHALL BE MANUFACTURED BY AN ISO 9001-2000 CERTIFIED FACILITY.

D. Product shall be free from defects in material or workmanship.

E. Product Specified product is based on acceptable manufacturers listed in the Construction Documents.

F. Product shall be lot-traceable by date code.

G. All critical manufacturing processes of the product shall have documented in-process inspections and production testing according to ISO 9001-2000.

H. Material and work specified herein shall comply with the applicable requirements of:

1. TIA-492 Telecommunications Infrastructure Standards for Data Centers
2. TIA-568 Commercial Building Telecommunications Cabling Standard
3. TIA-569 Telecommunications Pathway and Spaces
4. TIA-606 Administration Standard for Telecommunications Infrastructure
5. NECA/BICSI 607-2011, Standard for Telecommunications Bonding and Grounding Planning and Installation Methods for Commercial Buildings
6. NFPA 70-2014, including:
    a. NEC - Article 770

b. NEC - Article 800

7. Underwriters Laboratory
8. BICSI Telecommunications Distribution Methods Manual
9. BICSI Outside Plant Design Reference Manual
10. BICSI Information Transport Systems Installation Methods Manual
11. ANSI/NECA/BICSI 568-2001 Standard for Installing Commercial Building Telecommunications Cabling

1.04 SUBMITTALS

A. Product Data for each type of product specified.

B. Manufacturer's Instructions

C. Complete Product specifications including ANSI/TIA compliance.

PART 2 – PRODUCTS

2.01 COMMUNICATIONS EQUIPMENT ENCLOSURES AND HOUSINGS MANUFACTURER

A. Part numbers listed below are those of COMMSCOPE (Basis of Design).

B. Available Manufacturers: The manufacturers and their associated catalog numbers herein specified constitute the material and desired operating features that are to be furnished. Subject to compliance with requirements, other manufacturers offering similar products may be incorporated in the Work as approved by Professional.

2.02 FLOOR MOUNTED RACKS

A. Free Standing Relay Racks (Standard Rack)

B. Provide one (1) rack for each of the closets indicated on the drawings.

C. When racks are located adjacent to each other, the contractor shall bolt the cabinets tight together, removing the adjacent side panels. Provide quantity of racks as indicated on the drawings.

D. Racks shall meet the following physical specifications:

1. Racks shall be manufactured from lightweight 6061-T6 aluminum alloy construction.
2. Each rack will be configured with integrated Vertical Cable Management and shall measure 19" wide by 84" in height.
3. Each Rack shall have a 15" deep base with four (4) 3/4" bolt down holes, have double sided 12/24 tapped holes and .625" to .5" standard mounting spaces.
4. Equipment mounting channels will be 6" deep and punched on the front and rear flange with the EIA-310-E Universal hole pattern to provide 45 rack-mount spaces for equipment. Each mounting space will be marked and numbered on the mounting channel.
5. The rack will be UL Listed.
6. Finish shall have a flat black powder coat finish.
7. Acceptable Manufacturers/Design Make:
   a. Commscope Part Number# 760082495 or equivalent by Hubbell Premise Wiring

2.03 CABLE MANAGERS / ORGANIZER PANELS

A. Horizontal Cable Management

1. Provide One (1) Horizontal Ringed Cable Management Panel above and one (1) Horizontal Ringed Cable Management Panel below each Copper UTP Rack Mounted Patch Panel with the Equipment Cabinets and Racks at the Telecommunications Spaces.
2. Cable Management Panel shall measure 19" wide x 2 rack units in height and contain a cover.

3. Acceptable Manufacturers

    a. Commscope Part Number# 1375163-1 or equivalent by Hubbell Premise Wiring

B. Vertical Cable Management

1. When the system requires an equipment cabinet, either floor or wall mounted for the TS location, Vertical Wire Management is not required.
2. When the system requires an open frame equipment rack for the TS location, provide one (1) Vertical Finger Duct Panel on both sides equal in height to the racks.
3. When more than one rack is required and they are located adjacent to each other, provide one (1) Vertical Finger Duct Panel between each of two racks and one (1) Vertical Finger Duct Panel at sides.
4. Vertical Finger Duct Panel shall measure 78” high x 4” wide x 5” depth and be available in single and double sided versions.
5. Acceptable Manufacturers

    a. Commscope Part Number# 1375257-1 or equivalent by Hubbell Premise Wiring

2.04 EQUIPMENT RACK/CABINET ACCESSORIES

A. Equipment Shelves

1. Provide One (1) Ventilated Equipment Shelf for Client Agency provided equipment for each rack installed.
2. Equipment shelves shall be made of aluminum.
3. Color shall be black.
4. Shall be 19” rack mountable.
5. Acceptable Manufacturers

    a. Commscope Part Number# 760162024 or equivalent by Hubbell Premise Wiring

B. Grounding Bus Bars

1. Provide and install one (1) 3/16” x 3/4” isolated copper ground bar at the bottom of each equipment rack that are provided under this contract.
2. The isolated copper ground bar shall be tapped 10-32 and shall connect to the building ground system via #6 copper grounding wire.
3. Provide a #6 AWG wire suitable for grounding application.

C. Power Strips

1. Provide Two (2) Power Strip for each wall mount rack installed.
2. Power Strip shall be a 19” Rack Mount strip, with 6 rear facing outlets, surge suppression, and 15 Amp/15 ft. Power Cord, UL Listed.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Relay Racks

1. Assemble relay racks according to manufacturer’s instructions. Verify that equipment mounting rails are sized properly for rack-mount equipment before attaching the rack to the floor.
2. All racks must be attached to the floor in four places using appropriate floor mounting anchors. When placed over a raised floor, threaded rods should pass through the raised floor tile and be secured in the structural floor below. (Use CPI Part Number 40604-003 for concrete slab floors or 40607-001 wood floors. Raised floor support kits are also available.)

3. Racks shall be grounded to the TGB using appropriate hardware provided by the contractor. The ground will meet local code requirements and will be approved by the Authority Having Jurisdiction (AHJ).
4. In seismic areas, the rack should have additional bracing as required by building codes and the recommendations of a licensed structural Professional.
5. Ladder rack may be attached to the top of the rack to deliver cables to the rack. The rack should not be drilled to attach ladder rack. Use appropriate hardware from the ladder rack manufacturer.
6. The equipment load should be evenly distributed and uniform on the rack. Place large and heavy equipment towards the bottom of the rack. Secure all equipment to the rack with equipment mounting screws.

B. Floor Mounted Racks and Distribution Frames
1. All racks shall be anchored to the floor.
2. Mount with a minimum of 36" feet clear access behind and front of rack from the wall to a rack.
3. Install frames as indicated on drawings.
4. Install as per manufacturers instructions.

C. Backboards
1. Linear wall space used for anchoring equipment shall be lined for the full closet width with fire treated BCX grade exterior plywood 3/4" and 8' high.
2. Plywood for mounting termination equipment on shall be installed vertically side by side a minimum of 6" above finished floor. Mounting of said plywood shall be sufficient to support the equipment.
3. Plywood for supporting riser cables shall be installed vertically resting directly on the finished floor. Anchoring and mounting techniques of plywood used to support backbone riser cables shall be sufficient to support a minimum of 1500 pounds of weight.
4. In no cases shall the heads of mounting screws protrude past the face of the plywood.
5. Contractor shall install distribution rings for the cross-connect fields above all wall mounted blocks. Two rings per vertical row of blocks. Mount rings with two hex head screws per ring.

D. Miscellaneous Requirements
1. All cables shall be neatly “dressed out” in equipment rooms.
2. Fire stop all sleeves and conduit openings after the cable installation is complete.
3. Cable pathways shall incorporate the fire rated pathway:

E. Warranty
1. Product is warranted free of defects in material or workmanship.
2. Product is warranted to perform the intended function within design limits.

F. Grounding And Bonding
1. Copper bus provided in each Telecommunication Room.
2. Bond metallic equipment racks, conduits, cable tray, ladder racks to the ground bar.
3. All connectors and clamps shall be mechanical type made of silicon bronze.
4. Terminals shall be solderless compression type, copper long-barrel NEMA two bolt.
5. Bond the shield of shielded cable to the ground bar in communications rooms and spaces.
6. All connectors and clamps shall be mechanical type and made of silicon bronze.
7. Terminals shall be solderless compression type, copper long-barrel NEMA two bolt.

8. Provide #6 AWG conductor from the bus bar to the electrical system equipment ground.
9. Bond the ground bar in the main communication equipment room to dedicated communications equipment panel board where applicable.
10. Bond metallic equipment racks to the ground bar.
11. Bond the shield of shielded cable to the ground bar in communications rooms and spaces.

G. Preparation

1. Concrete floor should be clean and dry. Floor paint or sealants shall be applied prior to column installation. NOTE: Wet areas are not suitable for communications racks. Do not install if concrete floor is subject to flooding or moisture.
3. For installed access floor applications, remove floor tiles, stringers, and pedestals in the vicinity of construction. NOTE: Column installation may be performed before or after access floor installation.
4. Layout and mark the location of the rack series on the floor according to contract drawings. Then mark the location of the first column.
5. Place the floor template from the kit into position for the first column location.
6. Mark the hole patterns for three column locations, then remove the template.
7. Drill the holes into the concrete using the specified concrete drill bit. Drill to the proper depth according to manufacturer's instructions. CAUTION: insufficient hole depth will cause incomplete anchor bolt engagement.
8. Clean the drilled hole pattern and mount the floor anchors. Position the column and fasten the base hand-tight to the floor using the bolts and anchor washers provided.
9. Mount the second column with bolts hand-tight, and align the two columns with the bottom alignment fixture provided. Tighten the anchor bolts securely and then remove the bottom alignment fixture.
10. Mount the top plate with the screws provided, and tighten using the specified tool.
11. For a second rack bay, install a third column according to steps a through f above. Install one additional column at a time to complete the series of rack bays specified in the contract documents.
12. Bond the rack series to the TGB or TMGB grounding bus bar as required using #6 AWG grounding wire.
13. Assemble the spools and gates in the desired locations, and then clip the covers into position on the columns.
14. For 4-post installations, follow the same mounting procedure, and use the spacer bracket specified to position the rear pair of columns.

H. Field Quality Control - Testing

1. Verify the rack floor locations according to contract drawings.
2. Verify grounding and bonding to applicable standards and codes.
3. All anchor bolts shall be bottomed tightly onto the anchor washers with no gaps. NOTE: A gap under the anchor bolt thrust face indicates an improper hole depth. Correct this condition by drilling to the proper depth, and re-install anchor.

END OF SECTION

SECTION 271119

COMMUNICATIONS PATCH PANELS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. Scope

1. This section includes the product and installation requirements for the communications termination blocks and patch panels.
2. This section includes minimum requirements for the following:
    a. Category 6 Patch Panels

1.03 QUALITY ASSURANCE

A. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Network & Telecommunication Department. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

1.04 SUBMITTALS

A. Product Data for each type of product specified.

B. Complete Product specifications including EIA/TIA compliance.

C. Test Results and Documentation as per Section 271513.

PART 2 – PRODUCTS

2.01 STRUCTURED CABLING SYSTEMS MANUFACTURER

A. Part numbers listed below are those of Commscope equal by Hubbell, Leviton or as approved by the Professional are acceptable for this project.

B. Copper cabling, connectors, patch cords, and termination equipment shall be manufactured, certified, and warranted by a single manufacturer.

C. Category 6 Channel and Components must meet or exceed TIA/EIA 568-B.2-1 Category 6 standards. Channel to consist of Category 6 cable, patch cords, patch panel, and jack as listed herein.

2.02 RACK MOUNT PATCH PANEL (CATEGORY 6 UTP PATCH PANELS)

A. Horizontal (station) cables will terminate on Commscope Category 6 Patch Panels or equivalent by Hubbell or Leviton.

B. Category 6 rated Patch panels shall be provided at each IDF for termination of all UTP horizontal and vertical riser cables.

C. Ports shall be configured to EIA-568B wiring standards; meeting the requirements for Category 6

D. At each MDF panel, provide one RJ-45 port for each data station outlet port and each vertical riser, plus ten percent for future expansion. Separate Patch Panels shall be provided for Data Network connections.

E. At each MDF panel, provide one RJ-45 port for each voice station outlet port and each vertical riser, plus ten percent for future expansion. Separate Patch Panels shall be provided for Voice Network connections.

F. Patch panels shall be 19” rack mountable, include rear wire manager, and include paper labels for station identification. Clearly label each patch point with the location of its associated data station outlet port.

G. Patch panels for Category 6 UTP cable shall be Commscope Part No. NPP-6-DM-1U-24 (1U, 24 port populated), and Commscope Part No. NPP-6-DM-24-48(2U, 48 port populated).

H. See drawings and floor plans for port quantity per closet location.

I. Provide appropriate quantity of Horizontal cable managers above and below each rack mounted patch panel. Cable managers shall be 2 rack mount units in height, rings shall accommodate hook and loop fasteners, and shall have a front hinged, removable door. Horizontal Cable Manager shall be Commscope Part No. 1375163-1

PART 3 – EXECUTION

3.01 PATCH PANELS

A. Install and label as shown on drawings.

B. Install per manufacturer’s recommendations.

END OF SECTION

SECTION 271123

COMMUNICATIONS CABLE MANAGEMENT

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. Scope

1. This section includes the product and installation requirements for Equipment and cabling infrastructure.

B. This Section includes secure support from the building structure for network items by means of hangers, supports, anchors, sleeves, inserts, seals, and associated fastenings.

C. All supports shall utilize threaded fasteners for all connections/attachments. The use of clips or clip-on type supports is not acceptable.

1. Minimum composition requirements and installation methods for the following:

a. Cable Management Hardware

b. Cable Supporting Devices and Hangers

D. Types of supports, anchors, sleeves and seals specified in this section include the following:

1. Clevis hangers
2. Riser clamps
3. C-clamps
4. I-beam clamps
5. Conduit straps
6. Round steel rods
7. Lead expansion anchors
8. Toggle bolts
9. Wall and floor seals
10. Cable / Wire Tray

1.03 QUALITY ASSURANCE

A. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Network & Telecommunication Department. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

B. Supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment, are specified as part of that equipment assembly in other Division-27 sections.

C. Manufacturers: Firms regularly engaged in manufacture of supporting devices, of types, sizes, and ratings required, whose products have been in satisfactory use in similar service for not less than 3 years.

D. Installer's Qualifications: Firm with at least 3 years of successful installation experience with projects utilizing electrical supporting device work similar to that required for this project.

E. NEC Compliance: Comply with NEC requirements as applicable to construction and installation of network supporting devices.

F. MSS Compliance: Comply with applicable MSS standard requirements pertaining to fabrication and installation practices for pipe hangers and supports.

G. NECA Compliance: Comply with National Electrical Contractors Association's "Standard of Installation" pertaining to anchors, fasteners, hangers, supports, and equipment mounting.

H. UL Compliance: Provide electrical components which are UL listed and labeled.

I. FS Compliance: Comply with Federal Specification FF-S-760 pertaining to retaining straps for conduit, pipe and cable.

J. Electrical components shall be listed and labeled by ETL, CSA, or other approved, nationally recognized testing and listing agency that provides third-party certification follow-up services.

1.04 SUBMITTALS

A. Product Data for each type of product specified.

PART 2 – PRODUCTS

2.01 SUPPORTING DEVICES

A. Provide supporting devices of types, sizes and materials indicated; and having the following construction features:

1. Clevis Hangers: For supporting 2" rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod; approximately 54 pounds per 100 units.
2. Riser Clamps: For supporting 5" rigid metal conduit; black steel; with 2 bolts and nuts; and 4" ears; approximately 510 pounds per 100 units.
3. Reducing Couplings: Steel rod reducing coupling 1/2" x 5/8"; black steel; approximately 16 pounds per 100 units.
4. C-Clamps: Black malleable iron; 1/2" rod size' approximately 70 pounds per 100 units.
5. I-Beam Clamps: Black steel, 1-1/4" x 3/16" stock, 3/8" cross bolt; flange width 2"; approximately 52 pounds per 100 units.
6. One-Hole Conduit Straps: For supporting 3/4" rigid metal conduit; galvanized steel; approximately 7 pounds per 100 units.
7. Two-Hole Conduit Straps: For supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
8. Hexagon Nuts: For 1/2" rod size; galvanized steel; approximately 4 pounds per 100 units.
9. Round Steel Rod: Black steel; 1/2" dia.; approximately 67 pounds per 100 feet.
10. Offset Conduit Clamps: For supporting 2" rigid metal conduit; black steel; approximately 200 pounds per 100 units.

2.02 ANCHORS

A. Provide anchors of types, sizes and materials indicated; and having the following construction features:

1. Lead Expansion Anchors: 1/2", approximately 38 pounds per 100 units.
2. Toggle Bolts: Springhead; 3/16" x 4"; approximately 5 pounds per 100 units.

2.03 SLEEVES AND SEALS

A. Provide sleeves and seals, of types, sizes and materials indicated, with the following construction features:

1. Wall and Floor Seals: Provide factory-assembled watertight wall and floor seals, of types and sizes indicated; suitable for sealing around conduit, pipe, or tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.

2.04 CABLE MANAGERS / ORGANIZER PANELS

A. Horizontal Cable Management

1. Provide One (1) Horizontal Ringed Cable Management Panel above and one (1) Horizontal Ringed Cable Management Panel below each Copper UTP Rack Mounted Patch Panel with the Equipment Cabinets and Racks at the Telecommunications Spaces.
2. Cable Management Panel shall measure 19” wide x 2 rack units in height and shall allow for an optional installation of support bars.
3. Acceptable Manufacturers
    a. Commscope Part Number# 1375163-1 (Black) or equal as approved by the Professional.

2.05 WALL MOUNTED DISTRIBUTING "J" HOOKS

A. Contractor shall install open ended distribution rings for wall mounted cross-connect fields above all wall mounted blocks. Two rings per vertical row.

B. Design Make:

1. Caddy (wall mount) (mfg # CAT32)
2. Caddy (rod mount) (mfg # CAT12BC)

2.06 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be protected with zinc coating or with treatment of equivalent corrosion resistance using approved alternative treatment, finish, or inherent material characteristic. Products for use outdoors shall be hot-dip galvanized.

2.07 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels, and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

PART 3 – EXECUTION

3.01 GENERAL

A. Provide supporting devices which comply with manufacturer's standard materials, design and construction in accordance with published product information, and as required for complete installation; and as herein specified. Where more than one type of supporting device meets indicated requirements, selection is Installer's option.

B. Install hangers, anchors, sleeves and seals as indicated, in accordance with manufacturer's written instructions and with recognized industry practices to insure supporting devices comply with requirements. Comply with requirements of NECA and NEC for installations of supporting devices.

C. Coordinate with the building structural system and other electrical work, including raceway and wiring work, as necessary to interface installation of supporting devices with other work.

D. Do not fasten supports to pipes, ducts, mechanical equipment, and conduit.

E. Obtain approval from the Professional before drilling or cutting structural members.

F. Install surface-mounted cabinets and panelboards with minimum of four anchors.

3.02 MISCELLANEOUS SUPPORTS

A. Support miscellaneous network/electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers, and other devices.

3.03 CABLE SUPPORTS

A. Provide 8 inch “J” hooks 2 ft. on center for all exposed wall mounted vertical cable runs.

B. Keep horizontal wall mounted cable runs to a minimum. In general, horizontal runs shall be on wall mounted ladder rack.

C. Provide category 6 cable brackets 3’ on center supported to building structure for all cable runs not supported by cable tray.

3.04 FASTENING

A. Unless otherwise indicated, fasten network/electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cable trays, busways, cabinets, panelboards, transformers, boxes, disconnect switches, and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Threaded studs driven by a powder charge and provided with lock washers and nuts may be used instead of expansion bolts and machine or wood screws. Do not weld conduit, pipe straps, or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.

2. Holes cut into reinforced concrete beams or in concrete shall not cut reinforcing bars. If the Contractor cuts into any reinforcing bars, stop work and notify the Professional immediately. Fill holes that are not used.

3. Ensure that the load applied to any fastener does not exceed 25 percent of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

3.05 TESTS

A. Test pull-out resistance of one of each type, size, and anchorage material for the following fastener types:

1. Expansion anchors.

2. Toggle bolts.

3. Powder-driven threaded studs.

B Provide all jacks, jigs, fixtures, and calibrated indicating scales required for reliable testing. Obtain the structural Professional's approval before transmitting loads to the structure. Test to 90 percent of rated proof load for fastener. If fastening fails test, revise all similar fastener installations and retest until satisfactory results are achieved.

END OF SECTION

SECTION 271500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. Scope

1. This section includes the product and installation requirements for the fiber backbone cable.
2. This section includes minimum requirements for the following:
    a. Data Network Communications Cable Plant
        1) Category 6 UTP Cables

1.03 QUALITY ASSURANCE

A. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Network & Telecommunication Department. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

1.04 SUBMITTALS

A. Product Data for each type of product specified.

B. Complete Product specifications including EIA/TIA compliance.

C. Test Results and Documentation as per Section 271513.

PART 2 – PRODUCTS

2.01 STRUCTURED CABLING SYSTEMS MANUFACTURER

A. Part numbers listed below are those of Commscope. Equivalent by Hubbell, Berk-Tek or equal as approved by the Professional are acceptable for this project**.**

B. Copper cabling, connectors, patch cords, and termination equipment shall be manufactured, certified, and warranted by a single manufacturer.

C. Category 6 Channel and Components must meet or exceed TIA/EIA 568-B.2-1 Category 6 standards. Channel to consist of Category 6 cable, patch cords, patch panel, and jack as listed herein.

2.02 CATEGORY 6 CABLE (Horizontal Cabling to Data Network station outlets)

A. The horizontal cables must consist of Category 6 100 Ohm balanced 4-pair UTP that is approved within the Structured Cabling System warranty. The horizontal cable must exhibit matched impedance with the patch cords, jacks and patch panels at the nominal frequency bandwidth of 100 MHz. Impedance testing which is conducted with hand-held scanners that are not capable of exhibiting discrete point impedance data may use +/- 5 ohms as the reference value. Reference impedance traces from the factory using a network analyzer is recommended.

B. Cabling shall meet the published Category 6 standard per the requirements of ANSI/TIA/EIA-568-B.2. Product specifications shall be published by the manufacturer as Worst Case.

C. Conductors: 24 AWG solid bare copper. Cable shall contain a Fluoropolymer separator, non-lead, flame retardant PVC jacket, and all 4-pairs shall be insulated with 100% FEP

D. Cable shall be Commscope Part No. 700208093(blue). All Category 6 cable shall be plenum rated.

E. Provide one “homerun” UTP cable between each Data outlet port indicated on the drawings and the MDF. In field splicing of UTP cables shall not be permitted. Each homerun shall not exceed 90 meters in length.

F. The 2018 National Electric Code Article 800 Type CMP specification shall be recognized when UTP cables are installed, without benefit of adequate raceway, in a plenum air return.

PART 3 – EXECUTION

3.01 INSTALLATION OF DATA CABLES

A. Installation of equipment shall be made by qualified, Commscope -certified or -certifiable personnel. All installation shall be done in a neat, professional and high quality manner and in conformity with local and federal building codes and the Structured Cabling System requirements. All areas affected by installation, both inside and outside of the buildings, will be restored to their former condition. Bidder is responsible for the cost of all repairs, painting and other restoration needed due to damage caused by the installation.

B. Category 6 cables shall be installed with a minimum 18" clearance from light fixtures, electrically operated equipment and all wiring operating at 120 or more volts.

C. Data Cables shall be type, size and insulation as recommended by manufacturer and approved. Install in accordance with manufacturer's written instructions and in compliance with NEC.

D. Coordinate installation with other Work.

E. Install without damaging conductors or jacket.

F. Do not either in handling or installation bend cable to smaller radii than minimum recommended by manufacturer.

G. Ensure that minimum manufacturer's recommended pulling tensions are not exceeded.

H. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling means, including fish tape, cable, rope, and basket weave wire/cable grips that will not damage media or raceway.

I. Use pulling compound or lubricant where necessary; compound used must be approved by the cable manufacturer.

J. Install exposed cable, parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

K. No splices are allowed except at indicated splice points.

L. Tighten connectors and terminals, including screws and bolts, in accordance with manufacturer's published instructions or torque tightening values.

M. At no time during or after installation shall the successful bidder use plastic zip-lock tie wraps for securing the cables, both in the plenum and in the closets. The accepted method of securing the cables is the utilization of reusable hook and loop cable ties.

3.02 FIELD QUALITY CONTROL: HORIZONTAL CABLING

A. Prior to usage, test wiring for electrical continuity and for short circuits.

B. Test all cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.

C. "Category 6" System Certification

1. Coordinate this testing with the Professional. Notify the Professional at least seven days in advance of testing in order for the Professional to make plans to witness this testing.

2. After all punchdowns and cable terminations are complete test each Category 6 cable from the wiring closet to the Computer Outlet to Channel Testing requirements including the Category 6 Patch Cable assemblies.
3. This testing shall be conducted with a "Scope 350" EIA/TIA Category 6 LAN Tester or approved equal.
4. Measure and record the following data:
    a. Line Map: Connectivity and cable destination; show shorts, opens, combined shorts/opens, swaps, and room identification.
    b. Resistance
    c. Length
    d. Mutual Capacitance
    e. Attenuation: Swept Frequency 200kHz to 100MHz (sampled at 100kHz increments)
    f. Near-end Crosstalk (NEXT): Swept Frequency 200kHz to 100MHz (sampled at 100kHz increments)
    g. Impulse Noise
    h. Average Noise
    i. Traffic Noise
    j. Propagation Rate
5. All cables and product connectivity shall conform to the minimum requirements of ANSI/TIA/EIA-568-B.2, Category 6 standard and product specification data shall be published by the manufacturer based on Worst Case testing results.
6. Document the test results in graphic plot format immediately following each test, via a Wavetek "PTR-1" printer. Provide two copies of the recordings bound in two separate cable record books, indexed for easy reference and transmit these books to the Professional for review by the Professional. Bind the original recordings in a cable record book indexed for easy reference during future maintenance operations and turn book over to the Department's authorized representative. Each cable shall be printed on a separate sheet of 8 ½" x 11" paper, one page per cable.

D Replace malfunctioning transmission media with new materials, then retest until satisfactory performance is achieved.

3.03 COMMISSIONING

A. Subsequent to hookups of data transmission cable and equipment demonstrate proper functioning. Replace malfunctioning components with new materials, and then retest until satisfactory performance is achieved.

END OF SECTION

SECTION 271513

COMMUNICATIONS COPPER HORIZONTAL CABLING

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. Scope

1. This section includes the minimum requirements for the testing, certification administration and identification of backbone and horizontal cabling.
2. This section includes minimum requirements for the following:
    a. UTP testing and testers
    b. Labels and Labeling
    c. Documentation

1.03 QUALITY ASSURANCE

A. All testing procedures and testers shall comply with applicable requirements of:

1. ANSI/TIA/EIA 568- B.1 Commercial Building Telecommunications Cabling Standard, Part 1: General Requirements

1.04 SUBMITTALS

A. Manufacturers catalog sheets and specifications for copper cable testers.

B. Test reports

PART 2 - PRODUCTS

2.01 100 OHM UTP TESTER

A. Shall be capable of testing to TIA 568-B.1 criteria.

B. Physical interface shall be modular RJ-45 connector and a serial port with DB-9 connector.

B. Shall have auto-testing to determine if cable meets the requirements of TIA/EIA 568-B.1, ISO Class C, D, 10 Base-T, Token Ring, Fast Ethernet and ATM standards.

C. Acceptable Manufacturers:

1. Fluke or equal as approved by the Professional

2.02 LABELS

A. Shall meet the legibility, defacement, exposure and adhesion requirements of UL 969.

B. Shall be preprinted or laser printed type.

C. Where used for cable marking provide vinyl substrate with a white printing area and a clear “tail” that self laminates the printed area when wrapped around the cable. If cable jacket is white, provide cable label with printing area that is any other color than white, preferably orange or yellow – so that the labels are easily distinguishable.

D. Where insert type labels are used provide clear plastic cover over label.

E. Provide plastic warning tape 6 inches wide continuously printed and bright colored 18” above all direct buried services, underground conduits and duct-banks.

F. Acceptable Manufacturers:

1. Brothers (or better)

PART 3 – EXECUTION

3.01 100 OHM UTP CABLE TESTING

A. The testing parameters called for in this section shall include the horizontal Link/ channel for all installed drop locations.

B. Test cable with test set to match the NVP for the cable as stated by the cable manufacturer of the cable being installed.

C. The test parameters shall include Wire Map, Length, Attenuation, PS-NEXT, PS-ACR, PS-ELFEXT and Return-Loss

D. Wire Map

1. The wire map test shall verify pair to pin termination at each end and check for connectivity errors. The wire map shall indicate the following for each of the eight conductors:

a. Continuity to the remote end

b. Shorts between any two or more conductors

c. Crossed pairs

d. Reversed Pairs

e. Split Pairs

f. Any other miss wiring

E. Cable Performance

1. Must meet the minimum acceptable values as indicated in TIA/EIA 568B.1 Category 6 (TIA/EIA 568B.2-1) requirements.

3.02 IDENTIFICATION & LABELING

A. Confirm specific labeling requirements with customer's project coordinator prior cable installation or termination.

B. Cables

1. Backbone cables shall be marked at each endpoint and at all intermediate pull/ access points or junction boxes. Label shall indicate origination and destination TR ID, sheath ID and strand or pair range.

2. Horizontal cables shall be marked at each end, on the sheath indicating the TR, patch panel and panel port to which the cable is wired. Faceplates and Patch Panels

C. Faceplates and Patch Panels

1. Faceplates

a. Shall be labeled to indicate the room number and panel port [A thru Z] to which the cable is wired for each cable that it houses.

3.03 RECORD COPY AND AS - BUILT DRAWINGS

A. Provide record copy drawings periodically through out the project as per 25030 or as requested by the project manager and at end of the project. Record copy drawings shall include notations reflecting the as built conditions of any additions to or variation from the drawings provided.

3.04 TEST RESULTS

A. Horizontal Copper Cabling

1. The Contractor shall test all cables and submit all horizontal copper cable test result data in electronic format, with the resulting file formatted with one test result per 8.5"x 11" page.

B. High Pair Count Copper Cables

1. The Contractor shall test all high count copper cables and submit test result information in an electronic format.

2. See project coordinator for required format for test report documentation.

END OF SECTION

SECTION 271514

COMMUNICATIONS COPPER HORIZONTAL CABLING CABLE PLANT LIFE CYCLE ACTIVITIES

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SCOPE

A. Summary

1. Provide all labor, materials, tools, and equipment required for the complete installation of work called for in the Contract Documents.

1.03 CONTRACTOR REQUIREMENTS

A. Certifications.

1. Certified System Installer for the manufacturer.

B. Contractor shall be recognized by the manufacturer as a certified installer of the specific structured cabling system. This certification will enable the contractor to provide a minimum manufacturer's 20 year product warranty and a lifetime application assurance program guaranteeing that the installation will be operating the applications which the system was originally designed to support, as well as any new applications, far as long as the system is owned in its original place of installation. New applications are defined as any application introduced in the future by recognized standards organizations or user forums that adhere to the TIA / EIA 568-A or ISO / IEC IS 11801 component and channel specification for cabling. Copies of certifications shall be submitted with bid submittal.

C. Structured Cabling System installation must have a warranty of 25 years.

1.04 SUBMITTALS

A. Submit manufacturer warranty information with bid

B. Contractor certification to provide warranty with bid.

1.05 RELATED DOCUMENTS

A. Contractor shall submit a material list with the bid submittal. This shall include quantity, description and manufacturer's part numbers for all components in proposed system.

B. Contractor shall submit a qualification summary for each individual who will perform services involved with this project. Qualification summary shall list proposed job responsibility (ie. Project Management, Designer, Installer, etc.), and any relevant experience or qualifications.

C. Contractor shall submit a list of all test equipment proposed for the completion of this project. Test equipment list shall include test device manufacturer, model number, firmware revision, client software revision if applicable, and any other information that may be pertinent to this project.

D. Contractor shall provide a list of product technical training for all systems proposed and shall provide manufacturer's letters or certificates of completion for said training.

E. Contractor shall provide a list including the company name, contact name, and phone number of all subcontractors that will be used to complete this project. Subcontractor shall have the same training and certifications as contractor and shall be pre-approved (prior to bid opening) by the Department.

1.06 NETWORK SUPPORT

A. Contractor shall provide for a period of 1 year upon completion and final acceptance of system a customer service representative available to the district on an unlimited basis. The customer representative will be capable of supplying additional training on all systems provided under this contract. The cost of this representative shall be included in the base bid amount of this contract.

1.07 RECORD DOCUMENTS

A. Prepare record documents in accordance with the requirements in Division 1 Section.

1.08 PROJECT CLOSEOUT

A. When all work has been completed and before final acceptance, the Contractor shall furnish to the Professional a complete set of reproducible contract drawings clearly showing all contract work "as-built". Prior to delivery each drawing shall be signed and dated by the Contractor's project manager attesting to the accuracy of the as-built drawing.

B. Mark up a clean set of Specifications to indicate approved substitutions, change orders and actual equipment and materials used.

PART 2 - MAINTENANCE

2.01 CABLE PLANT MAINTENANCE

A. General: Sequence, coordinate, and integrate the various elements of network systems, materials, and equipment. Comply with the following requirements:

1. Coordinate network systems, equipment, and materials installation with other building components.
2. Verify all dimensions by field measurements.
3. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for network installations.
4. Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed.
5. Sequence, coordinate, and integrate installations of network materials and equipment for efficient flow of the Work. Give particular attention to large equipment requiring positioning prior to closing in the building.
6. Where mounting heights are not detailed or dimensioned, install systems, materials, and equipment to provide the maximum headroom possible.
7. Install systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible. Conform to arrangements indicated by the Contract Documents, recognizing that portions of the Work are shown only in diagrammatic form. Where coordination requirements conflict with individual system requirements, refer conflict to the Professional.
8. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and components.
9. Coordinate the cutting and patching of building components to accommodate installation of network equipment and materials.
10. Coordinate the installation of network materials and equipment above ceilings with suspension system, mechanical equipment and systems, and structural components.
11. Install network equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

2.02 CLEANING

A. Refer to the Division 1 Section PROJECT CLOSEOUT or FINAL CLEANING for general requirements for final cleaning.

2.03 TESTING

A. Contractor, at his own expense, shall make any tests directed by an inspection authority or by the Professional and shall provide all equipment, instruments and materials to make such tests.

B. Unless otherwise approved, all connections shall be made and all components shall be in place, complete and operational, at time of final inspection and tests.

C. Time of such tests, the manner in which they are made and the results of the tests, shall be subject to approval.

D. Upon completion of work, all component parts, both singularly and as a whole, shall be set, calibrated, adjusted and left in satisfactory operating condition to suit load conditions, by means of instruments furnished by the Contractor.

E. Complete testing of equipment and systems shall be provided throughout this project.

F. Industry standards shall apply except as otherwise specified.

G. Provide all labor, premium labor and materials required by shop and field testing as specified in the Contract Documents and as required by the authorities having jurisdiction.

H. Notify the Professional seven (7) days prior to the testing dates. Upon completion of a test, a statement of certification shall be forwarded to the Professional for his approval.

I. Conduct tests at a time agreeable to the Professional. Provide premium labor as necessary.

J. Products that are found defective or do not pass such tests shall be removed and replaced at the Contractor's expense. Tests shall be repeated.

2.04 INSTRUCTIONS TO THE DEPARTMENT

A. After the tests and adjustments have been made, approved factory authorized system representatives and the Contractor shall fully instruct Department in all details of operation and maintenance of equipment installed under this Contract. Dates and times of such instructions shall be as directed.

2.05 CABLE PLANT REPLACEMENT/WARRANTIES

A. Refer to the Division 1 Section SPECIFIC WARRANTIES for procedures and submittal requirements for warranties and to individual equipment specifications for additional warranty requirements. If a contradiction exists, the most demanding requirements shall prevail.

B. Compile and assemble the warranties specified in Division 27 into a separated set of vinyl covered, three ring binders, tabulated and indexed for easy reference.

C. Provide complete warranty information for each item to include date of beginning of warranty or bond; duration of warranty or bond; and names, address, and telephone numbers and procedures for filing a claim and obtaining warranty services.

PART 3 - EXECUTION

3.01 STRUCTURED CABLING SYSTEM WARRANTY

A. The successful Bidder shall warrant that all materials and equipment are new, in good working order, free from defects and in conformance with the Structured Cabling System specifications. All installed equipment must conform to the manufacturer's official published specifications. The warranty shall begin at the Structured Cabling System acceptance date and remain in effect for a period of twenty years from that date. The successful Bidder shall agree to repair, adjust and/or replace (as determined by the Purchaser to be in its best interest) any defective equipment, materials or other parts of the Structured Cabling System at the successful Bidder's sole cost. The Purchaser will incur no costs for service or replacement of parts within the channel during the warranty period of 25 years.

B. Selected vendor must provide a Network Performance Solutions Warranty for a minimum of 25 years. The Network Performance Solutions Warranty must guarantee the electrical performance to meet ANSI/TIA-568 for a period of twenty-five (25) years beginning at the acceptance by the Purchaser. The warranty must include complete parts and labor replacement of defective products. The products must be warranted for a minimum of 25 years by the manufacturer. The Structured Cabling System warranty must have provisions for replacing the contracting organization at no cost to the customer should the contractor lose his status as an authorized installer or otherwise not fulfill his obligations to the customer as outlined in the System warranty program.

C. The successful Bidder shall warrant and supply evidence that the installation of materials and hardware will be made in strict compliance with all applicable provisions of the National Electric Code, the rules and regulations of the Federal Communications Commission, and state and/or local codes or ordinances that may apply.

D. The successful Bidder shall warrant that the Structured Cabling System will function as specified in the approved manufacturer's Technical Description Guide.

E. The successful Bidder shall warrant that the Structured Cabling System will accommodate traffic at the levels specified in all appropriate sections of this Request for Proposal.

3.02 CATEGORY 6 CHANNEL SPECIFICATIONS

A. Structured Category 6 Cabling System must meet or exceed ISO/IEC 11801, including Amendments, and/or ANSI/TIA-568 for a period of twenty-five (25) years. Channel to consist of Category 6 cable, patch cords, patch panel, and jack as listed herein.

B. Structured Cabling System Specifications (Patch Panel to Jack)

1. Minimum values [min] represent worst case allowable in system. Minimum values are derived from and meet or exceed ANSI/TIA-568-C.2 Category 6 values.

2. Typical values [typical] were obtained from passive testing over a 100 meter channel in a UL certified laboratory under controlled conditions.

3. C6T channel and components guaranteed to meet or exceed ANSI/TIA-568-C.2 Category 6 standards. Channel consisted of cable, Patch Cord, Patch Panel and jack.

3.03 GENERAL

A. Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Lettering and Graphics: Coordinate names, abbreviations, colors, and other designations used in electrical identification work with corresponding designations specified or indicated. Install numbers, lettering, and colors as approved in submittals and as required by code.

C. Install identification devices as indicated, in accordance with manufacturer's written instructions and requirements of NEC.

D. Sequence of Work: Where identification is to be applied to surfaces that require finish, install identification after completion of finish work.

E. Regulations: Comply with governing regulations and requests of governing authorities for the identification of electrical work.

3.04 CABLE/CONDUCTOR IDENTIFICATION

A. Apply cable/conductor identification on each cable/conductor in each box/enclosure/cabinet where wires of more than one circuit or communication/signal system are present. Match identification with marking system used on shop drawings, contract documents, and similar previously established identification for project's electrical work.

3.05 OPERATION SIGNS

A. Provide instruction signs with approved legend where instructions or explanations are needed for system or equipment operation.

3.06 INSTALLATION

A. Provide equipment identification labels of engraved plastic-laminate on each major unit of electrical equipment in building, including central or master unit of each electrical system. This includes computer systems, unless unit is specified with its own self-explanatory identification. Except as otherwise indicated, provide single line of text, with 1/2-inch-high lettering on 1-1/2-inch-high label (2-inch-high where two lines are required), white lettering in black field. Text shall match terminology and numbering of the Contract Documents and shop drawings. Apply labels for each computer system component.

B. Provide labels at locations indicated and at locations for best convenience of viewing without interference with operation and maintenance of equipment.

END OF SECTION

SECTION 271543

COMMUNICATIONS FACEPLATES AND CONNECTORS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. Scope

1. This section includes the product and installation requirements for the communications faceplates and connectors.
2. This section includes minimum requirements for the following:
    a. Communications Faceplates
    b. Category 6 Connectors

1.03 QUALITY ASSURANCE

A. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Network & Telecommunication Department. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

1.04 SUBMITTALS

A. Product Data for each type of product specified.

B. Complete Product specifications including EIA/TIA compliance.

C. Test Results and Documentation as per Section 271513.

PART 2 – PRODUCTS

2.01 STRUCTURED CABLING SYSTEMS MANUFACTURER

A. Part numbers listed below are those of Commscope. Equivalent by Hubbell, Leviton or equal approved by the Professional are acceptable for this project.

B. Copper cabling, connectors, patch cords, and termination equipment shall be manufactured, certified, and warranted by a single manufacturer.

C. Category 6 Channel and Components must meet or exceed TIA/EIA 568-B.2-1 Category 6 standards. Channel to consist of Category 6 cable, patch cords, patch panel, and jack as listed herein.

2.02 CATEGORY 6 DATA CONNECTORS (Quantity and Type as described on drawings)

A. All jacks must meet the Category 6 standard per TIA/EIA-568-B.2-1. Jacks must be provided as individual units in order to provide the maximum flexibility. The jacks must have silver plated contacts oriented at 45 degrees to the conductor and be capable of terminating 22-26 AWG and must support termination of solid or stranded conductors. Jacks must support a minimum of 200 reterminations.

B. Data Outlets shall be rated to support Gigabit Ethernet applications

C. Data Outlets shall be configured to EIA-568B wiring standards

D. Category 6 Data Primary Connectors shall be Commscope Part No. 2-1375055-3 (Modular jack, white): Verify outlet color with department/Professional prior to installation.

E. Category 6 Data Secondary Connectors shall be Commscope Part No. 2-1375055-4 (Modular jack, gray): Verify outlet color with department/Professional prior to installation.

F. Category 6 Voice Primary Connectors shall be Commscope Part No. 6830 1 830-09 (Modular jack, green): Verify outlet color with department/Professional prior to installation.

2.03 DATA FACEPLATES AND INSERTS (Quantity and type as described on drawings)

A. Wall outlet termination will utilize Commscope modular wallplates.

B. Workstation Data Outlets – Surface Mounted

1. Flush mount Faceplates shall fit standard single-gang boxes, and shall be provided with two outlet labeling areas, and individual port ID area. Each workstation faceplate shall include two blank paper labels, two clear plastic label protectors, and six reversible-icon ID tabs numbered 1 through 6 (icon colors to match faceplate), and two mounting screws (#6-32 x 15/16"). Verify outlet color with department/Professional prior to installation. Provide faceplate size as necessary to accommodate workstation data/voice outlet configuration.

a. Single gang 4-port flush mount faceplate with 4 ports, shall be Commscope Part 1-2111011-3 (white).

c. Single gang 2-port flush mount faceplate with 2 ports, shall be Commscope Part 2111011-3 (white).

2. Provide the proper combination of connectors and blank filler inserts to construct a face plate with the proper number of outlets as required by the drawings. The colors of each piece will match one another.

C. Provide the proper combination of filler inserts and adapter inserts to construct a faceplate with the proper number of outlets as required by the drawings. The colors of each piece shall match one another – Verify color with department/Professional.

2.04 OUTLET AND DEVICE BOXES

A. Provide Enclosures, Boxes, and Fittings of indicated types, sizes, and NEMA enclosure classes. Where not indicated, provide units of types, sizes, and classes appropriate for the use and location. Provide all items complete with covers and accessories required for the intended use. Provide gaskets for units in damp or wet locations.

B. Outlet Boxes: Provide galvanized flat rolled sheet steel outlet wiring boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations. Provide outlet boxes with mounting holes, and with cable and conduit-size knockout openings in bottom and sides. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.

C. Outlet Box Accessories: Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Choice of accessories is Contractor's code-compliance option.

D. Conduit-body-type electrical enclosures and wiring fittings are specified in Division 16 Section RACEWAYS.

E. Manufacturers: Subject to compliance with requirements, provide interior outlet boxes of one of the following:

Eagle Electric Mfg. Co., Inc.

Midland-Ross Corporation

OZ/Gedney; General Signal Co.

Thepitt

Hubbell, Inc.

Thomas & Betts Co.

Pass and Seymour, Inc.

PART 3 - EXECUTION

3.01 INSTALLATION OF DATA CABLES

A. Installation of equipment shall be made by qualified, TE Connectivity-certified or –certifiable personnel. All installation shall be done in a neat, professional and high quality manner and in conformity with local and federal building codes and the Structured Cabling System requirements. All areas affected by installation, both inside and outside of the buildings, will be restored to their former condition. Bidder is responsible for the cost of all repairs, painting and other restoration needed due to damage caused by the installation.

B. Category 6 cables shall be installed with a minimum 18" clearance from light fixtures, electrically operated equipment and all wiring operating at 120 or more volts.

C. Data/Voice Cables shall be type, size and insulation as recommended by manufacturer and approved. Install in accordance with manufacturer's written instructions and in compliance with NEC.

D. Coordinate installation with other Work.

E. Install without damaging conductors or jacket.

F. Do not either in handling or installation bend cable to smaller radii than minimum recommended by manufacturer.

G. Ensure that minimum manufacturer's recommended pulling tensions are not exceeded.

H. Pull conductors simultaneously where more than one is being installed in same raceway. Use pulling means, including fish tape, cable, rope, and basket weave wire/cable grips that will not damage media or raceway.

I. Use pulling compound or lubricant where necessary; compound used must be approved by the cable manufacturer.

J. Install exposed cable, parallel and perpendicular to surfaces or exposed structural members, and follow surface contours where possible.

K. No splices are allowed except at indicated splice points.

L. Tighten connectors and terminals, including screws and bolts, in accordance with manufacturer's published instructions or torque tightening values.

M. At no time during or after installation shall the successful bidder use plastic zip-lock tie wraps for securing the cables, both in the plenum and in the closets. The accepted method of securing the cables is the utilization of KRONE reusable hook and loop cable ties.

3.02 TERMINATIONS

A. Terminations at the RJ-45 data jacks shall be made in accordance with EIA/TIA Standard T568B.

3.03 COLOR CODING

A. All data wiring shall be color coded as per ANSI/TIA/EIA-568-A. This color coding shall be consistent and continuous throughout the system.

3.04 FIELD QUALITY CONTROL: HORIZONTAL CABLING

A. Prior to usage, test wiring for electrical continuity and for short circuits.

B. Test all cable segments for faulty connectors, splices, terminations, and the integrity of the cable and its component parts.

C. "Category 6" System Certification

1. Coordinate this testing with the Professional. Notify the Professional at least seven days in advance of testing in order for the Professional to make plans to witness this testing.
2. After all punchdowns and cable terminations are complete test each Category 6 cable from the wiring closet to the Computer Outlet to Channel Testing requirements including the Category 6 Patch Cable assemblies.
3. This testing shall be conducted with a "Scope 350" EIA/TIA Category 6 LAN Tester or approved equal.
4. Measure and record the following data:
    a. Line Map: Connectivity and cable destination; show shorts, opens, combined shorts/opens, swaps, and room identification.
    b. Resistance
    c. Length
    d. Mutual Capacitance
    e. Attenuation: Swept Frequency 200kHz to 100MHz (sampled at 100kHz increments)
    f. Near-end Crosstalk (NEXT): Swept Frequency 200kHz to 100MHz (sampled at 100kHz increments)
    g. Impulse Noise
    h. Average Noise
    i. Traffic Noise
    j. Propagation Rate
5. All cables and product connectivity shall conform to the minimum requirements of ANSI/TIA/EIA-568-B.2, Category 6 standard and product specification data shall be published by the manufacturer based on Worst Case testing results.
6. Document the test results in graphic plot format immediately following each test, via a Wavetek "PTR-1" printer. Provide two copies of the recordings bound in two separate cable record books, indexed for easy reference and transmit these books to the Professional for review by the Professional. Bind the original recordings in a cable record book indexed for easy reference during future maintenance operations and turn book over to the Department's authorized representative. Each cable shall be printed on a separate sheet of 8 ½” x 11” paper, one page per cable.

D. Replace malfunctioning transmission media with new materials, then retest until satisfactory performance is achieved.

3.05 COMMISSIONING

A. Subsequent to hookups of data transmission cable and equipment demonstrate proper functioning. Replace malfunctioning components with new materials, and then retest until satisfactory performance is achieved.

END OF SECTION

SECTION 271649

COMMUNICATIONS PATCH CORDS AND STATION CORDS

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions for the Construction Contract", "Special Conditions" and "Division 1 - General Requirements" form a part of this Section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.02 SUMMARY

A. Scope

1. This section includes the product and installation requirements for the communications custom cable assemblies.
2. This section includes minimum requirements for the following:
    a. Communications Category 6 Patch Cords

1.03 QUALITY ASSURANCE

A. All methods of construction that are not specifically described or indicated in the contract documents shall be subject to the control and approval of the Network & Telecommunication Department. Equipment and materials shall be of the quality and manufacture indicated. The equipment specified is based upon the acceptable manufacturers listed. Where "approved equal" is stated, equipment shall be equivalent in every way to that of the equipment specified and subject to approval.

1.04 SUBMITTALS

A. Product Data for each type of product specified.

B. Complete Product specifications including EIA/TIA compliance.

C. Test Results and Documentation as per Section 271513.

PART 2 – PRODUCTS

2.01 STRUCTURED CABLING SYSTEMS MANUFACTURER

A. Part numbers listed below are those of Commscope. Equivalent by Hubbell, Berk-Tek, or equal as approved by the Professional are acceptable for this project.

B. Copper cabling, connectors, patch cords, and termination equipment shall be manufactured, certified, and warranted by a single manufacturer.

C. Category 6 Channel and Components must meet or exceed TIA/EIA 568-B.2-1 Category 6 standards. Channel to consist of Category 6 cable, patch cords, patch panel, and jack as listed herein.

2.02 CATEGORY 6 PATCH CABLE ASSEMBLIES

A. Patch cords shall be a major part of the Structured Cabling System and the bidder should show them on a bill of materials. This Contractor shall provide copper patch cables for every active cable. Active copper cables shall coincide with the number of outlets on the project. Two (2) copper patch cables shall be provided for every active cable, one (1) for equipment room side and one (1) for workstation side, respectively. All patch cords shall be Structured Cabling System factory made and shall not be field terminated. Each patch cord shall be of the appropriate length for the field of use and of lengths that are acceptable within the Structured Cabling System. Each patch cord shall have the appropriate ends for the intended field. Patch cords may not be cut in half for single-end punch down; products specifically manufactured for that purpose must be used.

B. Category 6 patch cords shall meet Category 6 component specification and be impedance matched for use in the Manufacturer end-to-end channel Structured Cabling System.

C. Design Requirements

1. Category 6 patch cords shall be constructed with a smoke-colored polycarbonate plug having vertically staggered, trifurcated contacts, each having 50 micro-inches of gold plating.
2. Plug dimensions and function shall comply with FCC 47, part 68.5.
3. Patch cords shall have a snag-less feature, integral to the strain relief boot on each end. Strain relief boot shall be molded PVC, and color matched to the cable jacket.
4. Patch cords shall be constructed with category 6 patch cable, with 24 AWG 7/32 tinned copper stranded conductors, each insulated with polyethylene, and overall jacket with UL flame-retardant PVC.
5. Patch cords shall be manufactured using a T568B wiring format and shall function suitably for either T568A or T568B wiring schemes.
6. Patch cords shall be available in the following colors: black, blue, gray, yellow, orange, red, green, white, and purple. Custom lengths and colors shall be available with a delivery lead-time quotation.
7. Standard patch cord lengths shall range from 3 ft. to 20 ft.
8. Category 6 patch cords shall be backward compatible with existing Category 3, 5, and 5e cabling systems for fit, form, and function.
9. Patch cords shall be manufactured in the USA.

D. Performance Requirements

1. All transmission performance parameters shall be independently verified by a UL or ETL third party testing organization.
2. Category 6 patch cords shall be channel performance balanced with Commscope Category 6 jacks, patch panels, and punch-down blocks.
3. Category 6 patch cords shall meet or exceed Category 6 component transmission requirements for connecting hardware, as specified in ANSI/TIA/EIA-568-B.2-1 standard.
4. The manufacturer shall provide Category 6 component compliance certificates from third party testing organization upon request.
5. Patch cords shall be cUL and UL LISTED 1863.
6. Patch cords shall exceed IEEE 802.3af DTE Power specification to 4 times the rated current limits with no degradation of performance or materials.
7. Patch cords shall be third party verified, error-free GIGABIT ETHERNET performance to IEEE 802.3ab.
8. Category 6 patch cords shall meet or exceed the 4-connector channel transmission performance requirements of Category 6, per ANSI/TIA/EIA-568-B.2-1 standard.
9. The 4-connector channel test configuration shall utilize Category 6 patch panels, blocks, and jacks, with Category 6 patch cords, all from the same manufacturer, with qualified Category 6 cable.
10. The 4-connector channel performance margins in the table below shall be guaranteed, provided the configuration satisfies requirement No. 9 above.
11. Category 6 panels shall meet the current draft 10 Gb/s performance requirements of IEEE 802.3an and TSB-155, for a maximum 55-meter channel length. Conditions of requirement no. 9 above apply exclusively.

E. Acceptable Manufacturers:

1. Workstation side Data and Voice Category 6 Patch cables shall be

   Commscope Part No. BPC3312-09 (15 ft. yellow), Commscope Part No. BPC3312-OZ (15 ft. blue)

2. Equipment side Data Category 6 patch cables shall be Commscope Part No. BPC3312-09 (10 ft. yellow)
3. Equipment side Voice Category 6 patch cables shall be Commscope Part No. BPC3312-OZ(10 ft. blue)

PART 3 – EXECUTION

3.01 PREPARATION

A. Horizontal and backbone cabling of the proper category shall be fully deployed throughout the building according to applicable codes and standards.

B. Telecommunications outlet locations, patch panels in the MDF shall be installed and terminated complete per manufacturer's instructions, and applicable codes and standards.

C. Faceplates at each to shall be assembled complete and properly mounted.

D. Metallic horizontal cable pathways shall be bonded to an approved ground according to ANSI-J-STD-607.

3.02 INSTALLATION

A. Remove patch cords from bags and apply channel or port identification labels per specification. Patch cord lengths should match the distance between connection points, with enough slack for cable management and bend radius control.

B. For cross-connect panels in the closet, place the patch cords properly into the installed front cable organizer. Plug each end into the respective panel and equipment ports. Push the plug into the receptacle until the latch clicks into position. Installed patch cords should be neat, with no kinks, tangles, or tight bends.

C. To connect workstation equipment to the TO, route the patch cord behind furniture and plug into the network port. Patch cords should not interfere with the operator space or electrical cords. (Note: workstation cords are normally installed after placement of office furniture).

3.03 FIELD QUALITY CONTROL – TESTING

A. Note: if permanent link tests are complete, and channel testing is not required in the contract documents, then channel testing after patch cord installation is not required. Proceed with step 'B' below only if channel testing is required in the contract documents.

B. For channel testing, each channel in the horizontal and backbone cabling system shall be identified and tested individually, using an industry standard level III tester with correct settings.

C. Each channel, including patch cord on each end, shall be tested for the parameters listed below.

Wire Map / Continuity	Length	Insertion Loss
NEXT	PSNEXT	ELFEXT
PSELFEXT	Delay and Delay Skew	Return Loss

D. A "PASS" indication shall be obtained for each channel using a level III tester.

END OF SECTION

SECTION 280540
POWER SUPPLIES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes: Power supplies for electronic security.

B. Related Documents: Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

C. Abbreviations:

1. CCTV - Closed Circuit Television
2. DPM – Distributed Power Monitoring
3. FAI - Fire Alarm Interface
4. Hz - Hertz
5. LAN - Local Area Network
6. LFP – Lithium Iron Phosphate
7. PTC - Positive Temperature Coefficient
8. REX – Request to Exit
9. SLA – Sealed Lead Acid
10. SNMP - Simple Network Management Protocol
11. WAN - Wide Area Network
12. VAC – Volts Alternating Current
13. VDC – Volts Direct Current

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product literature showing equipment specifications and installation instructions verifying compliance with this specification. Clearly identify all proposed substitutions, variances, and exceptions.

1. Annotate device cut sheets to indicate the specific equipment models proposed, and all proposed options and accessories.
2. Acceptable means of annotation are highlighting, arrows, drawing boxes, etc.
3. When providing a cut sheet that includes more than one (1) product on the document, highlight each product separately and indicate for each highlighted device the specific specification section reference.

B. Contractor shall not order equipment prior to receipt of approved submittals.

1.4 QUALITY ASSURANCE

A. System Manufacturer shall have a minimum of seven years' experience in the successful manufacture and installation of systems equivalent in function to the system proposed herein.

B. Installation contractor shall be authorized to install the service and maintain the system by the system manufacturer.

C. Source Limitations: Obtain power supplies of the same type from a single manufacturer.

D. All power supply products shall meet the quality assurance requirements including UL 294 and UL 603 listing verification prior to installation.

1.5 WARRANTY

A. Provide a lifetime warranty for all materials.

B. Provide a 1-year warranty on all installation labor.

C. Operation and maintenance documentation for all power supply units—including load calculations, battery backup ratings, and as-installed wiring diagrams—shall be submitted.

PART 2 - PRODUCTS

2.1 GENERAL

A. Furnish each power supply assembly manufactured as an integral unit, complete with all parts and ready for field installation.

B. Power Supplies shall have UL listing marks for the intended categories:

1. UL294 Access Control Systems
2. UL603 Burglar Alarm Power Supplies
3. UL2610 Security Alarm Units and Systems
4. UL1076 Proprietary Burglar Alarm Systems
5. ULCS318 Power Supplies for Burglar Alarm Systems
6. ULCS319 Electronic Access Control Systems
7. EN55032:2015
8. EN55035:2017
9. EN61000-3-2:2014
10. EN61000-3-3:2013
11. CSFM
12. FCC Part 15, Subpart B
13. IEC 62368-1:2014
14. IS13252(Part 1):2010
15. IEC 60950-1:2005
16. NOM-001-SCFI-2018
17. (EC) 1907/2006

18. RoHS 3
19. J62368-1(2020)
20. J55032(H29)
21. AS/NZS CISPR 32:2015 +A1
22. AS/NZS 62368.1:2018

C. Power Supplies shall be Class 2 power limited with correct accessory boards.

2.2 MATERIALS AND FABRICATION

A. Security Power Supplies
1. Power supplies shall be factory assembled and certified systems for various security needs.
2. Power Supply/Charger
a. Smart DC Power Supply/Charger
b. UL Listed
c. Power supplies shall be orderable for each of the following input voltages
1) 100 VAC +/-10%, 50/60Hz
2) 120 VAC +/-10%, 50/60Hz
3) 208 VAC +/-10%, 50/60Hz
4) 230 VAC +/-10%, 50/60Hz
d. Output Voltage:
1) 12VDC or 24VDC
e. Operating temperature: -4°F to 122° (-20°C to 50°C)
f. Battery chemistry supported: SLA or LFP
g. Features:
1) Intelligent battery charging – Controlled constant current charging which guarantees proper charging current for the battery and the fastest charge time without stress or damage to the battery.
2) Proactive Battery testing – Schedule battery load testing remotely and proactively receives battery replacement date alerts
3) Selectable output Voltages – One single switch for configuring the output between 12 and 24VDC.
4) Modular design – Power Supply and accessory board interconnection system uses common mounting footprints, predrilled mounting holes, snap-in standoffs, pluggable wires, and a dual buss distribution architecture to simplify installation and service.
5) Intelligent monitoring – Key power functions are monitored and reported through a PC or browser interface.
6) Environmentally conscious – systems are RoHS compliant, lead-free, and meet the latest state, federal, and European requirements for energy efficiency.
7) Remote main output reset – Allows remote shutdown of the main output voltage to perform a full system reset through the network.

8) Remote AC line monitoring – Watches and reports AC line voltage, with customizable alerts through the network.

9) On-Board Low Battery Disconnect – Automatically disconnects discharged battery sets to prevent deep discharge and protect sensitive electronics.

10) On-Board battery current sensor – Reports the total battery current draw through the network.

11) On-Board output current sensor – Reports the total output current being delivered by the power supply through the network.

3. DC-DC Voltage Regulator

a. A DC voltage regulator can provide an economical second voltage to an access power system.

b. Input Voltage: 12VDC or 24VDC

c. Output Voltage: 12VDC or 5-18V (adjustable)

4. Advanced Power Monitoring

a. Network connected

b. UL Listed

c. Features:

1) Complete visibility of field device power status

2) Proactive remote battery load testing and scheduling

3) Battery state of charge monitoring

4) Battery state of health monitoring

5) Load capacity of power supplies reporting

6) Battery replacement date alerts

7) Predictive failure alerts

8) Remotely scheduled battery testing

d. Capabilities:

1) Power monitoring devices shall support the following functions:

a) RS485 communication to manage multiple modules on one network drop.

b) Current sensor inputs.

c) Volt meter input.

d) Contact monitor input.

e) Temperature sensor input.

f) On-board relays or electronic outputs for controlling and power cycling external equipment.

5. Power Distribution

a. Managed Power Distribution

1) Networked power distribution boards provide remote monitoring and control to previously unmonitored auxiliary devices such as access control panels, readers, and REX devices.

2) Input voltage: 12VDC and/or 24VDC, 20A

3) Output voltage is jumper selectable to either 12VDC or 24VDC when used in a dual-voltage power system.

a) Dual-color LEDs visually indicate voltage levels by output (Green for 12V, Blue for 24V).

b) Each output is network programmable for fire alarm override.

4) Auxiliary device monitoring

a) Allows remote monitoring and control of devices, including access panels, REX devices, and readers.

5) Customizable trigger points on output parameters.

a) Provides real-time alerts on current or impending device or wiring problems.

6) RS485 data connection to allow remote deployment.

7) Temperature sensor

a) Provides environmental data enabling alerts when the product is outside of the customizable optimal data ranges.

8) Switch monitoring inputs

a) Detect and alert when enclosure tamper switches or other switch contacts are disrupted.

9) Multiple fused or Class 2 power-limited outputs.

b. Standard Power Distribution

1) 8 auxiliary power outputs.

2) Input voltage: 12VDC and/or 24VDC.

3) Output voltage is jumper selectable to either 12VDC or 24VDC when used in a dual-voltage power system.

a) Dual-color LEDs visually indicate voltage levels by output (Green for 12V, Blue for 24V).

b) Each output is configurable for fire alarm override in single-voltage applications.

6. Integrated Power

a. Integrated engineered power supply enclosures for various access control platforms.

b. Factory pre-wiring

1) Optional pre-installed wiring harnesses for various access control platforms.

a) Mercury Security

b) Software House

c) Honeywell

d) AMAG

e) HID VertX or Aero

f) Brivo

g) DMP

h) Kisi

i) Salto

j) AXIS

k) Gallagher

l) Kantech

m) Napco

n) ProDataKey (PDK)

o) ZKTeco

p) Alarm.com

q) Accentra

r) Siemens

s) Hirsch (Formerly Identiv)

t) Genetec

u) ICT

v) Schneider Electric

w) Hartmann Controls

x) ButterflyMX

2) Able to be specified by desired power supplies and auxiliary boards.

3) Guarantees uniform installations across an enterprise.

4) Pre-installed wire harness for panel power, lock control, communication, faults, and tamper switch.

5) Point-to-point wiring; labeled, color-coded, twisted pair, shielded communication.

6) Tie Wrap or Panduit cable management.

7) Managed systems monitor power, batteries, and outputs.

8) UL/CUL certified as an integrated access power.

c. Enclosures

1) Options for wall and rack mount enclosures with optional battery shelves.

2) Option for weatherized NEMA enclosure.

(1) Maintenance-free and corrosion-resistant enclosure for exterior applications.

(2) Dimensions: 17”x15”x6.5” (432mm x 381mm x 165mm).

d. Advanced Locking Options

1) Cabinets shall have options for card reader locking with OSDP and Weigand interfaces, along with electromechanical and fully mechanical locking solutions. Locks shall have options for door-status monitoring and include SFIC keyways.

7. Automatic Transfer Switches (ATS)

a. AC module

1) Dual AC inputs for redundant AC power in mission-critical applications.

a) Two independent AC inputs are monitored by the ATS to provide a single AC output.

b) In the event of a failure of the main AC power source, the ATS will automatically switch the output to the backup AC source.

2) 120VAC or 230VAC input, 10A output.

3) Building blocks can be added to power supplies.

b. DC ATS

1) Dual DC inputs for redundant DC power in mission-critical applications.

2) Two identical power supplies are combined in a single enclosure with the ATS to provide a single output voltage. In the event of a failure of the main power source, the ATS will automatically switch the output to the backup power supply.

a) Zero voltage drop or output sag on system switchover.

3) 120VAC or 230VAC input, 12VDC or 24VDC output.

a) Network managed for instant trouble notification via email/snmp.

c. AC ATS PDU

1) Dual AC inputs for redundant AC power in mission-critical applications.

a) The ATS provides eight AC outputs for powering rack-mounted equipment and utilizes a primary and an optional secondary AC input for redundancy.

b) If the primary AC input is compromised, the ATS automatically uses the secondary AC input to power the outputs.120VAC or 230VAC input, 10A output.

2) 120VAC or 230VAC input, 10A output.

3) Secure remote network management of the ATS and its connected devices is possible through a standard web browser.

a) Monitor output parameters such as voltage and current.

b) Remotely power cycling individual outputs.

c) Programmable upper and lower limits for output parameters, environmental monitoring.

d) Able to monitor outside voltages and relay or switch contacts.

8. PoE Devices

a. Midspan injector

1) Provide power and pass data to PoE-compliant devices such as IP cameras, door locks, IR illuminators, and other access control edge devices.

2) 8 and 16-port models.

3) Each port is capable of providing 802.3bt 90W, 500W total PoE budget.

4) Remote management via LAN/WAN.

5) Plug-and-play operation.

6) Remote PoE shutdown per port or all ports simultaneously.

7) 10/100/1000BaseT Gigabit support.

8) Built-in fire alarm connection provides Single-point Fire Interface (SFI) control for PoE Access Control power Supplies.

9) Universal AC input (100-240VAC) for global deployment.

10) Integrated 48V SLA battery charger provides economic backup to all connected PoE devices on an AC failure.

11) 19" rack mountable and 1U in height.

12) UL294 approved.

b. PoE switch

1) Unmanaged PoE switch supports up to eight PoE network devices.

2) Two SFP fiber ports allow high data speeds over long connections.

3) 500 watts total power with up to 90 watts per port (802.3bt compliant).

4) Universal AC input (100-240VAC) for global deployment.

5) Network monitoring for the PoE outputs provides voltage, current, and power measurements, battery and fault status, and allows PoE power cycling remotely for each network port.

6) 10/100/1000BaseT Gigabit support.

7) Single Point Fire Alarm Interface (SFI) provides a fire alarm disconnect to multiple compatible PoE power supply splitters with a single fire alarm connection at the switch.

8) Integrated 48V SLA battery charger provides economic backup to all connected PoE devices on an AC failure.

9) 19" rack mountable and 1U in height.

10) UL294 approved.

c. Access control power extractor splitter

1) Converts PoE to 12VDC and 24VDC for use in access control, surveillance, or other applications.

2) SLA or LFP battery charger.

3) Dual-color LEDs visually indicate voltage levels by output (Green for 12V, Blue for 24V).

4) Onboard low battery disconnect.

5) Shall have a model compatible with the Single Point Fire Alarm Interface (SFI) topology.

a) 50W DC output.

6) Shall have a model that is fully compatible with 802.3bt.

a) 75W DC output.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions are appropriate and satisfactory to accept the equipment and work identified in this section. Do not begin installation until all unsatisfactory conditions have been noted and corrected.

B. Verify all roughing in is completed as shown on Electrical drawings prior to installation of equipment.

C. Inspect all equipment for workmanship features, dimensions, and finishes per the manufacturer’s specification and the procurement order. Verify that the equipment is free from physical defects prior to installation.

3.2 COORDINATION AND PREPARATION

A. Coordinate installation with the work of associated trades. Coordinate the presence of other appropriate low-voltage equipment contractor representatives prior to installation.

B. Conduit routing and raceway installation for power supply branch circuits shall comply with Division 26, unless specifically designated within this Division 28 scope.

C. All conductors, cables, conduits, and raceways associated with power supply output wiring to access control devices shall comply with the common work results specified in Division 27.

D. Power requirements for electric locking hardware—including strikes, maglocks, and electrified exit devices—shall be coordinated with the door hardware schedule in Section 08 06 71 to confirm current draw compatibility with power supply output ratings.

E. Voltage and current specifications for credential readers, REX devices, and electrified hardware shall be reviewed against Section 08 71 00 prior to finalizing power supply load calculations.

F. Power supply output circuits shall be sized and assigned in coordination with the access control system architecture specified in Section 28 15 11, including panel location, device counts, and supervised output requirements.

3.3 INSTALLATION

A. Comply with all the manufacturer’s written installation instructions, unless more stringent requirements are indicated. Notify the owner in writing of all conflicts between construction documents and written manufacturer’s requirements. Resolve all conflicts prior to installation.

B. If required, the installation environment shall be verified for protection from excessive heat, water, or temperature to ensure reduction of internal housing temperatures.

C. Install all equipment plumb and true at locations shown on the Drawings.

D. Equipment grounding and bonding for power supply enclosures and associated metallic components shall conform to the requirements of Division 26.

E. Dedicated circuit breaker protection for each power supply unit shall be coordinated with the panelboard schedule specified in Division 26 prior to installation.

F. Where a facility-level UPS is specified under Division 26, coordination with the power supply unit’s onboard battery backup shall be verified to avoid redundant or conflicting secondary power sources.

G. Low-voltage wiring pathways from power supply output terminals to downstream access control hardware shall be installed per Division 27, unless otherwise detailed on security drawings.

H. Where power supply units supply power to dual-listed or fire alarm-adjacent devices, installation shall not conflict with fire alarm circuit requirements specified in Division 28 and applicable NFPA 72 provisions.

3.4 CONFIGURATION

A. Configure all features and options in accordance with the drawings and details and with approved submittals.

3.5 ADJUSTING

A. Adjust equipment after installation for proper operation.

B. Complete all required adjustments prior to commencing cleaning, training, or testing.

3.6 CLEANING

A. After completing equipment installation, inspect all components. Remove spots, dirt, and debris. Repair damaged finishes or replace materials and components to match the original finish.

3.7 TESTING

A. Conduct full testing of the proper operation of the equipment and document test results.

1. Verify compliance with each functional and technical requirement defined in the drawings and details.

B. Attend and assist with Owner verification testing.

3.8 CLOSE OUT

A. Provide all Record Drawings and close out documentation required in the general requirements.

B. Operation and maintenance documentation for all power supply units—including load calculations, battery backup ratings, and as-installed wiring diagrams—shall be submitted.

END OF SECTION 28 0540

SECTION 281511
ACCESS CONTROL

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes: Integrated physical access control field devices including standard proximity/smartcard readers, PIN keypads, and matching entry accessories

1.3 SUBMITTALS

A. Product Data: Manufacturer's technical data sheets, electrical requirements, and installation templates for each device type.

B. Shop Drawings: Wiring diagrams illustrating point-to-point connections between readers, door controllers, locks, and power supplies.

C. As-Built Documentation: Record drawings indicating final device locations, unique internal device IDs, addresses, and physical port assignment

1.4 QUALITY ASSURANCE

A. System Manufacturer shall have a minimum of seven years’ experience in the successful manufacture and installation of systems equivalent in function to the system proposed herein.

B. Installation contractor shall be authorized to install the service and maintain the system by the system manufacturer.

1.5 WARRANTY

A. Provide a 1-year warranty for all materials covering defects in materials and workmanship under normal use.

B. Provide a 1-year warranty on all installation labor.

C. Operation and maintenance documentation for all units shall be submitted.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Access control card readers shall be as manufactured by a global company who is a recognized leader in the production of access control devices. Card readers manufactured for non-access control applications shall not be acceptable.

B. Substitutions: No substitutions allowed. Provide specified systems that integrate into the university student one-card system.

2.02 ACCESS CONTROL CARD READER

A. Read only multi-technology contactless smart card and Mobile ID reader

1. The multi-technology contactless smart card reader(s) shall be designed to securely read, interpret, and authenticate access control data from 2.4 GHz mobile devices, 13.56 MHz contactless smart card credentials and 125 kHz proximity cards.

2. The multi-technology contactless smart card reader shall be optimally designed for use in access control applications by providing:

    a. Customized security protection through support of the device-independent Secure Identity Object™ (SIO) portable credential methodology to provide enhanced security and performance features.

    b. Unique read selection that enables reading of the Secure Identity Object™ (SIO), standard iCLASS, 125 kHz proximity, or multiple technologies at the same time.

    c. Participates in an advanced, bounded and trust-based security system utilizing the Trusted Identity Platform™ (TIP) architecture.

    d. A migration platform to upgrade from the most popular 125 kHz proximity technologies to SIO on iCLASS Seos smart cards and Mobile IDs by reading, when the base reader is so properly equipped, both 125 kHz proximity technology and 13.56 MHz contactless smart card technology, NFC and 2.4GHz Bluetooth Smart technology.

    e. Guaranteed compatibility to read all HID data formats and ensuring card-to-reader interoperability in multi-location installations and multi-card and reader populations when used with Genuine HID products.

    f. Backwards compatibility with legacy 13.56 MHz contactless smart card and 125 kHz proximity access control formats (e.g., 26-bit, 32-bit, 35-bit, 37-bit, 56-bit, and HID Corporate 1000 formats). Compatibility across the product line shall be assured without the need of special programming.

    g. Global, off-the-shelf availability.

    h. Enables secure access with a mobile device by leveraging standard communication technologies that work with both iOS® and Android™ operating systems. Including validation of support with at minimum 15 different mobile device models.

    i. Enhances the transactional experience by opening doors with a “Tap” or “Twist and Go” gesture, merging security with convenience. Including ability to configure the read range and interaction mode via mobile device app.

    j. Simultaneously, when the base reader is so properly equipped, support of BLE Mobile Devices, NFC Mobile Devices and 13.56MHz and 125kHz contactless credentials. Supporting new Mobile IDs and existing card populations for seamless migration to a more secure standard.

    k. Reader can be purchased as “mobile-ready” to be installed in preparation for moving to mobile at a later time. Once user decides to move to mobile, the reader can be configured for the user specific requirements.

l. No special system modifications are required to read mobile credentials. Existing Wiegand readers can easily be replaced and work with existing access control panel hardware.

m. The multi-technology contactless smart card reader may optionally have BAA/TAA compliance in accordance with reading, processing, and procurement to satisfy HSPD-12 and FIPS-201 requirements.

3. The multi-technology contactless smart card reader shall provide enhanced security technology and features.

a. The multi-technology contactless smart card reader shall be Secure Identity Object™ (SIO) enabled. The multi-technology contactless smart card reader platform shall support the standards-based, device-independent Security Identity Object™ (SIO) portable credential that binds the credential to the physical media to ensure data authenticity and privacy. The SIO shall be able to reside on any number of identity devices, including Mobile ID, iCLASS Seos, iCLASS SE, iCLASS SR, MIFARE Classic, MIFARE DESFire EV1/EV2/EV3, and optionally PIV credentials.

b. The multi-technology contactless smart card reader shall be a certified end-point (TIP Node) within a Trusted Identity Platform™ (TIP) infrastructure. TIP shall provide a scalable, on-demand, secure identity delivery system that validates, registers and provides lifecycle management support for certified trusted end-point multi-technology contactless smart card readers.

c. The multi-technology contactless smart card reader shall increase security by narrowing the possibility of unwanted configuration changes and denials of service. The multi-technology contactless smart card reader shall utilize TIP-enabled secure configuration of multi-technology contactless smart card readers with counters and uniquely diversified configuration cards.

d. The multi-technology contactless smart card reader shall utilize Secure Element Technology™ to protect keys and cryptographic functions, minimally, to the international standard Evaluation Assurance Level of EAL 5+.

e. The multi-technology contactless smart card reader shall be configurable to utilize Velocity Checking to provide breach resistance against electronic attacks that invoke multiple improper authentication attempts.

f. The multi-technology contactless smart card reader shall be configurable to provide multiple hierarchical degrees of key compatibility for accessing the smart card access control data. Compatibility shall be provided for the following key structure options:

1. Compatibility with the standard SIO and iCLASS access control application data model to ensure convenient off the shelf compatibility with Mobile IDs, iCLASS Seos, iCLASS SE, and iCLASS credentials.
2. Compatibility with higher security SE Elite credential programming that uniquely assigns a reader and credential keyset that provides site-specific security.

g. The multi-technology contactless smart card reader shall have a unique electronic serial number.

h. The multi-technology contactless smart card reader reads Mobile IDs powered by the Seos standard based software application or applet

technology. Seos technology is independent of communication medium (e.g., 13.56Mhz ISO14443A or 2.4HGz BLE) allowing for a unified security platform across credentials using BLE, NFC and contactless smart card credentials.

4. The multi-technology contactless smart card reader shall provide enhanced usability features.

    a. The multi-technology contactless smart card reader shall simplify troubleshooting through Anti-passback Notification that the card has already been processed and it must be removed from reader field temporarily prior to processing again.

    b. The multi-technology contactless smart card reader shall provide enhanced user feedback options through the use of clear and bright tri-colored LEDs configurable to support any three color combinations (RGB - Red, Green, and Blue).

    c. The multi-technology contactless smart card reader shall enable ease of installation through identical wiring methods as legacy 13.56MHz and 125 kHz proximity readers.

    d. The multi-technology contactless smart card reader shall enable backwards compatibility with legacy 13.56 MHz and 125 kHz proximity access control formats (e.g., 26-bit, 32-bit, 35-bit, 37-bit, 56-bit, and HID Corporate 1000 formats).

    e. The multi-technology contactless smart card reader manufacturer shall provide a full product line of compatible products including readers, readers with integral keypads, credentials and cards without the need of special programming.

    f. The multi-technology contactless smart card reader manufacturer shall provide global, off-the-shelf availability.

    g. The multi-technology contactless smart card reader shall provide universal compatibility with most access control systems by outputting card data in compliance with the SIA AC-01 Wiegand standard.

    h. Multi-technology contactless smart card reader shall be configurable to provide secure, bidirectional communication in compliance with v2 of the SIA OSDP (Open Supervised Device Protocol) standard.

    i. Multi-technology contactless smart card keypad reader shall allow the reader firmware to be upgraded in the field to face security threats and enable the potential read of future credential technologies. Both firmware and configuration updates shall be executed via a secure channel created between HID Origo enabled utilities/applications and the reader secure element.

    j. Multi-technology contactless smart card reader shall allow for secure installation practices through mounting methods utilizing tamper resistant screws.

    k. Multi-technology contactless smart card reader shall provide the ability to transmit an alarm signal via and integrated tamper relay if an attempt is made to remove the reader from the wall. The tamper function shall be programmable to provide a selectable action compatible with various

tamper communication schemes provided by access control panel manufacturers. The selectable action shall include one of the following:

1. The reader tamper line changes from a closed state to an open state.
2. During a tamper state, the “I’m Alive” message is inverted.

.

l. Multi-technology contactless smart card reader shall provide ability of an on-line “I’m Alive” message so the reader’s functional health can be monitored at all times when paired with a compatible access control panel.

m. The multi-technology contactless smart card reader shall provide customizable reader behavior options either from the factory, or defined in the field through the use of pre-configured commands. Reader behavior programming options shall include:

1. Audio/Visual Templates for card reads, proximity enabled, and attack detection.
2. Velocity Check timing and thresholds
3. 125 kHz ASK, FSK and PSK configurations and outputs
4. Tamper actions
5. RF scan delay
6. Hold Mode
7. Intelligent Power Management
8. Key diversifiers
9. Key rolling
10. CSN output configuration
11. Data Model prioritization
12. Default LED color

n. Multi-technology contactless smart card reader shall provide the following programmable audio/visual indication:

1. An audio beeper shall provide various tone sequences to signify the following: access granted, access denied, power up, and diagnostics.
2. A high-intensity red/green/blue (RGB) light bar shall provide clear visual status. The light bar shall provide uniform distribution of light eliminating individual bright spots.

o. Multi-technology contactless smart card reader shall provide the ability for mounting to standard electrical boxes through the use of universal international mounting holes.

p. Multi-technology contactless smart card reader shall be designed to accept hardware expansion modules that add processing power or communication functionalities.

q. Multi-technology contactless smart card reader will support BLE communication to Mobile Access Configuration Mobile Application running on iOS and Android devices. This will enable the following features.
1. Bluetooth communication Controller Firmware version identification.
2. Bluetooth communication Controller Firmware update.
3. Mobile ID Application Brand configuration: HID Global or ASSA ABLOY.
4. Reader operation modes configuration: “Tap” OR “Twist and Go” OR “Tap” and “Twist and Go”.
5. Mobile Range and Power Setting configuration for following settings: Tap Range, Twist and Go Range, or Transmit Power
6. Mobile Configuration options can be configured without power cycling reader

7. Mobile Configuration options can only be modified with secure element based Mobile Admin Card authentication with reader.

r. Multi-technology contactless smart card reader must support Bluetooth communication to Mobile Device credential. This communication must use Bluetooth Low Energy (BLE) communication and not require pairing with mobile devices.

s. Multi-technology contactless smart card reader must support NFC communication card emulation mode. This communication must only occur with credentials stored via Host Card Emulation or a Secure Element in the mobile device. This communication must not occur via NFC peer-to-peer or Reader/Writer mode.

t. Multi-technology contactless smart card reader must support, by default, Apple's Enhanced Contactless Polling(ECP) to support credentials in the Apple Wallet, and support for credentials in Google Wallet.

u. Multi-technology contactless smart card reader must support being connected and managed in a modern ecosystem to allow for control and administration of reader configuration, reader updates and functionality upgrades.

v. Multi-technology contactless smart card reader must support the following 2 modes of interaction with BLE credentials:
   1. Tap Mode: The mobile device must be brought very close to or touching the reader (a similar user experience to that observed using Prox cards)
   2. Twist and Go: The mobile device holder must initiate the read by twisting the mobile device in using a sharp 90° rotation in either direction.

5. Multi-technology contactless smart card readers shall provide the following enhanced performance features:

   a. The multi-technology contactless smart card reader shall provide built-in support, when the base reader is so properly equipped, for 125 kHz proximity FSK (HID Proximity, AWID), PSK (Indala), and ASK (EM4102) 125 kHz technology to increase credential technology migration options.

   b. The multi-technology contactless smart card reader shall enable user prioritization of High-frequency/High-frequency and High-frequency/Low-frequency credential reads. Technology prioritization shall synchronize a site's credential technology read priority to the access panel configuration while reducing unintended credential reads.

   c. The multi-technology contactless smart card reader shall have the ability to provide consistent optimal read range by implementing an auto-tune surface detection function that adjusts for mounting environment and manufacturing tolerances to enhance consistency of read performance.

   d. The multi-technology contactless smart card reader shall be field programmable to provide secure upgrades for migration and extended lifecycle.

e. The multi-technology contactless smart card reader shall be designed as a system to provide optimal read range and read speed for increased access control throughput.

f. The multi-technology contactless smart card reader firmware shall be based on Common Language Infrastructure implemented by a .NET virtual machine complying to ECMA-335 standard. This virtual machine shall execute applications stored in a library. Applications that execute on this virtual machine shall be implemented or revoked without modification of the underlying firmware.

g. The multi-technology contactless smart card reader must have spacer available as optional accessory from reader manufacturer to space reader away from metallic surfaces and reduce the impact the metal will have on read range, and/or the optional spacer accessory may be used for flush mount installation.

h. The multi-technology contactless smart card reader utilizes directional BLE antenna enabling long range reading distances of up to 6.6’ in correct orientation – in front of the reader and not behind it.

6. Multi-technology contactless smart card reader shall provide enhanced environmental and sustainability features, including but not limited to:

    a. The multi-technology contactless smart card reader shall reduce power consumption by as much as 50% through the use of Intelligent Power Management (IPM) technology.

    b. Multi-technology contactless smart card reader shall be fully compliant with Restriction of Hazardous Substances directive (RoHS) restricting the use of specific hazardous materials found in electrical and electronic products. The substances banned under RoHS are lead (Pb), mercury (Hg), cadmium (Cd), hexavalent chromium (CrVI), polybrominated biphenyls (PBB) and polybrominated diphenyl ethers (PBDE).

7. Multi-technology contactless smart card reader shall comply with the following 13.56MHz-related standards to ensure product compatibility and predictability of performance:

    a. ISO 15693

    b. ISO 14443A

    c. Sony FeliCa and contactless ePurse Applications (CEPAS)

8. Multi-technology contactless smart card reader shall implement the following high security 2.4 GHz and 13.56 MHz applications out-of-box.

    a. Secure Identity Object on Mobile Devices

    b. Secure Identity Object on iCLASS Seos

    c. Secure Identity Object on iCLASS SE

    d. Secure Identity Object on iCLASS SR

    e. Secure Identity Object on MIFARE Classic

f. Secure Identity Object on MIFARE DESFire EV1 / EV2 / EV3

9. Multi-technology contactless smart card reader shall be suitable for global deployment by meeting worldwide radio regulatory, safety regulatory, and environmental ratings including:

    a. UL294 (US)

    b. cUL (Canada)

    c. FCC Certification (US)

    d. IC (Canada)

    e. CE (EU)

    f. RCM (Australia, New Zealand)

    g. SRRC (China)

    h. KCC (Korea)

    i. NCC (Taiwan)

    j. iDA (Singapore)

    k. RoHS

    l. MIC (Japan)

    m. GreenCircle

    n. Bluetooth SIG certification

10. Multi-technology contactless smart card reader shall be provided with a full enclosed assembly.

11. Multi-technology contactless smart card reader shall provide the following typical Mobile ID read ranges:

    a. 6.6’ (2m) reading twist and go SIO on Mobile ID using Bluetooth & Seos

    b. 5.9” (15cm) reading tap SIO on Mobile ID using Bluetooth & Seos

    c. 1.0” (2.5 cm) reading Mobile ID using NFC

12. Multi-technology contactless smart card reader shall provide the following typical contactless read ranges:

    a. Up to 1.6” to 4” (4 to 10 cm) Seos®, MIFARE Classic, MIFARE DESFire EV1/EV2/EV3 & ISO14443A Single Technology Cards

    b. Up to 2.8” to 6” (7 to 15 cm) iCLASS SE®, iCLASS SR®, iCLASS & ISO15693 Single Technology Cards

    c. Up to 2.4” to 4” (6 to 10 cm) HID / AWID Proximity® EM Proximity & 125kHz Single technology cards

13. Multi-technology contactless smart card reader shall be designed for low current operation to enable contactless smart card migration from most legacy proximity applications without the need to replace existing access control panels and/or power supplies. Contactless smart card power requirements shall be:

    a. Operating voltage: 12 VDC, reverse voltage protected. Linear power supply recommended.

    b. Current requirements and power consumption:

        1. 65 mA (Normal Standby Current)
        2. 250 mA (Peak Current Draw)

14. Multi-technology contactless smart card reader shall meet the following physical specifications:

    a. Dimensions : 3.15 x 4.78 x 0.77 (79.9 mm x 121.5 mm x 19.5mm)

    b. Weight: 4.94 oz (140g) Pigtail and 4.23 oz (120g) Terminal

    c. Material: UL94 Polycarbonate

    d. Plastics: Consist of two-piece design with mounting plate and either separate front bezel and reader body (totaling three-pieces) or combined front bezel/reader body (totaling two-pieces).

    e. Color: Black or White Bezel with Silver Trim baseplate. Black Trim baseplate is available as an additional accessory item.

15. Multi-technology contactless smart card reader shall meet the following environmental specifications:

    a. Operating temperature: -31°F to +150°F (-35°C to +66°C)

    b. Operating humidity: 0% to 95% Non-Condensing

    c. Storage Temperature: -40°F to +185°F (-40°C to +85°C)

    d. Weatherized design suitable to withstand harsh environments with a rating of IP65 per IP Code of International Electrotechnical Commission.

16. Multi-technology contactless smart card reader cabling requirements shall be:

    a. Cable distance:
        1. Wiegand or Clock & Data: 500 feet (150m)
        2. RS-485 (OSDP): 4000 feet (1200m)

    b. Cable type:
        1. Wiegand or Clock & Data: 5-conductor #22 AWG
        2. RS-485 (OSDP): 4-conductor #24 AWG

    c. Standard reader termination: 18” (0.5m) cable pigtail

    d. Optional reader termination: terminal strip

17. The multi-technology smart card reader shall be provisioned through secure connections utilizing Trusted Identity Platform™ Secure Delivery Infrastructure (SDI)

where all cryptographic keys governing system security are delivered with end-to-end privacy and integrity.

18. The multi-technology contactless smart card reader shall provide a lifetime warranty against defects in materials and workmanship.

19. Multi-technology contactless smart card reader shall be HID Global Signo 40 reader, base part number: 40NKS, 40TKS, 40HNKS, 40HTKS, 40NKWS, or 40TWS.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify site conditions are appropriate and satisfactory to accept the equipment and work identified in this section. Do not begin installation until all unsatisfactory conditions have been noted and corrected.

B. Verify all roughing in is completed as shown on Electrical drawings prior to installation of equipment.

C. Inspect all equipment for workmanship features, dimensions, and finishes per the manufacturer's specification and the procurement order. Verify that the equipment is free from physical defects prior to installation.

3.2 COORDINATION AND PREPARATION

A. Coordinate installation with the work of associated trades. Coordinate the presence of other appropriate low-voltage equipment contractor representatives prior to installation.

B. Conduit routing and raceway installation for power supply branch circuits shall comply with Division 26, unless specifically designated within this Division 28 scope.

C. All conductors, cables, conduits, and raceways associated with power supply output wiring to access control devices shall comply with the common work results specified in Division 27.

D. Power requirements for electric locking hardware—including strikes, maglocks, and electrified exit devices—shall be coordinated with the door hardware schedule in Section 08 06 71.

3.3 INSTALLATION

A. Comply with all the manufacturer's written installation instructions, unless more stringent requirements are indicated. Notify the owner in writing of all conflicts between construction documents and written manufacturer's requirements. Resolve all conflicts prior to installation.

B. If required, the installation environment shall be verified for protection from excessive heat, water, or temperature to ensure reduction of internal housing temperatures.

C. Install all equipment plumb and true at locations shown on the Drawings.

D. Low-voltage wiring pathways from power supply output terminals to downstream access control hardware shall be installed per Division 27, unless otherwise detailed on security drawings.

E. Isolation: Use specialized insulating spacers or mounting brackets when anchoring readers directly onto metallic surfaces or storefront aluminum frames to eliminate RF signal attenuation.

F. Tamper Protection: Connect the reader's internal optical tamper switches to an un-bypassable supervisory monitor circuit on the regional field interface panel.

G. Cabling Standards: Run dedicated, overall-shielded, twisted-pair cable (minimum 22 AWG) between field readers and controllers.

H. Separation: Enforce a minimum separation of 12 inches from parallel high-voltage AC electrical lines to avoid electromagnetic interference.

I. Grounding: Terminate the cable drain shield wire strictly at the controller end of the line to prevent localized ground loop distortion.

3.4 CONFIGURATION

A. Configure all features and options in accordance with the drawings and details and with approved submittals.

3.5 ADJUSTING

A. Adjust equipment after installation for proper operation.

B. Complete all required adjustments prior to commencing cleaning, training, or testing.

C. Functional Matrix: Validate every reader for rapid credential response time (under 500 milliseconds), audio-visual feedback indicators, and immediate entry rejection processing.

D. Offline Fail-Safe Execution: Verify that field entry hardware properly retains local database authorization storage, executing distributed access privileges flawlessly if network connectivity to the central host server is broken.

E. Life Safety Interface: Test all designated emergency exit doors to ensure integrated field lock control drops power instantly upon fire alarm relay activation.

3.6 CLEANING

A. After completing equipment installation, inspect all components. Remove spots, dirt, and debris. Repair damaged finishes or replace materials and components to match the original finish.

3.7 TESTING

A. Conduct full testing of the proper operation of the equipment and document test results.

1. Verify compliance with each functional and technical requirement defined in the drawings and details.

B. Attend and assist with Owner verification testing.

3.8 CLOSE OUT

A. Operator Training: Provide dedicated field training to owner-designated technicians covering physical swap procedures, cleaning schedules, and diagnostic light code analysis.

B. Provide all Record Drawings, maintenance documentation and close out documentation required in the general requirements.

END OF SECTION 28 1511

SECTION 282300

VIDEO SURVEILLANCE

PART 1 – GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 SYSTEM DESCRIPTION

A. General Requirements

1. The specified products shall be of manufacturer's official product line, designed for commercial and/or industrial 24/7/365 use.
2. The specified products shall be based upon standard components and proven technology using open and published protocols.

1.03 QUALITY ASSURANCE

A. The contractor or security sub-contractor shall be a licensed security Contractor with a minimum of five (5) years' experience installing and servicing systems of similar scope and complexity and evidence that is completed at least three (3) projects of similar design and is currently engaged in the installation and maintenance of systems herein described.

B. All installation, configuration, setup, program and related work shall be performed by electronic technicians thoroughly trained by the manufacturer in the installation and service of the equipment provided.

C. The contractor or designated sub-contractor shall submit credentials of completed manufacturer certification, verified by a third-party organization, as proof of the knowledge.

D. All installation shall be performed by technicians carrying installation certificates meeting the safety/license/bonding requirementKs for the site.

E. The specified products shall be manufactured in accordance with ISO9001.

1.04 WARRANTY

A. The manufacturer shall provide a five (5) year limited hardware warranty for product that is free from defects in design, workmanship and materials under substantiated normal use. Defective products under the warranty period will be either repaired or replaced by the manufacturer.

1.05 SOFTWARE UPGRADES

A. The manufacturer shall provide free upgrades to new software releases within the same major version for the lifetime of the version.

B. The software shall be backed by free support for the lifetime of the version.

PART 2 – PRODUCTS

2.01 GENERAL

A. The specified products shall be IP-based and comply with established network and video standards.

B. The specified products shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third-party applications.

C. The specified products shall be powered by the switch utilizing the network cable. Power injectors (midspans) shall be provided by the contractor when required for proper operation.

D. The video management system shall support integration with compatible devices that are compliant with relevant parts of IEC 62676-2-3.

E. Any further accessories to the specified products shall be provided by the contractor when

required for proper operation.

F. Available Manufacturers: The manufacturers and their associated catalog numbers herein specified constitute the material and desired operating features that are to be furnished. Subject to compliance with requirements, other manufacturers offering similar products may be incorporated in the Work as approved by Professional.

2.02 VIDEO SURVEILLANCE SCHEDULE

A. The product or product types listed below describing various resolutions, form-factor and features shall be supplied by a single manufacturer for video surveillance system.

B. The product name and model numbers will be as follows:

1. The access control network panel shall be an AXIS A1610 Network door controller
2. Generic touch-free reader shall be AXIS A4020-E
3. Flexible network video intercom with deep learning shall be AXIS I8116-E
4. Fixed 2 MP network outdoor dome camera shall be AXIS P3265–LVE
5. 7 MP panoramic camera with 180° coverage shall be AXIS P3827–PVE
6. Dual-sensor panoramic camera shall be AXIS P4707–PLVE
7. All-in-one recorder with PoE switch for UHD surveillance shall be AXIS Camera Station S2224 Appliance

2.03 VIDEO SURVEILLANCE PRODUCTS

A. Network door controller

1. The access control network panel shall meet or exceed the following design specifications:
    a. The network door controller shall be a fully functional stand-alone door network door controller, supporting two readers, REX-buttons, auxiliary and external I/Os (break and emergency), door position sensors and door looks.
    b. The network door controller shall operate on an open source; Linux-based platform, include a built-in web server and be equipped with a standard Ethernet-port for remote access and control.
    c. The network door controller casing shall be:
        1) Designed for DIN rail and wall-mount.
        2) Be fitted with tamper detection
        3) Equipped with detachable color-coded connectors for reader, I/O door inputs, relay outputs, auxiliary functions and external inputs.
    d. The network door controller shall support up to 4x OSDP, or 2x Wiegand, readers and supported interfaces shall include:
        1) Wiegand
        2) RS485 (OSDP)
        3) OSDP Secure Channel
    e. The network door controller shall be plenum rated.
2. The access control network panel shall meet or exceed the following performance specifications:
    a. Credentials
        1) Store up to 250 000 defined cardholders.
            a) Utilize both central processing and true distributed processing technology.
            b) Local processing stores cardholder data, access groups, time zones, input and output information in network door controller RAM.

c) Distributed processing shall take over the functions of making access decisions, controlling doors, monitoring alarms, activating relays and performing the functions of remote control and time activated actions.

b. Door control functionality

1) The network door controller shall support multifactor authentication.

2) The network door controller shall provide correct response within no more than 1 second of presenting a defined credential.

3) The network door controller shall support individually adjustable shunt times for each door.

c. User Interface

1) Web server

a) The network door controller shall contain a built-in web server making hardware configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.

b) Optional components downloaded from the network door controller for specific tasks shall be signed by an organization providing digital trust services.

2) Language Specification

a) The network door controller shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.

3) IP addresses

a) The network door controller shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.

b) The network door controller shall allow for automatic detection of the Network door controller based on UPnP and Bonjour when using a computer with an operating system supporting this feature.

c) The network door controller shall provide support both for IPv4 and IPv6.

d) The network door controller shall provide support for IPv6 USGv6.

d. Event functionality

1) The network door controller shall hold a history of the last 100.000 events (first in, first out).

2) The network door controller shall be equipped with an integrated event functionality, which can be triggered by:

a) Tamper detection (Removal of unit cover/tamper front; reader tampering; tilting, vibration)

b) Power loss

c) Network loss

d) Changes in the unit’s configuration

e) Door

f) Event logger

g) Hardware

h) Input signal

i) Schedule

j) System

k) Time

l) Virtual inputs through API

3) Response to triggers shall include event actions:

a) Send notification, using email, HTTP, HTTPS, TCP and SNMP trap

b) External output activation

c) Displaying status LED

4) Event functions can be configurable via the web interface.

5) The network door controller shall be able to respond to triggers from other products on the same network, and be able to generate response in other products as a result of a triggered event.

e. Protocol

1) The network door controller shall incorporate support for at least IPv4, IPv6 USGv6, ICMPv4/ICMPv6, HTTP, HTTPS, HTTP/2, TLS, QoS Layer 3 DiffServ, SFTP, CIFS/SMB, SMTP, mDNS (Bonjour), UPnP, SNMP v1/v2c/v3 (MIB-II), DNS/DNSv6, DDNS, NTP, NTS, RTSP, RTCP, RTP, SRTP, TCP, UDP, IGMPv1/v2/v3, DHCPv4/v6, ARP, SSH, NTCIP, SIP, LLDP, CDP, MQTT v3.1.1, Syslog, Link-Local address (ZeroConf).

2) The SMTP implementation shall include support for SMTP authentication.

f. Time and Date

1) To ensure accuracy, the network door controller shall accept external time synchronization from an NTP (Network Time Protocol) server.

2) The network door controller shall support the definition of holidays/exception-days in the calendar configured through a third-party software.

3) The network door controller shall support time schedules to be defined by a third-party software, only limited in number by the network door controllers' total memory usage.

g. Security

1) The network door controller shall support the use of HTTPS and TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication.

2) All communication between network door controller and the access control application shall be done using at least 256-bit AES encryption.

3) The network door controller shall support IEEE 802.1X authentication.

4) The network door controller shall provide support for restricting access to pre-defined IP addresses only, so-called IP address filtering.

5) The network door controller shall restrict access to the built-in web server by usernames and passwords.

h. System integration

1) The network door controller shall be fully supported by an open and published API, which shall provide necessary information for integration of functionality into third-party applications.

2) The camera shall conform to ONVIF profile A as defined by the ONVIF Organization.

3) The camera shall conform to ONVIF profile C as defined by the ONVIF Organization.

i. Installation and maintenance

1) The network door controller shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware of the network door controller.

2) The network door controller shall contain a built-in web server making hardware configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.

3) The network door controller shall support the use of SNMP-based management tools according to SNMP v1, 2c, 3 / MIB-II.

4) The network door controller shall allow updates of the software (firmware) over the network, using FTP or HTTP.

5) The network door controller shall accept external time synchronization from an NTP (Network Time Protocol) server.

6) The network door controller shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.

j. Access log

1) The network door controller shall provide an event history of the last 250 000 events, stored locally in the unit. Such transaction history shall be automatically uploaded to the server once communication has been restored.

2) The network door controller shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.

k. Network door controller diagnostics

1) The network door controller shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the network door controller's operational status and provide information about communication with receiver, the network status and the network door controller status.

2) The network door controller shall be equipped with LED, capable of indicating over-current protection.

3) The network door controller shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.

4) The network door controller shall through its web interface and API provide the current status of all inputs and outputs, and provide an ability to force-control outputs for test purpose.

l. Hardware interfaces

1) Door status inputs

a) The network door controller shall through color-coded detachable terminals be equipped with four (4) door inputs.

b) The network door controller shall through color-coded detachable terminals be equipped with two (2) form C relays for lock control, with the possibility to source with 12 or 24 V from the network door controller or sourcing from external power supply/dry contact.

c) The network door controller shall through color-coded detachable terminals be equipped with four (4) configurable inputs/outputs for auxiliary equipment and two (2) configurable input/output for external equipment, supporting max 30 V DC.

2) Readers

a) The network door controller shall through color-coded detachable terminal blocks be able to support two wired readers, either communicating using a Wiegand interface or a OSDP over RS-485 half-duplex.

3) Inputs/Outputs

a) The network door controller shall through detachable terminal blocks provide:

1)) Six ports that can either be configured as digital (alarm) inputs or digital outputs, supporting max 30 V DC. When used as input, it should be configured to respond to normally open (NO) or normally closed (NC) dry contacts.

2)) All alarm points shall be individually annunciated upon any change of state. Alarm contacts shall not be connected in parallel or series in zones, unless specifically shown on the contract drawings or stated herein. Double doors with alarm contacts on each leaf of the double door unit may be wired in series, for that double door unit.

4) Network interface

a) The network door controller shall be equipped with one 10BASE-T/100BASE-TX Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed and transfer mode (full and half duplex).

m. Enclosure

1) The network door controller shall be manufactured with a repaintable aluminum enclosure and be fitted with tamper switchers and concealable cable entries.

n. Power

1) The network door controller shall have the following power requirements

a) 10,5–28 V DC, max 36 W

b) Power over Ethernet (PoE) IEEE 802.3at Type 2 Class 4

c) 12 V DC as backup

2) The network door controller shall be able to provide the following power to doors and accessories

a) 2x relay NO/NC, max 2 A DC for accessories and relays

b) 2x 12/24 V DC, max 24 W for door lock

3) The network door controller shall, when operating on DC-power, be able to provide 1800 mA at 12 V to connected devices.

4) The network door controller shall, when operating via PoE Class 4, be able to provide 900 mA at 12 V to connected devices.

5) The network door controller shall be able to rely on a separate battery power input without manual intervention when the primary power source fails.

o. Environmental

1) Operate in a temperature range of -40º C to 55º C (-40º F to 131º F).

2) Operate in a humidity range of 20–85% RH (non-condensing).

B. Generic touch-free reader

1. The specified product shall meet or exceed the following design specifications:

a. The reader shall be manufactured with an IP65 and NEMA 4X-rated, IK07 plastic casing.

b. The reader shall be equipped with an RS-485 - OSDP port for communication with controllers.

c. The reader shall be equipped with LED indicators for status information.

2. The specified product shall meet or exceed the following performance specifications:
   a. Reading technology
      1) The reader shall support the following generic 13.56 Mhz reading technologies:
         a) MIARE Classic
         b) MIFARE Plus (Level 1)
         c) MIFARE DESFire EV1 and EV2
      2) The reader shall support a reading distance of at least 30-40 mm.
   b. Reader functionality
      1) The reader shall support the following forms of authentication:
         a) Card/tag
            1)) Access granted
            2)) Access denied
         b) The reader shall provide the following visual status information:
            1)) RGB LED
            2)) Buzzer
   c. Protocol
      1) The reader shall incorporate support for at least Open supervised device protocol (OSDP).
   d. Security
      1) The reader shall support the following:
         a) EAL 6+ Certified Secure Element Hardware
         b) Built-in tamper switch for detecting both open casing and removal from wall
      2) Firmware support
         a) The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.
         b) The device should maintain high-level cybersecurity without introducing any significant functional changes or affecting any existing integrations.
   e. Hardware interfaces
      1) The reader shall be equipped with a 4-pin 26-18 AWG terminal block, providing power and one RS-485 serial port to the controller.
   f. Enclosure
      1) The camera shall:
         a) Be manufactured with an IP65 and NEMA 4X-rated, IK07 plastic casing, hard-coated scratch- and impact-resistant front.
   g. Power
      1) The reader shall utilize
         a) 12-24 V DC
   h. Environmental
      1) The reader shall:
         a) Operate in a temperature range of -30 ºC to 65 ºC (-22 ºF to 149 ºF)
         b) Operate in a humidity range of 10-100% RH (condensing).

C. Fixed 2 MP network outdoor dome camera

1. The specified product shall meet or exceed the following design specifications:
    a. The camera shall operate on an open source and Linux-based platform, and include a built-in web server.
    b. The camera shall provide a removable IR-cut filter, providing day/night functionality.
    c. The camera shall be equipped with:
        1) A varifocal 3.4–8.9 mm, IR-corrected megapixel lens with P-Iris and a 2 MP image sensor (9 mm model).
        2) A varifocal 9–22 mm, IR-corrected megapixel lens with P-Iris and a 2 MP image sensor (22 mm model).
    d. The camera shall provide:
        1) A horizontal field of view between 100° and 36° and a vertical field of view between 53° and 20° (9 mm model).
        2) A horizontal field of view between 35° and 15° and a vertical field of view between 19° and 9° (22 mm model).
    e. The camera shall provide local video storage utilizing a microSD/microSDHC/microSDXC memory card expansion.
    f. The camera shall be manufactured with a repaintable polycarbonate casing.
    g. The camera shall be manufactured with an IP66-, NEMA 4X- and IK10-rated polycarbonate casing and hard coated dome
    h. The camera shall provide a manual 3-axis (pan/tilt/rotation) positioning to allow adjustment for optimum camera rotation and placement.
    i. The camera shall provide options for clear and smoked lower dome
2. The specified product shall meet or exceed the following performance specifications:
    a. Illumination
        1) For its 9 mm model, the camera shall meet or exceed the following illumination specifications:
            a) Color: 0.1 lux at 50 IRE, F1.8
            b) B/W: 0.02 lux at 50 IRE, F1.8
            c) 0 lux with IR illumination on
        2) For its 22 mm model, the camera shall meet or exceed the following illumination specifications:
            a) Color: 0.1 lux at 50 IRE, F1.6
            b) B/W: 0.02 lux at 50 IRE, F1.6
            c) 0 lux with IR illumination on
    b. Resolution
        1) The camera shall be designed to provide video streams in HDTV 1080p (1920x1080) at up to 60 frames per second (60Hz mode) or 50 frames per second (50Hz mode) using H.264, H265 or Motion JPEG.
        2) The camera shall provide 2 individually cropped out view areas.
        3) The camera shall support video resolutions including:
            a) 1920x1080 (HDTV 1080p)
            b) 1280x720 (HDTV 720p)
        4) The camera shall provide both landscape format (4:3 and 16:9 aspect ratio) as well

as corridor format (3:4 and 9:16 aspect ratio).

c. Viseo streaming

1) The camera shall provide independently configured simultaneous H.264 and Motion JPEG streams.

2) The camera shall provide configurable compression levels.

3) The camera shall provide a video streaming indicator.

4) The camera shall support standard baseline profile with motion estimation.

5) The camera shall support motion estimation in H.264/MPEG-4 Part 10/AVC.

6) The camera shall support motion estimation in H.265 (MPEG-H Part 2/HEVC

7) The camera shall support the following video encoding algorithms:

a) Motion JPEG encoding in a selectable range from 1 up to 50/60 frames per second.

b) Baseline Profile H.264 encoding with motion estimation in up to 50/60 frames per second.

c) Main Profile H.264 and H.265 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 50/60 frames per second.

d) High Profile H.264 encoding with motion estimation up to 50/60 frames per second.

8) The camera shall in H.264 and H.265 support Variable Bit Rate (VBR), Average Bit Rate (ABR) and Maximum Bit Rate (MBR).

9) The camera shall be able to deliver predictable storage using Average Bit Rate (ABR) bitrate controlling algorithm based on a bitrate budget and selected retention time.

a) The camera shall be able to deliver predictable storage using Average Bit Rate (ABR) bitrate controlling algorithm based on a bitrate budget and the selected retention time.

1)) The ABR bitrate algorithm, depending on the bitrate budget and the selected retention time, shall adjust the bitrate to meet the bitrate budget over the whole retention time.

2)) The ABR algorithm shall have a method to keep the video quality even during busy periods by allowing the current bitrate to be significantly above the configured average bitrate during significant parts of the retention time.

b) The camera shall in H.264 and H.265 support flexible retention period for Average Bit Rate (ABR) algorithm up to 1 year.

c) When using Average Bit Rate (ABR) the camera shall keep bitrate history up to at least 30 days.

d) The camera shall in H.264 and H.265 support reuse of past Average Bit Rate (ABR) history if a stream is disconnected and the camera reconnects with the same basic stream parameters.

e) When using Average Bit Rate (ABR), the camera shall in H.264 and H.265 support multiple parallel stream with independent ABR-history.

f) The camera shall issue bitrate degradation events when using Average Bit Rate (ABR) if the configuration is predicted to be

1)) unrealistic

2)) not fulfilling basic quality requirements

3)) not fulfilling the bitrate budget.

10) The camera shall support scene adaptive bitrate control with one of the following capabilities to lower bandwidth and storage:
    a) Automatic dynamic Region of Interest to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements.
    b) Automatic dynamic Group of Pictures to lower bandwidth and storage requirements
    c) Automatic dynamic Frames per Second to lower bandwidth and storage requirements
11) The camera shall support optimized image processing time for live streams by reducing the latency in live streams to the minimum.

d. Transmission
    1) The camera shall allow for video to be transported over:
        a) HTTP (Unicast)
        b) HTTPS (Unicast)
        c) RTP (Unicast & Multicast)
        d) RTP over RTSP (Unicast)
        e) RTP over RTSP over HTTP (Unicast)
        f) SRTP/RTSPS (Unicast & Multicast)
    2) The camera shall support Quality of Service (QoS) to be able to prioritize traffic.

e. Image
    1) The camera shall incorporate automatic and manual white balance.
    2) The camera shall incorporate an electronic shutter operating in the range of 1/66500 s to 2 s.
    3) The camera shall incorporate capture mode with the following settings:
        a) HDTV 1080p (1920x1080) with WDR: 25/30 fps (50/60 Hz)
        b) HDTV 1080p (1920x1080) without WDR: Up to 50/60 fps (50/60 Hz)
    4) The camera shall incorporate wide dynamic range – forensic WDR functionality.
    5) The camera shall incorporate forensic wide dynamic range functionality providing up to 120 dB dynamic range.
    6) The camera shall support manually defined values for:
        a) Saturation
        b) Brightness
        c) Sharpness
        d) Contrast
    7) The video encoder shall contain embedded de-interlacing filters.
    8) The camera shall support multiple scene profiles for:
        a) forensic
        b) vivid
        c) traffic overview
        d) backlit entrance
    9) The camera shall incorporate a function for optimization of low-light behavior at different light levels.
    10) The camera shall incorporate a function to manually correct barrel distortion, by

using a slider to correct distortion in the image.

11) The camera shall allow for rotation of the image in steps of 90º.

12) The camera shall incorporate automatic defog functionality.

f. Audio

1) For its 9 mm model, the camera shall support two-way full duplex audio:

a) Input sources

1)) External microphone

2)) External line device

3)) Ring power technology (with selected microphone models)

b) Output devices

1)) External line device

2) For its 22 mm model, the camera shall support two-way audio connectivity via edge-to-edge technology:

a) Input sources

1)) External microphone

2)) Ring power technology (with selected microphone models)

b) Output devices

1)) Network speaker pairing

3) Encoding

a) The camera shall support:

1)) 24bit LPCM

2)) AAC-LC 8/16/32/44.1/48 kHz

3)) G.711 PCM 8 kHz

4)) G.726 ADPCM 8 kHz

5)) Opus 8/16/48 kHz

6)) Configurable bit rate

g. IR Illumination

1) The camera shall be equipped with built-in IR LEDs with:

a) A range of up to 40 m (130 ft) with a wavelength of 850 nm (9 mm model).

b) A range of up to 45 m (148 ft) with a wavelength of 850 nm (22 mm model).

2) The camera shall be equipped with built-in IR LEDs with automatic seamless adapting angle of illumination and intensity.

h. User Interface

1) Web server

a) The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.

b) Optional components downloaded from the camera for specific tasks shall be signed by an organization providing digital trust services.

2) Language Specification

a) The camera shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.

3) IP addresses

a) The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.

b) The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a computer with an operating system supporting this feature.

c) The camera shall provide support for both IPv4 and IPv6.

d) The camera shall provide support for IPv6 USGv6.

i. PTZ functionality

1) The camera shall:

a) Provide digital PTZ functionality.

b) Provide preset positions functionality.

c) Provide optical and digital zoom functionality:

1)) Optical zoom: 2.6x

2)) Digital zoom: 12x

d) Provide a guard tour functionality which allows the dome to automatically move between selected presets using an individual speed and viewing time for each preset.

j. Event conditions

1) The camera shall be equipped with an integrated event functionality:

a) Analytics

b) External input

c) Supervised external input

d) Virtual inputs through API

e) Audio

1)) Audio clip playing

2)) Audio clip currently playing

f) Call

1)) State

2)) State change

g) Device status

1)) Operating temperature failure

2)) IP address

3)) Network lost

4)) System ready

5)) Ring power overcurrent protection

6)) Live stream active

7)) Casing open (22 mm model)

h) Digital audio

1)) Digital signal

i) Edge storage

1)) Recording ongoing

2)) Storage disruption
3)) Storage health

j) I/O
1)) Digital input
2)) Manual trigger
3)) Virtual inputs

k) MQTT
1)) Subscribe

l) Scheduled and recurring

m) Video
1)) Average bitrate degradation
2)) Day-night mode
3)) Live stream open
4)) Tampering

2) Response to triggers shall include event actions:
a) Calls: End SIP call, make SIP call, answer call
b) I/O: Toggle I/O once, toggle I/O while the rule is active
c) MQTT: Publish
d) Record video: SD card and network share
e) Upload of images and video clips: FTP, SFTP, HTTP, HTTPS, email or network share
f) Send notification: email, HTTP, HTTPS, TCP and SNMP trap
g) Pre- and post-alarm video or image buffering for recording or upload
h) Overlay text
i) External output activation
j) Play audio clip
k) Zoom preset
l) Day and night mode
m) Flash status LED
n) Use lights
o) Set defog mode
p) Set WDR mode

3) The camera shall provide memory for pre- and post-alarm recordings.

k. Storage
1) The camera shall support continuous and event controlled recording to:
a) Local memory added to the cameras microSD-card slot
b) Network attached storage, located on the local network

2) The camera shall incorporate encryption functionality for the SD card (AES-XTS-Plain64 256bit).

3) The camera shall incorporate encryption functionality for the SD card.

4) The camera shall be able to detect and notify edge storage disruptions.

l. Protocol

1) The camera shall incorporate support for at least IPv4, IPv6 USGv6, ICMPv4/ICMPv6, HTTP, HTTPSa , HTTP/2, TLSa , QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP, mDNS (Bonjour), UPnP® , SNMP v1/v2c/v3 (MIB-II), DNS/DNSv6, DDNS, NTP, NTS, RTSP, RTCP, RTP, SRTP/RTSPS, TCP, UDP, IGMPv1/v2/v3, DHCPv4/v6, ARP, SSH, SIP, LLDP, CDP, MQTT v3.1.1, Secure syslog (RFC 3164/5424, UDP/TCP/TLS), Link-Local address (ZeroConf).

2) The SMTP implementation shall include support for SMTP authentication.

m. Text overlay

1) The camera shall:

a) Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.

b) Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds.

c) Provide the ability to manually set up and configure privacy masks to the image.

d) Allow for the overlay of a graphical image, such as a logotype, into the image.

n. Security

1) The camera shall support the following:

a) Secure web browsing

1)) The use of HTTPS and TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.

2)) Restrict access to the built-in web server by usernames and passwords at three different levels.

b) Certificate management

1)) Provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.

c) Enhanced security features

1)) The use of signed firmware validates the firmware's integrity before accepting to install it.

2)) The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.

3)) The use of signed video (adding cryptographic checksum to H.264 videos signed by the manufacturer's secured device ID) provides support for validating the video's authenticity and origin.

4)) The use of a cryptographically verifiable hardware module where a collection of certificates, required to verify device identification, is installed.

5)) Support for encrypted filesystem (AES-XTS-Plain64 256bit).

6)) The collection of certificates (using IEEE 802.1AR) proves that the device and its firmware are authentic and produced by the manufacturer.

7)) The product shall include a tamper-resistant hardware module, certified to at least Common Criteria EAL6+. The module shall use a Trusted

Execution Environment (TEE), providing a set of cryptographic features suitable for protecting private keys from unauthorized access.

d) Authentication

1)) IEEE 802.1x (EAP-TLS, PEAP-MSCHAPv2) authentication.

2)) IEEE 802.1AE (MACsec PSK/EAP-TLS) authentication.

3)) Restrict access to pre-defined IP addresses via a host-based firewall.

e) Brute force delay protection

2) Firmware support

a) The manufacturer should provide a Software Bill of Material (SBOM) for each product firmware in machine-readable format (CycloneDX, SPDX) that contains information about the software composition of the device's operating system, publicly available for download.

b) The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.

c) The device should maintain high-level cybersecurity without introducing any significant functional changes or affecting any existing integrations.

o. System integration

1) The camera shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third-party applications.

2) The camera shall be fully supported by the manufacturer's own application platform, including Native SDK and Computer vision SDK.

3) The camera shall conform to ONVIF profile G as defined by the ONVIF Organization.

4) The camera shall conform to ONVIF profile M as defined by the ONVIF Organization.

5) The camera shall conform to ONVIF profile S as defined by the ONVIF Organization.

6) The camera shall conform to ONVIF profile T as defined by the ONVIF Organization.

p. Analytics

1) The camera shall provide a platform allowing the upload of third-party applications into the camera.

2) The camera shall be equipped with a built-in, deep-learning processing unit capable of executing neural network algorithms, such as object detection, classification and segmentation (including vehicle types, license plates, people and faces). The deep-learning processing unit shall contain multiple parallel hardware accelerated compute recourses capable of performing real-time video inference. The camera manufacturer shall support approved third-party developers to enable custom made deep-learning applications using the DLPU to accelerate custom trained deep-learning networks with commonly available network architectures.

3) The camera shall be supplied with preinstalled advanced video analytics capabilities, capable of detecting and classifying humans and vehicles in non-critical indoor and outdoor spaces.

q. Installation and maintenance

1) The camera shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the

cameras' configuration.

2) The camera shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.

3) The camera shall allow updates of the software (firmware) over the network, using FTP or HTTP.

4) The camera shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.

5) The camera shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.

6) The camera shall accept external time synchronization from an NTP (Network Time Protocol) server.

7) The camera shall provide remote zoom functionality.

r. Access log

1) The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.

2) The camera shall provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.

s. Camera diagnostics

1) The camera shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the camera's operational status and provide information about power, communication with receiver, the network status and the camera status.

2) The camera shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.

3) The camera shall send a notification when the unit has rebooted and all services are initialized.

t. Hardware interfaces

1) Network interface

a) The camera shall be equipped with one 10BASE-T/100BASE-TX Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed (100 MBit/s and 10 MBit/s) and transfer mode (full and half duplex).

2) Inputs/Outputs

a) The camera shall provide I/O connectivity via portcast technology with an accessory audio and I/O interface device.

b) The camera shall be equipped with one digital (alarm) input and one digital output, accessible via a removable terminal block. This input shall be configurable to respond to normally open (NO) or normally closed (NC) dry contacts. The output shall be able to provide 12 V DC, 25 mA.

3) Audio

a) The camera shall provide audio connectivity via portcast technology with an accessory audio and I/O interface device.

b) The camera shall be equipped with one 3.5 mm jack for line/mic input and one 3.5 mm jack for line output.

4) Power

a) The camera shall be equipped with a removable terminal block providing connectivity for external power.

u. Enclosure

1) The camera shall:

a) Be manufactured with an IP66-, NEMA 4X- and IK10-rated polycarbonate casing and hard coated dome.

b) Be fitted with a fixed weather shield.

v. Power

1) The camera shall provide power over Ethernet IEEE 802.3af/802.3at Type 1 Class 3

a) Max: 10.7 W

b) Typical: 4.8 W

w. Environmental

1) The camera shall:

a) Operate in a temperature range of –40 ºC to 50 ºC (–40 ºF to 122 ºF)

b) Operate in a maximum temperature (intermittent) of 74 °C (165 °F)

c) Operate in a humidity range of 10–100% RH (condensing).

D. 7 MP panoramic camera with 180° coverage

1. The specified product shall meet or exceed the following design specifications:

a. The camera shall operate on an open source and Linux-based platform, and include a built-in web server.

b. The camera shall provide a removable IR-cut filter, providing day/night functionality.

c. The camera shall be equipped with a fixed 3.3 mm lens with a 7 MP image sensor with a horizontal field of view of 180° and a vertical field of view of 90°.

d. The camera shall provide local video storage utilizing a microSD/microSDHC/microSDXC memory card expansion.

e. The camera shall be manufactured with a repaintable metal (aluminum) casing.

f. The camera shall be manufactured with an IP66/IP67-, NEMA 4X- and IK10-rated enclosure fitted with a fixed weather shield.

g. The camera shall provide a manual 3-axis (pan/tilt/rotation) positioning to allow adjustment for optimum camera rotation and placement.

2. The specified product shall meet or exceed the following performance specifications:

a. Illumination

1) The camera shall meet or exceed the following illumination specifications:

a) Color: 0.15 lux at 50 IRE, F2.0

b) B/W: 0.05 lux at 50 IRE, F2.0

b. Resolution

1) The camera shall be designed to provide video streams in 7 MP (3712x1856) at up to 30 frames per second (60Hz mode) or 25 frames per second (50Hz mode) using H.264, H265 or Motion JPEG.

2) The camera shall provide 8 individually cropped out view areas.

3) The camera shall support video resolutions including:

a) 2560x1440 (16:9)

b) 3712x1856 (2:1)

c) 2560x1280 (2:1)

d) 1920x960 (2:1)

c. Video streaming

1) The camera shall provide independently configured H.264, H.265 and Motion JPEG streams.

2) The camera shall provide configurable compression levels.

3) The camera shall provide a video streaming indicator.

4) The camera shall support standard baseline profile with motion estimation.

5) The camera shall support motion estimation in H.264/MPEG-4 Part 10/AVC.

6) The camera shall support motion estimation in H.265 (MPEG-H Part 2/HEVC

7) The camera shall support the following video encoding algorithms:

a) Motion JPEG encoding in a selectable range from 1 up to 25/30 frames per second.

b) Baseline Profile H.264 encoding with motion estimation in up to 25/30 frames per second.

c) Main Profile H.264 and H.265 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 25/30 frames per second.

d) High Profile H.264 encoding with motion estimation up to 25/30 frames per second.

8) The camera shall in H.264 and H.265 support Variable Bit Rate (VBR), Average Bit Rate (ABR) and Maximum Bit Rate (MBR).

9) The camera shall be able to deliver predictable storage using Average Bit Rate (ABR) bitrate controlling algorithm based on a bitrate budget and selected retention time.

a) The camera shall be able to deliver predictable storage using Average Bit Rate (ABR) bitrate controlling algorithm based on a bitrate budget and the selected retention time.

1)) The ABR bitrate algorithm, depending on the bitrate budget and the selected retention time, shall adjust the bitrate to meet the bitrate budget over the whole retention time.

2)) The ABR algorithm shall have a method to keep the video quality even during busy periods by allowing the current bitrate to be significantly above the configured average bitrate during significant parts of the retention time.

b) The camera shall in H.264 and H.265 support flexible retention period for Average Bit Rate (ABR) algorithm up to 1 year.

c) When using Average Bit Rate (ABR) the camera shall keep bitrate history up to at least 30 days.

d) The camera shall in H.264 and H.265 support reuse of past Average Bit Rate (ABR) history if a stream is disconnected and the camera reconnects with the same basic stream parameters.

e) When using Average Bit Rate (ABR), the camera shall in H.264 and H.265 support multiple parallel stream with independent ABR-history.

f) The camera shall issue bitrate degradation events when using Average Bit Rate (ABR) if the configuration is predicted to be

1)) unrealistic

2)) not fulfilling basic quality requirements

3)) not fulfilling the bitrate budget.

10) The camera shall support scene adaptive bitrate control with one of the following capabilities to lower bandwidth and storage:

a) Automatic dynamic Region of Interest to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements.

b) Automatic dynamic Group of Pictures to lower bandwidth and storage requirements

c) Automatic dynamic Frames per Second to lower bandwidth and storage requirements

11) The camera shall support optimized image processing time for live streams by reducing the latency in live streams to the minimum.

d. Transmission

1) The camera shall allow for video to be transported over:

a) HTTP (Unicast)

b) HTTPS (Unicast)

c) RTP (Unicast & Multicast)

d) RTP over RTSP (Unicast)

e) RTP over RTSP over HTTP (Unicast)

f) SRTP/RTSPS (Unicast & Multicast)

2) The camera shall support Quality of Service (QoS) to be able to prioritize traffic.

e. Image

1) The camera shall incorporate automatic and manual white balance.

2) The camera shall incorporate an electronic shutter operating in the range of 1/31500 s to 1.5 s.

3) The camera shall incorporate capture mode with the following settings:

a) 7 MP (3712x1856) with WDR: 25/30 fps (50/60 Hz)

4) The camera shall incorporate wide dynamic range – forensic WDR functionality.

5) The camera shall incorporate forensic wide dynamic range functionality providing up to 120 dB dynamic range.

6) The camera shall support manually defined values for:

a) Saturation

b) Brightness

c) Sharpness

d) Contrast

7) The camera shall support multiple scene profiles for:

a) forensic

b) vivid

c) traffic overview

d) backlit entrance

8) The camera shall incorporate a function for optimization of low-light behavior at different light levels.

9) The camera shall incorporate a function for motion-adaptive exposure to reduce

motion blur from approaching or nearby object.

f. Audio
    1) The camera shall support configurable one-way and two-way simplex, half duplex and full duplex audio:
        a) Input sources
            1)) External unbalanced microphone, with an optional 5 V microphone power
            2)) Digital input, with an optional 12 V ring power
            3)) Unbalanced line input
        b) Output sources
            1)) Network speaker pairing
    2) Encoding
        a) The camera shall support:
            1)) 24bit LPCM
            2)) AAC-LC 8/16/32/48 kHz
            3)) G.711 PCM 8 kHz
            4)) G.726 ADPCM 8 kHz
            5)) Opus 8/16/48 kHz
            6)) Configurable bit rate

g. IR Illumination
    1) The camera shall be equipped with built-in IR LEDs, with a range of up to 15 m (50 ft) with a wavelength of 850 nm.

h. User Interface
    1) Web server
        a) The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.
        b) Optional components downloaded from the camera for specific tasks shall be signed by an organization providing digital trust services.
    2) Language Specification
        a) The camera shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.
    3) IP addresses
        a) The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.
        b) The camera shall allow for automatic detection of the camera based on UPnP and Bonjour when using a computer with an operating system supporting this feature.
        c) The camera shall provide support for both IPv4 and IPv6.
        d) The camera shall provide support for IPv6 USGv6.

i. PTZ functionality
    1) The camera shall:
        a) Provide digital PTZ functionality.

j. Event conditions

1) The camera shall be equipped with an integrated event functionality:
    a) Device status
        1)) Operating temperature failure
        2)) Fan
        3)) IP address
        4)) Network lost
        5)) System ready
        6)) Ring power
        7)) Live stream
        8)) Casing open
    b) Digital audio input status
    c) Edge storage
        1)) Recording ongoing
        2)) Storage disruption
        3)) Storage health
    d) I/O
        1)) Digital input
        2)) Manual trigger
        3)) Virtual inputs
    e) MQTT subscribe
    f) Scheduled and recurring
    g) Video
        1)) Average bitrate degradation
        2)) Day-night mode
        3)) Live stream
        4)) Tampering
2) Response to triggers shall include event actions:
    a) Audio clips: play, stop
    b) Day and night mode
    c) I/O: toggle I/O once, toggle I/O while the rule is active
    d) MQTT: publish
    e) Notification: HTTP, HTTPS, TCP and email
    f) Overlay text
    g) Recordings: SD card and network share
    h) SNMP traps: send, send while the rule is active
    i) Upload of images and video clips: FTP, SFTP, HTTP, HTTPS, email or network share
3) The camera shall provide memory for pre- and post-alarm recordings.

k. Storage
1) The camera shall support continuous and event controlled recording to:
    a) Local memory added to the cameras microSD-card slot

b) Network attached storage, located on the local network

2) The camera shall incorporate encryption functionality for the SD card (AES-XTS-Plain64 256bit).

3) The camera shall incorporate encryption functionality for the SD card.

4) The camera shall be able to detect and notify edge storage disruptions.

l. Protocol

1) The camera shall incorporate support for at least IPv4, IPv6 USGv6, ICMPv4/ICMPv6, HTTP, HTTPS, HTTP/2, TLS, QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP, mDNS (Bonjour), UPnP, SNMP v1/v2c/v3 (MIB-II), DNS/DNSv6, DDNS, NTP, NTS, RTSP, RTP, SRTP, TCP, UDP, IGMPv1/v2/v3, RTCP, ICMP, DHCPv4/v6, ARP, SSH, LLDP, CDP, MQTT v3.1.1, Secure syslog (RFC 3164/5424, UDP/TCP/TLS), Link-Local address (ZeroConf), IEEE 802.1X (EAP-TLS), IEEE 802.1AR.

2) The SMTP implementation shall include support for SMTP authentication.

m. Text overlay

1) The camera shall:

a) Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.

b) Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds.

c) Provide the ability to manually set up and configure privacy masks to the image.

d) Allow for the overlay of a graphical image, such as a logotype, into the image.

n. Security

1) The camera shall support the following:

a) Secure web browsing

1)) The use of HTTPS and TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.

2)) Restrict access to the built-in web server by usernames and passwords at three different levels.

b) Certificate management

1)) Provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.

c) Enhanced security features

1)) The use of signed firmware validates the firmware’s integrity before accepting to install it.

2)) The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.

3)) The use of signed video (adding cryptographic checksum to H.264 videos signed by the manufacturer’s secured device ID) provides support for validating the video’s authenticity and origin.

4)) The use of trusted platform module (TPM) provides a set of cryptographic features suitable for protecting private keys from unauthorized access.

5)) TPM is certified according to FIPS 140-2 level 2.

6)) The use of a cryptographically verifiable hardware module where a collection of certificates, required to verify device identification, is installed.

7)) Support for encrypted filesystem (AES-XTS-Plain64 256bit).

8)) The collection of certificates (using IEEE 802.1AR) proves that the device and its firmware are authentic and produced by the manufacturer.

9)) The product shall include a tamper-resistant hardware module, certified to at least Common Criteria EAL4.

d) Authentication

1)) IEEE 802.1x (EAP-TLS, PEAP-MSCHAPv2) authentication.

2)) IEEE 802.1AE (MACsec PSK/EAP-TLS) authentication.

3)) Restrict access to pre-defined IP addresses via a host-based firewall.

e) Brute force delay protection

2) Firmware support

a) The manufacturer should provide a Software Bill of Material (SBOM) for each product firmware in machine-readable format (CycloneDX, SPDX) that contains information about the software composition of the device's operating system, publicly available for download.

b) The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.

c) The device should maintain high-level cybersecurity without introducing any significant functional changes or affecting any existing integrations.

o. System integration

1) The camera shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third-party applications.

2) The camera shall be fully supported by the manufacturer's own application platform, including Native SDK and Computer vision SDK.

3) The camera shall conform to ONVIF profile G as defined by the ONVIF Organization.

4) The camera shall conform to ONVIF profile M as defined by the ONVIF Organization.

5) The camera shall conform to ONVIF profile S as defined by the ONVIF Organization.

6) The camera shall conform to ONVIF profile T as defined by the ONVIF Organization.

p. Analytics

1) The camera shall provide a platform allowing the upload of third-party applications into the camera.

2) The camera shall be equipped with a built-in, deep-learning processing unit capable of executing neural network algorithms, such as object detection, classification and segmentation (including vehicle types, license plates, people and faces). The deep-learning processing unit shall contain multiple parallel hardware accelerated compute recourses capable of performing real-time video inference. The camera manufacturer shall support approved third-party developers

to enable custom made deep-learning applications using the DLPU to accelerate custom trained deep-learning networks with commonly available network architectures.

3) The camera shall be supplied with preinstalled advanced video analytics capabilities, capable of detecting and classifying humans and vehicles in non-critical indoor and outdoor spaces.

a) The camera shall provide a function to measure how long an object (human or vehicle) stayed in a monitored area.

q. Installation and maintenance

1) The camera shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.

2) The camera shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.

3) The camera shall allow updates of the software (firmware) over the network, using FTP or HTTP.

4) The camera shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.

5) The camera shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.

6) The camera shall accept external time synchronization from an NTP (Network Time Protocol) server.

r. Access log

1) The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.

2) The camera shall provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.

s. Camera diagnostics

1) The camera shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the camera's operational status and provide information about power, communication with receiver, the network status and the camera status.

2) The camera shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.

3) The camera shall send a notification when the unit has rebooted and all services are initialized.

t. Hardware interfaces

1) Network interface

a) The camera shall be equipped with one 10BASE-T/100BASE-TX/1000BASE-T Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed and transfer mode (full and half duplex).

2) Inputs/Outputs

a) The camera shall be equipped with one digital (alarm) input and one digital output, accessible via a removable terminal block. This input shall be configurable to respond to normally open (NO) or normally closed (NC) dry

contacts. The output shall be able to provide 12 V DC, 15 mA.

3) Audio
   a) The camera shall be equipped with one 3.5 mm jack for line/mic input and one 3.5 mm jack for line output.
4) Power
   a) The camera shall be equipped with a removable terminal block providing connectivity for external power.

u. Enclosure
   1) The camera shall:
      a) Be manufactured with an IP66/IP67-, NEMA 4X- and IK10-rated aluminum enclosure and a polycarbonate hard-coated dome.
      b) Be fitted with a fixed weather shield.

v. Power
   1) The camera shall support power over Ethernet IEEE 802.3af/802.3at Type 2 Class 4
      a) Max: 18 W
      b) Typical: 12 W

w. Environmental
   1) The camera shall:
      a) Operate in a temperature range of -40 °C to 55 °C (-40 °F to 131 °F)
      b) Operate in a maximum temperature (intermittent) of 74 °C (165 °F)
      c) Operate in a humidity range of 10–100% RH (condensing).

E. Dual-sensor panoramic camera
   1. The specified product shall meet or exceed the following design specifications:
      a. The camera shall operate on an open source and Linux-based platform, and include a built-in web server.
      b. The camera shall provide a removable IR-cut filter, providing day/night functionality.
      c. The camera shall be equipped with two varifocal 3.3–8.1 mm IR-corrected lenses with a 5 MP image sensor with fixed iris, a 2.5x remote zoom and remote focus.
      d. The camera shall provide the following fields of view and focus distance:
         1) Horizontal: 98° and 36°
         2) Vertical: 69° and 27°
         3) Diagonal: 133° and 46°
         4) Focus distance: 0.5 m (1.6 ft)
      e. The camera shall provide local video storage utilizing a microSD/microSDHC/microSDXC memory card expansion.
      f. The camera shall be manufactured with an IP66-, IP67-, NEMA 4X- and IK10-rated aluminum and plastic casing with a polycarbonate hard-coated dome.
      g. The camera shall provide a manual 3-axis (pan/tilt/rotation) positioning to allow adjustment for optimum camera rotation and placement.
      h. The camera shall provide options for clear and smoked lower dome
   2. The specified product shall meet or exceed the following performance specifications:
      a. Illumination

1) The camera shall meet or exceed the following illumination specifications:
    a) Color: 0.19 lux at 50 IRE, F1.9
    b) B/W: 0 lux at 50 IRE, F1.9
    c) 0 lux with IR illumination on

b. Resolution
    1) The camera shall be designed to provide video streams in 2x 5 MP (2560x1440) at up to 30 frames per second (60Hz mode) or 25 frames per second (50Hz mode) using H.264, H.265 or Motion JPEG.
    2) The camera shall support video resolutions including:
        a) 2x 2560x1440 (2x 5 MP, 16:9)
        b) 2x 2592x1944 (2x 5 MP, 4:3)
    3) The camera shall provide both landscape format (4:3 and 16:9 aspect ratio) as well as corridor format (3:4 and 9:16 aspect ratio).

c. Video streaming
    1) The camera shall provide independently configured H.264, H.265 and Motion JPEG streams.
    2) The camera shall provide configurable compression levels.
    3) The camera shall provide a video streaming indicator.
    4) The camera shall support standard baseline profile with motion estimation.
    5) The camera shall support motion estimation in H.264/MPEG-4 Part 10/AVC.
    6) The camera shall support motion estimation in H.265 (MPEG-H Part 2/HEVC
    7) The camera shall support the following video encoding algorithms:
        a) Motion JPEG encoding in a selectable range from 1 up to 25/30 frames per second.
        b) Baseline Profile H.264 encoding with motion estimation in up to 25/30 frames per second.
        c) Main Profile H.264 and H.265 encoding with motion estimation and context-adaptive binary arithmetic coding (CABAC) in up to 25/30 frames per second.
        d) High Profile H.264 encoding with motion estimation up to 25/30 frames per second.
    8) The camera shall in H.264 and H.265 support Variable Bit Rate (VBR), Average Bit Rate (ABR) and Maximum Bit Rate (MBR).
    9) The camera shall be able to deliver predictable storage using Average Bit Rate (ABR) bitrate controlling algorithm based on a bitrate budget and selected retention time.
        a) The camera shall be able to deliver predictable storage using Average Bit Rate (ABR) bitrate controlling algorithm based on a bitrate budget and the selected retention time.
            1)) The ABR bitrate algorithm, depending on the bitrate budget and the selected retention time, shall adjust the bitrate to meet the bitrate budget over the whole retention time.
            2)) The ABR algorithm shall have a method to keep the video quality even during busy periods by allowing the current bitrate to be significantly above the configured average bitrate during significant parts of the retention time.
        b) The camera shall in H.264 and H.265 support flexible retention period for

Average Bit Rate (ABR) algorithm up to 1 year.

c) When using Average Bit Rate (ABR) the camera shall keep bitrate history up to at least 30 days.

d) The camera shall in H.264 and H.265 support reuse of past Average Bit Rate (ABR) history if a stream is disconnected and the camera reconnects with the same basic stream parameters.

e) When using Average Bit Rate (ABR), the camera shall in H.264 and H.265 support multiple parallel stream with independent ABR-history.

f) The camera shall issue bitrate degradation events when using Average Bit Rate (ABR) if the configuration is predicted to be

1)) unrealistic

2)) not fulfilling basic quality requirements

3)) not fulfilling the bitrate budget.

10) The camera shall support scene adaptive bitrate control with one of the following capabilities to lower bandwidth and storage:

a) Automatic dynamic Region of Interest to reduce bitrate in unprioritized regions in order to lowering bandwidth and storage requirements.

b) Automatic dynamic Group of Pictures to lower bandwidth and storage requirements

c) Automatic dynamic Frames per Second to lower bandwidth and storage requirements

11) The camera shall support optimized image processing time for live streams by reducing the latency in live streams to the minimum.

d. Transmission

1) The camera shall allow for video to be transported over:

a) HTTP (Unicast)

b) HTTPS (Unicast)

c) RTP (Unicast & Multicast)

d) RTP over RTSP (Unicast)

e) RTP over RTSP over HTTP (Unicast)

f) SRTP (Unicast & Multicast)

2) The camera shall support Quality of Service (QoS) to be able to prioritize traffic.

e. Image

1) The camera shall incorporate automatic and manual white balance.

2) The camera shall incorporate an electronic shutter operating in the range of 1/33500 s to 1/5 s.

3) The camera shall incorporate capture mode with the following settings:

a) 2x 5 MP(2560x1440) with WDR: 25/30 fps (50/60 Hz)

4) The camera shall incorporate wide dynamic range – forensic WDR functionality.

5) The camera shall incorporate forensic wide dynamic range functionality providing up to 74 dB dynamic range.

6) The camera shall support manually defined values for:

a) Saturation

b) Brightness

c) Sharpness

d) Contrast

7) The camera shall incorporate a function for optimization of low-light behavior at different light levels.

8) The camera shall incorporate a function to manually correct barrel distortion, by using a slider to correct distortion in the image.

9) The camera shall allow for rotation of the image in steps of 90º.

f. Audio

1) The camera shall support two-way audio connectivity via edge-to-edge technology.

2) The camera shall support one-way simplex audio:

a) Input/output sources

1)) External microphone input

2)) External line device

3)) Ring power technology (with selected microphone models)

4)) Digital audio input

5)) Automatic gain control

3) Encoding

a) The camera shall support:

1)) 24bit LPCM

2)) AAC-LC 8/16/32/44.1/48 kHz

3)) G.711 PCM 8 kHz

4)) G.726 ADPCM 8 kHz

5)) Opus 8/16/48 kHz

6)) Configurable bit rate

g. IR Illumination

1) The camera shall be equipped with built-in IR LEDs, with a range of up to 15 m (50 ft) with a wavelength of 850 nm.

2) The camera shall be equipped with built-in IR LEDs with automatic seamless adapting angle of illumination and intensity.

h. User Interface

1) Web server

a) The camera shall contain a built-in web server making video and configuration available to multiple clients in a standard operating system and browser environment using HTTP, without the need for additional software.

b) Optional components downloaded from the camera for specific tasks shall be signed by an organization providing digital trust services.

2) Language Specification

a) The camera shall provide a function for altering the language of the user interface, and shall include support for at least 10 different languages.

3) IP addresses

a) The camera shall support both fixed IP addresses and dynamically assigned IP addresses provided by a Dynamic Host Control Protocol (DHCP) server.

b) The camera shall allow for automatic detection of the camera based on UPnP

and Bonjour when using a computer with an operating system supporting this feature.

c) The camera shall provide support for both IPv4 and IPv6.

d) The camera shall provide support for IPv6 USGv6.

i. Event conditions

1) The camera shall be equipped with an integrated event functionality:

a) Analytics

b) Virtual inputs through API

c) Audio

1)) Audio detection

d) Device status

1)) Operating temperature failure

2)) IP address

3)) Network lost

4)) System ready

5)) Ring power overcurrent protection

6)) Live stream active

7)) Casing open

e) Digital audio:

1)) Digital signal

f) Edge storage

1)) Recording ongoing

2)) Storage disruption

3)) Storage health

g) I/O

1)) Manual trigger

2)) Virtual inputs

h) MQTT subscribe

i) Scheduled and recurring

j) Video

1)) Average bitrate degradation

2)) Day-night mode

3)) Live stream open

4)) Tampering

2) Response to triggers shall include event actions:

a) Overlay text

b) Day/night mode

c) Flash status LED

d) Audio clips: play, stop

e) Illumination: use lights, use lights while the rule is active

f) MQTT: Publish

g) Notification: HTTP, HTTPS, TCP and email

h) Pre- and post-alarm video or image buffering for recording or upload

i) Record video: SD card and network share

j) SNMP traps: send, sent while the rule is active

k) Upload of images or video clips: FTP, SFTP, HTTP, HTTPS, network share and email

3) The camera shall provide memory for pre- and post-alarm recordings.

j. Storage

1) The camera shall support continuous and event controlled recording to:

a) Local memory added to the cameras microSD-card slot

b) Network attached storage, located on the local network

2) The camera shall incorporate encryption functionality for the SD card (AES-XTS-Plain64 256bit).

3) The camera shall incorporate encryption functionality for the SD card.

4) The camera shall be able to detect and notify edge storage disruptions.

k. Protocol

1) The camera shall incorporate support for at least IPv4, IPv6 USGv6, ICMPv4/ICMPv6, HTTP, HTTPSa , HTTP/2, TLSa , QoS Layer 3 DiffServ, FTP, SFTP, CIFS/SMB, SMTP, mDNS (Bonjour), UPnP® , SNMP v1/v2c/v3 (MIB-II), DNS/DNSv6, DDNS, NTP, NTS, RTSP, RTCP, RTP, SRTP/RTSPS, TCP, UDP, IGMPv1/v2/v3, DHCPv4/v6, ARP, SSH, LLDP, CDP, MQTT v3.1.1, Secure syslog (RFC 3164/5424, UDP/TCP/TLS), Link-Local address (ZeroConf).

2) The SMTP implementation shall include support for SMTP authentication.

l. Text overlay

1) The camera shall:

a) Provide embedded on-screen text with support for date & time, and a customer-specific text, camera name, of at least 45 ASCII characters.

b) Provide the possibility to choose different font sizes for embedded on-screen text, and to use white or black text on at least four different backgrounds.

c) Provide the ability to manually set up and configure privacy masks to the image.

m. Security

1) The camera shall support the following:

a) Secure web browsing

1)) The use of HTTPS and TLS, providing the ability to upload signed certificates to encrypt and secure authentication and communication of both administration data and video streams.

2)) Restrict access to the built-in web server by usernames and passwords at three different levels.

b) Certificate management

1)) Provide centralized certificate management, with both pre-installed CA certificates and the ability to upload additional CA certificates. The certificates shall be signed by an organization providing digital trust services.

c) Enhanced security features

1)) The use of signed firmware validates the firmware's integrity before accepting to install it.

2)) The use of a secure boot process, based on the use of signed firmware, ensures that the camera can boot only with authorized firmware.

3)) The product shall include a tamper-resistant hardware module, certified to at least Common Criteria EAL4+. The trusted platform module (TPM) shall provide a set of cryptographic features suitable for protecting private keys from unauthorized access. TPM is certified according to FIPS 140-2 level 2.

4)) The use of a cryptographically verifiable hardware module where a collection of certificates, required to verify device identification, is installed.

5)) Support for encrypted filesystem (AES-XTS-Plain64 256bit).

6)) The collection of certificates (using IEEE 802.1AR) proves that the device and its firmware are authentic and produced by the manufacturer.

d) Authentication

1)) IEEE 802.1x (EAP-TLS, PEAP-MSCHAPv2) authentication.

2)) IEEE 802.1AE (MACsec PSK/EAP-TLS) authentication.

3)) Restrict access to pre-defined IP addresses via a host-based firewall.

e) Brute force delay protection

2) Firmware support

a) The manufacturer should provide a Software Bill of Material (SBOM) for each product firmware in machine-readable format (CycloneDX, SPDX) that contains information about the software composition of the device's operating system, publicly available for download.

b) The manufacturer must provide firmware with long-term support that only contains corrections for critical bugs, security flaws and performance issues.

c) The device should maintain high-level cybersecurity without introducing any significant functional changes or affecting any existing integrations.

n. System integration

1) The camera shall be fully supported by an open and published API (Application Programmers Interface), which shall provide necessary information for integration of functionality into third-party applications.

2) The camera shall conform to ONVIF profile G as defined by the ONVIF Organization.

3) The camera shall conform to ONVIF profile M as defined by the ONVIF Organization.

4) The camera shall conform to ONVIF profile S as defined by the ONVIF Organization.

5) The camera shall conform to ONVIF profile T as defined by the ONVIF Organization.

o. Analytics

1) The camera shall provide a platform allowing the upload of third-party applications into the camera.

2) The camera shall be equipped with a built-in, deep-learning processing unit capable of executing neural network algorithms, such as object detection,

classification and segmentation (including vehicle types, ;license plates, people and faces). The deep-learning processing unit shall contain multiple parallel hardware accelerated compute recourses capable of performing real-time video inference. The camera manufacturer shall support approved third-party developers to enable custom made deep-learning applications using the DLPU to accelerate custom trained deep-learning networks with commonly available network architectures.

3) The camera shall be supplied with preinstalled advanced video analytics capabilities, capable of detecting and classifying humans and vehicles in non-critical indoor and outdoor spaces.

p. Installation and maintenance

1) The camera shall be supplied with Windows-based management software which allows the assignment of IP addresses, upgrade of firmware and backup of the cameras' configuration.

2) The camera shall support the use of SNMP-based management tools according to SNMP v1, 2c & 3 / MIB-II.

3) The camera shall allow updates of the software (firmware) over the network, using FTP or HTTP.

4) The camera shall store all customer-specific settings in a non-volatile memory that shall not be lost during power cuts or soft reset.

5) The camera shall provide the ability to apply a rectangle of customer-defined number of pixels to the image, which can be used as a pixel counter identifying the size of objects in number of pixels.

6) The camera shall accept external time synchronization from an NTP (Network Time Protocol) server.

7) The camera shall provide remote zoom and remote focus functionality.

q. Access log

1) The camera shall provide a log file, containing information about the 250 latest connections and access attempts since the unit's latest restart. The file shall include information about the connecting IP addresses and the time of connecting.

2) The camera shall provide a connection list of all currently connected viewers. The file shall include information about connecting IP address, time of connecting and the type of stream accessed.

r. Camera diagnostics

1) The camera shall be equipped with LEDs, capable of providing visible status information. LEDs shall indicate the camera's operational status and provide information about power, communication with receiver, the network status and the camera status.

2) The camera shall be monitored by a Watchdog functionality, which shall automatically re-initiate processes or restart the unit if a malfunction is detected.

3) The camera shall send a notification when the unit has rebooted and all services are initialized.

s. Hardware interfaces

1) Network interface

a) The camera shall be equipped with one 10BASE-T/100BASE-TX/1000BASE-T Ethernet-port using a RJ45 connector and shall support auto negotiation of network speed and transfer mode (full and half duplex).

2) Audio

a) The camera shall be equipped with one 3.5 mm jack for line/mic input and one 3.5 mm jack for line output.

t. Enclosure

1) The camera shall:

a) Be manufactured with an IP66-, IP67-, NEMA 4X- and IK10-rated aluminum and plastic casing with a polycarbonate hard-coated dome.

b) Be fitted with an adjustable weather shield.

u. Power

1) The camera shall provide power over Ethernet IEEE 802.3at Type 2 Class 4

a) IR illumination on

1)) Max: 17.5 W

2)) Typical: 10.7 W

b) IR illumination off

1)) Max: 10.6 W

2)) Typical: 5.2 W

v. Vironmental

1) The camera shall:

a) Operate in a temperature range of -30 °C to 50 °C (-22 °F to 122 °F)

b) Operate in a maximum temperature (intermittent) of 74 °C (165 °F)

c) Operate in a humidity range of 10–100% RH (non-condensing).

F. All-in-one recorder with PoE switch for UHD surveillance

1. The all-in-one recorder shall meet or exceed the following design specifications:

a. Be equipped with an Intel Core i5 processor or better.

b. Be fitted with a minimum of 8 GB RAM.

c. Contain at least 24x 10BASE-T/100BASE-TX network ports with PoE+ and 260 W power budget for connection of network cameras and other devices.

d. Contain at least 3x 1000BASE-T Gigabit network ports using RJ45/SFP for uplink.

e. Be equipped with at least 2x 6 TB Surveillance Class hard drive.

f. Be equipped with at least 1x USB 3.0, 2x USB 2.0, 1x Displayport, 1x HDMI port, 1x audio line in and 1x audio line out.

g. Be designed for tabletop mounting or rack mounting.

h. Be provided with an Intel HD Graphics.

i. The unit shall require 100-240 V AC, max 520 W of which 260 W is dedicated for PoE.

j. Operate in a temperature range of 0 C to +40 C (+32 F to +104 F).

k. Operate in a humidity range of 10–90% RH (non-condensing).

l. The operating system shall be:

1) Microsoft Windows 10 IoT Enterprise, with operating system drive 120 GB SSD

2) With support for operating system recovery

m. The all-in-one recorder shall support the following enhanced security features:

1) Encrypted operating drive and recording drive support

2) The use of Trusted Platform Module (TPM) provides a set of cryptographic features suitable for protecting private keys from unauthorized access.

3) TPM (2.0) is certified according to FIPS 140-2 level 2.

2.04 CERTIFICATIONS AND STANDARDS

A. General abbreviations and acronyms

1. ABR: Average Bit Rate
2. AGC: Automatic gain control
3. AES: Advanced Encryption Standard
4. API: Application Programming Interface
5. Aspect ratio: A ratio of width to height in images
6. Bit Rate: The number of bits/time unit sent over a network
7. Bonjour: Enables automatic discovery of computers, devices, and services on IP networks.
8. DHCP: Dynamic Host Configuration Protocol
9. DNS: Domain Name System
10. EIS: Electronic Image Stabilization
11. FPS: Frames per Second
12. FTP: File Transfer Protocol
13. SFTP: Secure File Transfer Protocol
14. H.264 (Video Compression Format)
15. H.265 (Video Compression Format)
16. HSMS: Hosted Security Management System (SaaS PACS Application)
17. IEEE 802.1x: Authentication framework for network devices
18. IP: Internet Protocol
19. IR light: Infrared light
20. ISO: International Standards Organization
21. JPEG: Joint Photographic Experts Group (image format)
22. LAN: Local Area Network
23. LED: Light Emitting Diode
24. LPR: License Plate Recognition
25. Lux: A standard unit of illumination measurement
26. MBR: Maximum Bit Rate
27. MPEG: Moving Picture Experts Group
28. Multicast: Communication between a single sender and multiple receivers on a network
29. NTP: Network Time Protocol
30. NTSC: National Television System Committee – a color encoding system based on 60Hz
31. ONVIF: Global standard for the interface of IP-based physical security products
32. PACS: Physical Access Control System
33. PAL: Phase Alternating Line – a color encoding system based on 50Hz
34. PoE: Power over Ethernet (IEEE 802.3af/at) standard for providing power over network cable
35. Progressive scan: An image scanning technology which scans the entire picture
36. PTZ: Pan/Tilt/Zoom
37. QoS: Quality of Service
38. RAID: Redundant Array of Independent Disks

39. RMD: Radar Motion Detection
40. RPC: Remote Procedure Call
41. SaaS: Software as a Service
42. SIP: Session Initiation Protocol
43. SMTP: Simple Mail Transfer Protocol
44. SMPTE: Society of Motion Picture and Television Engineers
45. SNMP: Simple Network Management Protocol
46. SSL: Secure Sockets Layer
47. TCP: Transmission Control Protocol
48. TLS: Transport Layer Security
49. Unicast: Communication between a single sender and single receiver on a network
50. UPnP: Universal Plug and Play
51. UPS: Uninterruptible Power Supply
52. VBR: Variable Bit Rate
53. VMS: Video Management System
54. WDR: Wide dynamic range

B. Approvals and standards
   1. AXIS A1610
      a. The specified unit shall carry the following EMC approvals:
         1) EN 55032 Class A
         2) EN 61000-3-2
         3) EN 61000-6-1
         4) EN 61000-6-2
         5) FCC Part 15 Subpart B Class A
         6) VCCI Class A
         7) RCM AS/NZS CISPR 32 Class A
      b. The specified unit shall meet the following product safety standards:
         1) IEC/EN/UL 62368-1 ed. 3
         2) UL 294
      c. The specified unit shall meet the following standards
         1) Networking:
            a) IEEE 802.3at (Power over Ethernet Plus)
            b) IEEE 802.1x (EAP-TLS) (Authentication)
            c) IPv4 (RFC 791)
            d) IPv6 (RFC 2460)
            e) QoS – DiffServ (RFC 2475)
         2) Mechanical Environment:
            a) EN 50581
   2. AXIS A4020-E Reader
      a. The specified unit shall carry the following EMC approvals:
         1) EN 61000-6-1

2) EN 61000-6-3
3) FCC Part 15 Subpart B Class B

b. The specified unit shall meet the following wireless approvals:
1) EN 300330
2) EN 301489-1
3) EN 301489-3
4) EN 62311
5) FCC Part 15 Subpart C

c. The specified unit shall meet the following product safety standards:
1) IEC/EN/UL 60950-22
2) IEC/EN/UL 62368-1

d. The specified unit shall meet the following standards
1) Mechanical Environment:
a) IEC 60068-2-1
b) IEC 60068-2-2
c) IEC 60068-2-6
d) IEC 60068-2-14
e) IEC 60068-2-27
f) IEC 60068-2-78
g) IEC/EN 60529 IP65
h) NEMA 250 Type 4X

3. AXIS I8116–E

a. The specified unit shall carry the following EMC approvals:
1) EN 55035
2) EN 55032 Class A
3) EN 61000-6-1
4) EN 61000-6-2
5) USA
a) FCC Part 15 Subpart B Class A

b. The specified unit shall meet the following product safety standards:
1) IEC/EN/UL 60950-22
2) IEC/EN/UL 62368-1

c. The specified unit shall meet relevant parts of the following video standards:
1) SMPTE 296M (HDTV 720p)
2) SMPTE 274M (HDTV 1080p)
3) SMPTE ST 2036-1 (UHDTV)

d. The specified unit shall meet the following standards
1) MPEG-4:
a) ISO/IEC 14496-10 Advanced Video Coding (H.264)
b) ISO/IEC 23008-5 Advanced Video Coding (H.265)
2) Networking:

a) IEEE 802.3af/802.3at (Power over Ethernet)
b) IEEE 802.1x (EAP-TLS, PEAP-MSCHAPv2) (Authentication)
c) IPv4 (RFC 791)
d) IPv6 (RFC 2460)
e) QoS – DiffServ (RFC 2475)

3) Cybersecurity
a) ETSI EN 303 645

4) Mechanical Environment:
a) IEC 60068-2-1
b) IEC 60068-2-2
c) IEC 60068-2-6
d) IEC 60068-2-14
e) IEC 60068-2-27
f) IEC 60068-2-78
g) IEC/EN 60529 IP65
h) NEMA 250 Type 4X

4. AXIS P3265–LVE
a. The specified unit shall carry the following EMC approvals:
1) EN 55032 Class A
2) EN 55035
3) EN 61000-3-2
4) EN 61000-3-3
5) EN 61000-6-1
6) EN 61000-6-2
7) FCC Part 15 Subpart B Class A
8) RCM AS/NZS CISPR 32 Class A
9) VCCI Class A

b. The specified unit shall meet the following product safety standards:
1) CAN/CSA-C22.2 No. 60950-22
2) CAN/CSA C22.2 No. 62368-1
3) IEC/EN/UL 62368-1
4) IEC/EN/UL 60950-22
5) IEC/EN 62471
6) IS 13252

c. The specified unit shall meet relevant parts of the following video standards:
1) SMPTE 296M (HDTV 720p)
2) SMPTE 274M (HDTV 1080p)

d. The specified unit shall meet the following standards
1) MPEG-4:
a) ISO/IEC 14496-10 Advanced Video Coding (H.264)
b) ISO/IEC 23008-5 Advanced Video Coding (H.265)

2) Networking:
    a) IEEE 802.3af/802.3at (Power over Ethernet)
    b) IEEE 802.1x (EAP-TLS, PEAP-MSCHAPv2) (Authentication)
    c) IPv4 (RFC 791)
    d) IPv6 (RFC 2460)
    e) QoS – DiffServ (RFC 2475)
    f) NIST SP500-267
3) Cybersecurity
    a) ETSI EN 303 645
4) Mechanical Environment:
    a) IEC 60068-2-1
    b) IEC 60068-2-2
    c) IEC 60068-2-6
    d) IEC 60068-2-14
    e) IEC 60068-2-27
    f) IEC 60068-2-78
    g) IEC/EN 60529 IP66
    h) IEC/EN 62262 IK10
    i) NEMA 250 Type 4X
    j) NEMA TS2 (2.2.7-2.2.9)
5) Railway environment:
    a) EN 50121-4
    b) IEC 62236-4

5. AXIS P3827-PVE
    a. The specified unit shall carry the following EMC approvals:
        1) CISPR 35
        2) CISPR 32 Class A
        3) EN 55035
        4) EN 55032 Class A
        5) EN 61000-6-1
        6) EN 61000-6-2
        7) USA:
            a) FCC Part 15 Subpart B Class A
    b. The specified unit shall meet the following product safety standards:
        1) CAN/CSA C22.2 No. 62368-1 ed. 3
        2) IEC/EN/UL 62368-1 ed. 3
        3) IS 13252
    c. The specified unit shall meet relevant parts of the following video standards:
        1) SMPTE 296M (HDTV 720p)
        2) SMPTE 274M (HDTV 1080p)
        3) SMPTE ST 2036-1 (UHDTV)

d. The specified unit shall meet the following standards
    1) MPEG-4:
        a) ISO/IEC 14496-10 Advanced Video Coding (H.264)
        b) ISO/IEC 23008-5 Advanced Video Coding (H.265)
    2) Networking:
        a) IEEE 802.3af/802.3at (Power over Ethernet)
        b) IEEE 802.1x (EAP-TLS, PEAP-MSCHAPv2) (Authentication)
        c) IPv4 (RFC 791)
        d) IPv6 (RFC 2460)
        e) QoS – DiffServ (RFC 2475)
        f) NIST SP500-267
    3) Cybersecurity
        a) ETSI EN 303 645
        b) FIPS 140
    4) Mechanical Environment:
        a) IEC 60068-2-1
        b) IEC 60068-2-2
        c) IEC 60068-2-6
        d) IEC 60068-2-14
        e) IEC 60068-2-27
        f) IEC 60068-2-78
        g) NEMA 250 Type 4X
        h) NEMA TS 2 (2.2.7-2.2.9)
        i) MIL-STD-810H (Method 501.7, 502.7, 505.7, 506.6, 507.6, 509.7, 512.6)
    5) Railway environment:
        a) EN 50121-4
        b) IEC 62236-4

6. AXIS P4707–PLVE
    a. The specified unit shall carry the following EMC approvals:
        1) CISPR 35
        2) EN 55032 Class A
        3) EN 61000-6-1
        4) FCC Part 15 Subpart B Class A
    b. The specified unit shall meet the following product safety standards:
        1) CAN/CSA-C22.2 No. 60950-22
        2) CAN/CSA C22.2 No. 62368-1
        3) IEC/EN/UL 62368-1
        4) IEC/EN/UL 60950-22
    c. The specified unit shall meet relevant parts of the following video standards:
        1) SMPTE 296M (HDTV 720p)
        2) SMPTE 274M (HDTV 1080p)

d. The specified unit shall meet the following standards
    1) MPEG-4:
        a) ISO/IEC 14496-10 Advanced Video Coding (H.264)
        b) ISO/IEC 23008-5 Advanced Video Coding (H.265)
    2) Networking:
        a) IEEE 802.3af/802.3at (Power over Ethernet)
        b) IEEE 802.1x (EAP-TLS, PEAP-MSCHAPv2) (Authentication)
        c) IPv4 (RFC 791)
        d) IPv6 (RFC 2460)
        e) QoS – DiffServ (RFC 2475)
        f) NIST SP500-267
    3) Cybersecurity
        a) ETSI EN 303 645
        b) FIPS 140
    4) Mechanical Environment:
        a) IEC 60068-2-1
        b) IEC 60068-2-2
        c) IEC 60068-2-6
        d) IEC 60068-2-14
        e) IEC 60068-2-27
        f) IEC 60068-2-78
        g) IEC/EN 62262:2002 IK10
        h) IEC/EN 60529 IP66/IP67
        i) MIL-STD-810H (Method 501.7, 502.7, 505.7, 506.6, 507.6, 509.7, 512.6)
        j) NEMA 250 Type 4X, NEMA TS 2 (2.2.7-2.2.9)
        k) VDMA 24364
    5) Railway environment:
        a) EN 50121-4
        b) IEC 62236-4

7. AXIS S2224
    a. The specified unit shall carry the following EMC approvals:
        1) CNS 13438
        2) EAC
        3) EN 55024
        4) EN 55032 Class A
        5) EN 61000-3-2
        6) EN 61000-6-1
        7) EN 61000-6-2
        8) FCC Part 15 Subpart B Class A
        9) VCCI Class A
    b. The specified unit shall meet the following product safety standards:

1) IEC/EN 60950-1
2) IEC/EN 62368-1
3) UL 62368-1

c. The specified unit shall meet relevant parts of the following video standards:
   1) Video
      a) SMPTE 296M (HDTV 720p)
      b) SMPTE 274M (HDTV 1080p)
      c) SMPTE ST 2036-1 (UHDTV)

d. The specified unit shall meet the following standards
   1) Networking:
      a) IEEE 802.3at (Power over Ethernet Plus)
      b) IEEE 802.1X (Authentication)
      c) IPv4 (RFC 791)
      d) IPv6 (RFC 2460)
   2) The integrated PoE switch shall support:
      a) IEEE 802.3at (Power over Ethernet Plus)
      b) IPv4 (RFC 791)'

PART 3 – EXECUTION

3.01 INSTALLATION

A. The contractor's or subcontractor's main resources within the project shall carry proper professional certification issued by the manufacturer and verified by a third-party organization to confirm sufficient product and technology knowledge.

B. The contractor shall carefully follow instructions in documentation provided by the manufacturer to ensure all steps have been taken to provide a reliable, easy-to-operate system.

C. All equipment shall be tested and configured in accordance with instructions provided by the manufacturer prior to installation.

D. All firmware found in products shall be the latest and most up-to-date version as specified by the manufacturer, or by the product component provider.

E. All equipment requiring users to log on using a password shall be configured with user/site-specific password/passwords. No system/product default passwords shall be allowed.

F. A proper installation shall meet NEC (National Electrical Code – US only) per the guidelines of that year's revision. When properly installed equipment meets Low Voltage, Class 2 classification of the NEC.

END OF SECTION

SECTION 2383111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this section.

B. The system and all associated operations shall be in accordance with the following:

1. Requirements of the following Model Building Code: IBC 2018Edition
2. Requirements of the following Model Fire Code: IFC 2018Edition
3. Requirements of the following Model Mechanical Code: IMC 2018 Edition
4. NFPA 72, National Fire Alarm Code, 2016 Edition
5. NFPA 70, National Electrical Code, 2017 Edition
6. NFPA 101, Life Safety Code, 2018 Edition
7. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems, 2018 Edition
8. ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, 2016 Edition
9. ICC/ANSI A117.1 Accessible and Useable Buildings and Facilities, 2009 Edition
10. Local Jurisdictional Adopted Codes and Standards
11. ADA Accessibility Guidelines

1.03 SUMMARY

A. This Section covers the extension of the existing fire alarm system, including initiating devices, notification appliances, controls, and supervisory devices.

B. Work covered by this section includes the furnishing of labor, equipment, and materials for installation of the fire alarm system as indicated on the drawings and specifications.

C. The Fire Alarm System shall consist of all necessary hardware equipment and software programming to perform the following functions:

1. Fire alarm system detection and notification operations.
2. Control and monitoring of door hold-open devices, fire suppression systems, emergency power systems, and other equipment as indicated in the drawings and specifications.

1.04 DEFINITIONS

A. ADA: Americans with Disabilities Act

B. AHJ: Authority Having Jurisdiction

C. ANSI: American National Standards Institute

D. ASME: American Society of Mechanical Engineers

E. FACU: Fire Alarm Control Unit

F. FM: Factory Mutual

G. IBC: International Building Code

H. ICC: International Code Council

I. IDC: Initiating Device Circuit

J. IEEE: Institute of Electrical and Electronic Engineers

K. IFC: International Fire Code

L. IMC: International Mechanical Code

M. IRI: Industrial Risk Insurers

N. LED: Light-emitting diode.

O. NAC: Notification Appliance Circuit

P. NFPA: National Fire Protection Association

Q. NICET: National Institute for Certification in Engineering Technologies.

R. RAC: Releasing Appliance Circuit

S. SLC: Signaling Line Circuit

T. UL: Underwriters Laboratories

U. ULC: Underwriters Laboratories, Canada

1.05 SCOPE OF WORK

A. Provide an extension to the existing fire alarm system. Provide new notification and annunciation devices, extender panels and programming of the existing FACU for the new equipment.

1.06 SYSTEM DESCRIPTION

A. General: Provide a complete, non-coded addressable, microprocessor-based fire alarm system with initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

B. Wiring/Signal Transmission:

1. Transmission shall be hard-wired using separate individual circuits for each zone of alarm operation, as required or addressable signal transmission, dedicated to fire alarm service only.

2. System connections for initiating device circuits shall be Class B, Style D, signaling line circuits shall be Class B, Style 4 and notification appliance circuits shall be Class B, Style Y.

3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACU. Provide a distinctive indicating audible tone and alphanumeric annunciation.

C. Required Functions: The following are required system functions and operating features:

1. Priority of Signals: Fire alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Priority Two, Supervisory and Trouble events have second-, third-, and fourth-level priority, respectively. Signals of a higher-level priority take precedence over signals of lower priority even though the lower-priority condition occurred first. Annunciate all events regardless of priority or order received.

2. Noninterfering: An event on one zone does not prevent the receipt of signals from any other zone. All zones are manually resettable from the FACU after the initiating device or devices are restored to normal. The activation of an addressable device does not prevent the receipt of signals from subsequent addressable device activations.

3. Transmission to an approved Supervising Station: Automatically route alarm, supervisory, and trouble signals to an approved supervising station service provider, under another contract.

4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACU and the remote annunciator, indicating the type of device, the operational state of the device (i.e. alarm, trouble or supervisory) and shall display the custom label associated with the device.

5. Selective Alarm: A system alarm shall include:

a. Indication of alarm condition at the FACU and the annunciator(s).

b. Identification of the device /zone that is the source of the alarm at the FACU and the annunciator(s).

c. Operation of audible and visible notification appliances until silenced at FACU.

d. Closing doors normally held open by magnetic door holders.

e. Unlocking designated doors.

f. Shutting down supply and return fans serving zone where alarm is initiated.

g. Closing smoke dampers on system serving zone where alarm is initiated.

h. Transmission of signal to the supervising station.

i. Initiation of elevator Phase I functions (recall, shunt trip, illumination of indicator in cab, etc.) in accordance with ANSI/ASME A17.1 / CSA B44, Safety Code for Elevators and Escalators, when specified detectors or sensors are activated, as appropriate.

6. Supervisory Operations: Upon activation of a supervisory device such as a tamper switch, the system shall operate as follows:

   a. Activate the system supervisory service audible signal and illuminate the LED at the control unit and the remote annunciator.

   b. Pressing the Supervisory Acknowledge Key will silence the supervisory audible signal while maintaining the Supervisory LED "on" indicating off-normal condition.

   c. Record the event in the FACU historical log.

   d. Transmission of supervisory signal to the supervising station.

   e. Restoring the condition shall cause the Supervisory LED to clear and restore the system to normal.

7. Alarm Silencing: If the "Alarm Silence" button is pressed, all audible alarm signals shall cease operation.

8. System Reset

   a. The "System Reset" button shall be used to return the system to its normal state. Display messages shall provide operator assurance of the sequential steps ("IN PROGRESS", "RESET COMPLETED") as they occur. The system shall verify all circuits or devices are restored prior to resetting the system to avoid the potential for re-alarming the system. The display message shall indicate "ALARM PRESENT, SYSTEM RESET ABORTED."

   b. Should an alarm condition continue, the system will remain in an alarmed state.

9. A manual evacuation (drill) switch shall be provided to operate the notification appliances without causing other control circuits to be activated.

10. WALKTEST: The system shall have the capacity of 8 programmable passcode protected one person testing groups, such that only a portion of the system need be disabled during testing. The actuation of the "enable one person test" program at the control unit shall activate the "One Person Testing" mode of the system as follows:

    a. The city circuit connection and any suppression release circuits shall be bypassed for the testing group.

    b. Control relay functions associated with one of the 8 testing groups shall be bypassed.

    c. The control unit shall indicate a trouble condition.

    d. The alarm activation of any initiating device in the testing group shall cause the audible notification appliances assigned only to that group to sound a code to identify the device or zone.

e. The unit shall automatically reset itself after signaling is complete.

f. Any opening of an initiating device or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

1) Any device which is activated during the time that Walktest is enabled, but is not within the group under test shall immediately cause a normal alarm sequence to commence as if the system was not under any testing sequence.

11. Install Mode: The system shall provide the capability to group all non-commissioned points and devices into a single "Install Mode" trouble condition allowing an operator to clearly identify event activations from commissioned points and devices in occupied areas.

a. It shall be possible to individually remove points from Install Mode as required for phased system commissioning.

b. It shall be possible to retrieve an Install Mode report listing that includes a list of all points assigned to the Install Mode. Panels not having an install mode shall be reprogrammed to remove any non-commissioned points and devices.

12. Module Distribution:

a. The fire alarm control unit shall be capable of allowing remote location of the following modules; interface of such modules shall be through a Style 4 (Class B) supervised serial communications channel (SLC):

1) Initiating Device Circuits

2) Notification Appliance Circuits

3) Auxiliary Control Circuits

4) Graphic Annunciator LED/Switch Control Modules

a) In systems with two or more Annunciators and/or Command Centers, each Annunciator/Command Center shall be programmable to allow multiple Annunciators/Command Centers to have equal operation priority or to allow hierarchal priority control to be assigned to individual Annunciator/Command Center locations.

5) Initiating Device Signaling Line Circuits

6) Notification Appliance Signaling Line Circuits

7) Power Supplies

D. Integrated Automation

1. Security Integration

a. The FA System shall provide the means to be integrated directly to a Software House C•Cure 9000 Security Management System (SMS) or a Kantech Corporate and Global EntraPass system via a software interface for the purpose of communicating fire alarm events directly to the security system.

b. Communication between the FA System and security system shall be accomplished using Computer Port Protocol (CPP).

1) The FA and the security system shall be connected via a local or network serial port server based RS-232 serial port connection.

c. The CPP shall consist of a bi-directional serial protocol capable of accessing most of the Fire Alarm Control Unit (FACU) diagnostic features.

d. The interface shall provide the means to communicate the following information to the security system:

1) Device/Point status changes (e.g., Fire, Trouble, Disabled)

2) Panel event status (e.g. Number of Unacknowledged Fire Alarms, Card Failure

Troubles, etc.)

3) Panel health status (e.g., AC power, battery status)

e. Interface software shall include a data acquisition function that provides the following:

1) Establishes and maintains a supervised serial link

2) Extraction of the point database from the FACU

3) Merges the FACU database into the C•Cure SMS database

f. The software interface shall not allow system control functionality from the security system to the FA System.

g. The installation, programming and maintenance of the FA/security integration software interface shall be conducted by factory trained certified technicians.

E. Analog Smoke Sensors:

1. Monitoring: FACU shall individually monitor sensors for calibration, sensitivity, and alarm condition, and shall individually adjust for sensitivity. The control unit shall determine the condition of each sensor by comparing the sensor value to the stored values.

2. Environmental Compensation: The FACU shall maintain a moving average of the sensor's smoke chamber value to automatically compensate for dust, dirt, and other conditions that could affect detection operations.

3. Programmable Sensitivity: Photoelectric Smoke Sensors shall have 7 selectable sensitivity levels ranging from 0.2% to 3.7%, programmed and monitored from the FACU.

4. Sensitivity Testing Reports: The FACU shall provide sensor reports that meet NFPA 72 calibrated test method requirements.

a. Reports shall be capable of being printed for annual recording and logging of the calibration maintenance schedule.

b. Where required, reports shall be accessible remotely through:

1) A Fire Panel Internet Interface using Ethernet and TCP/IP communications protocol compatible with IEEE Standard 802.3. The Fire Panel Internet Interface shall be capable of automatically scheduling email reports to individual user accounts on a weekly, bi-weekly, or monthly schedule

5. The FACU shall automatically indicate when an individual sensor needs cleaning. The system shall provide a means to automatically indicate when a sensor requires cleaning. When a sensor's average value reaches a predetermined value, (3) progressive levels of reporting are provided. The first level shall indicate if a sensor is close to a trouble reporting condition and will be indicated on the FACU as "ALMOST DIRTY." This condition provides a means to alert maintenance staff of a sensor approaching dirty without creating a trouble in the system. If this indicator is ignored and the second level is reached, a "DIRTY SENSOR" condition shall be indicated at the FACU and subsequently a system trouble is reported to the Supervising Station. The sensor base LED shall glow steady giving a visible indication at the sensor location. The "DIRTY SENSOR" condition shall not affect the sensitivity level required to alarm the sensor. If a "DIRTY SENSOR" is left unattended, and its average value increases to a third predetermined value, an "EXCESSIVELY DIRTY SENSOR" trouble condition shall be indicated at the control unit.

6. The FACU shall continuously perform an automatic self-test on each sensor that will check sensor electronics and ensure the accuracy of the values being transmitted. Any sensor that fails this test shall indicate a "SELF TEST ABNORMAL" trouble condition.

7. Multi-Sensors shall combine photoelectric smoke sensing and heat sensing technologies. An alarm shall be determined by either smoke detection, with selectable sensitivity from 0.2 to 3.7 %/ft obscuration; or heat detection, selectable as fixed temperature or fixed with selectable rate-of-rise; or based on an analysis of the combination of smoke and heat activity.

8. Programmable bases. It shall be possible to program relay and sounder bases to operate independently of their associated sensor.
9. Magnet test activation of smoke sensors shall be distinguished by its label and history log entry as being activated by a magnet.

F. Fire Suppression Monitoring:
1. Water flow: Activation of a water flow switch shall initiate general alarm operations.
2. Sprinkler valve tamper switch: The activation of any valve tamper switch shall activate system supervisory operations.
3. Water flow switch and sprinkler valve tamper switch shall be capable of existing on the same initiating zone. Activation of either device shall distinctly report which device has been activated on the initiating zone.

G. Audible Alarm Notification: By horns in areas as indicated on drawings.

H. Network Communication:
1. A single open, ground or short on the network communication pathway shall not degrade network communications. At the same time the fault condition status of the communication link shall be reported.
2. If a group of nodes becomes isolated from the rest of the network due to multiple fault conditions, that group shall automatically form a sub-network with all common interaction of monitoring and control remaining intact. The network shall be notified with the exact details of the lost communications.
3. Fiber optics communication shall be provided as an option via a fiber optics media module. All fire alarm network fiber optic communication is to be via full duplex transmission over a single fiber optic cable, either single mode or multi mode.

I. Addressable Notification Appliances:
1. Monitoring: The FACU shall monitor individual addressable notification appliances for status, condition, type of appliance, and configured appliance settings. A fault in any individual appliance shall automatically report a trouble condition on the FACU.
2. Individual Appliance Custom Label: Each addressable appliance shall have its own 40 character custom label to identify the location of the appliance and to aid in troubleshooting fault conditions.
3. Individual Appliance Information Display:
    a. The FACU shall be capable of calling up detailed information for each addressable appliance including the appliance location, status, condition, type of appliance, and configured appliance settings.
4. Programmable Appliance Settings:
    a. The selectable operation of each addressable notification appliance shall be capable of being configured by the FACU without having to replace or remove the appliance from the wall or ceiling.
        1) Programmable appliance settings for applicable addressable notification appliances shall include:
            a) Operation:
                (1) General Evac
                (2) Alert
                (3) User Defined
            b) Style:
                (1) Indoor

(2) UL Weatherproof

(3) ULC Weatherproof

c) Candela Selections:

(1) Indoor: 15, 30, 75, 110, 135, or 185 cd (per UL1971)

(2) UL Weatherproof: 15 or 75 cd (per UL1971), and 75 or 185 cd (per UL1638)

d) Horn Volume:

(1) Hi

(2) Low

e) Horn Cadence:

(1) Temporal 3

(2) Temporal 4

(3) March Time 20 bpm

(4) March Time 60 bpm

(5) March Time 120 bpm

(6) Steady

f) Horn Tone:

(1) 520 HZ

(2) Bell

(3) Slow Whoop

(4) Siren

(5) Hi / Lo

5. Programmable Notification Zones:

a. Changing the notification zone assigned to a notification appliance shall be configurable by the FACU and shall not require additional circuits or wiring.

6. Other Emergency and Non Emergency Notification:

a. Where required, notification appliances for purposes not related to fire alarm shall be capable of:

1) being connected to the same circuit as the fire alarm appliances, and

2) being individually configured for their intended use without requiring additional circuits or wiring.

7. Addressable Notification Appliance Automated Self-Test:

a. The fire alarm control unit shall be capable of performing an automated functional self-test of all self-test notification appliances and meet the requirements in NFPA 72,14.2.8 Automated Testing and Table 14.4.3.2 testing requirements.

b. Test results for each self-test notification appliance shall be stored in non-volatile memory at the fire alarm control unit.

c. The fire alarm control unit shall be capable of running a functional automated test for all self-test notification appliances in a general alarm group or for all self-test appliances within a specific notification zone.

d. The duration required to complete the automated functional test for all self-test notification appliances shall be accomplished in 2 minutes or less.

e. The automated test results for all self-test notification appliances shall be available from the fire alarm control unit within 4 minutes from the start of the test.

f. If any notification appliance fails its automated functional self-test an audible and visual trouble signal shall be annunciated at the fire alarm control unit.

1) The self-test trouble signal shall be a latching trouble signal which requires manual restoration to normal.

8. Addressable Notification Appliance Reports:

a. The fire alarm control unit shall maintain configuration and test data for each self-test addressable notification appliance.

b. The fire alarm control unit shall be capable of generating configuration, self-test, and deficiency reports, that can be viewed through the fire alarm control unit user interface or printed via the fire alarm control unit service port.

1) At minimum, the configuration report shall include the following information applicable for each addressable notification appliance:

a) Point ID

b) Custom Label

c) Device Type

d) Candela Setting

2) At minimum, the self-test report shall include the following information applicable for each self-test notification appliance:

a) Point ID

b) Custom Label

c) Time and Date of last test

d) Pass / Fail results of last visual test

e) Pass / Fail results of last audible test

c. The fire alarm control unit shall also be capable of providing a deficiency report that includes a list of all self-test notification appliances that have failed self-test.

9. Magnet test: When the control unit is in diagnostic mode, the appliances shall be capable of being tested with a magnet. The magnet diagnostics shall:

a. Pulse the appliance LED to indicate appliance address[,and]

b. briefly sound the individual horn to confirm the audible appliance operation

c. briefly flash the individual strobe to confirm visible appliance operation

1.07 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

1. Product data sheets for system components highlighted to indicate the specific products, features, or functions required to meet this specification. Alternate or as-equal products submitted under this contract must provide a detailed line-by-line comparison of how the submitted product meets, exceeds, or does not comply with this specification.

2. Wiring diagrams from manufacturer.

3. Shop drawings showing system details including location of FACU, all devices, circuiting and details of graphic annunciator.

4. System power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate in accordance with the prescribed backup time periods

and under all voltage conditions per UL and NFPA standards.

5. System operation description including method of operation and supervision of each type of circuit and sequence of operations for all manually and automatically initiated system inputs and outputs. A list of all input and output points in the system shall be provided with a label indicating location or use of IDC, SLC, NAC, relay, sensor, and auxiliary control circuits.
6. Operating instructions for FACU.
7. Operation and maintenance data for inclusion in Operating and Maintenance Manual. Include data for each type product, including all features and operating sequences, both automatic and manual. Provide the names, addresses, and telephone numbers of service organizations.
8. Product certification signed by a certified representative of the manufacturer of the fire alarm system components certifying that their products comply with indicated requirements.
9. Record of field tests of system.

B. Submission to Authority Having Jurisdiction: In addition to routine submission of the above material, make an identical submission to the authority having jurisdiction. Include copies of shop drawings as required to depict component locations to facilitate review. Upon receipt of comments from the Authority, make resubmissions, if required, to make clarifications or revisions to obtain approval.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: A factory authorized installer is to perform the work of this section.

B. Each and every item of the Fire Alarm System shall be listed under the appropriate category by a Nationally Recognized Testing Laboratory and shall bear the respective "NRTL" label.

1.09 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Client Agency or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Professional no fewer than two days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Professional’s

1.10 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

1.11 EXTRA MATERIALS

A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows:

1. Break Rods for Manual Stations: Furnish quantity equal to 15 percent of the number of manual stations installed; minimum of 6 rods.
2. Notification Appliances: Furnish quantity equal to 10 percent of each type and number of units installed, but not less than one of each type.
3. Smoke Detectors or Sensors, Fire Detectors, and Flame Detectors: Furnish quantity equal to 10 percent of each type and number of units installed but not less than one of each type.
4. Detector or Sensor Bases: Furnish quantity equal to 2 percent of each type and number of units installed but not less than one of each type.

PART 2 – PRODUCTS

2.01 ACCEPTABLE EQUIPMENT AND SERVICE PROVIDERS

A. Manufacturers: The equipment and service described in this specification are those supplied and supported by Johnson Controls and represent the base bid for the equipment.

1. Subject to compliance with the requirements of this specification, provide products by one of the following:

a. Simplex, a Johnson Controls Company

1) The above item has been approved by the Department as a Proprietary item. No other item will be accepted. Article 9, Paragraph 9.6, Substitution of Materials, of the General Conditions to the Construction Contract does not apply to the above item.

2.02 SYSTEMS OPERATIONAL DESCRIPTION

A. Fire-alarm signal initiation shall be by one or more of the following devices and systems:

1. Manual stations.
2. Heat detectors.
3. Smoke detectors.
4. Duct smoke detectors.
5. Verified automatic alarm operation of smoke detectors.
6. Automatic sprinkler system water flow.
7. Heat detectors in elevator shaft and pit.
8. Fire-extinguishing system operation.
9. Fire standpipe system.

B. Fire-alarm signal shall initiate the following actions as required:

1. Continuously operate alarm notification appliances.
2. Identify alarm at fire-alarm control unit and remote annunciators.
3. Transmit an alarm signal to the remote alarm receiving station.
4. Unlock electric door locks in designated egress paths.
5. Release fire and smoke doors held open by magnetic door holders.
6. Switch heating, ventilating, and air-conditioning equipment controls to fire-alarm mode.
7. Close smoke dampers in air ducts of designated air-conditioning duct systems.
8. Recall elevators to primary or alternate recall floors.
9. Activate emergency shutoffs for gas and fuel supplies.
10. Record events in the system memory.

C. Supervisory signal initiation shall be by one or more of the following devices and actions:

1. Valve supervisory switch.
2. Low-air-pressure switch of a dry-pipe sprinkler system.
3. Elevator shunt-trip supervision.

D. System trouble signal initiation shall be by one or more of the following devices and actions:

1. Open circuits, shorts, and grounds in designated circuits.
2. Opening, tampering with, or removing alarm-initiating and supervisory signal-initiating devices.
3. Loss of primary power at fire-alarm control unit.

4. Ground or a single break in fire-alarm control unit internal circuits.
5. Abnormal AC voltage at fire-alarm control unit.
6. Break in standby battery circuitry.
7. Failure of battery charging.
8. Abnormal position of any switch at fire-alarm control unit or annunciator.

E. System Trouble and Supervisory Signal Actions: Initiate notification appliance and annunciate at fire-alarm control unit and remote annunciators. Record the event on system printer where provided.

2.03 FIRE ALARM CONTROL UNIT (FACU)

A. The following FACU hardware shall be existing to remain:

2.04 ADDRESSABLE INITIATING

A. Addressable Manual Pull Stations

1. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
2. Description: Addressable [single-] [double-]action type, red LEXAN. Station shall mechanically latch upon operation and remain so until manually reset by opening with a key common with the control units. Station shall be pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit. Where double-action stations are provided, the mechanism shall require two actions [break front glass] [push top activation door] to initiate an alarm.
3. Provide with a front showing red LED showing that will flash each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the station LED shall be on steady.

B. Addressable Analog Smoke Sensors

1. General Requirements for System Smoke Detectors:
   a. Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
   b. Factory Nameplate: Serial number and type identification.
   c. Operating Voltage: 24 VDC, nominal and shall be two-wire type.
   d. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore normal operation.
   e. [Plug-In Arrangement: Sensor and associated electronic components are mounted in a module that connects to a fixed base with a twist-locking plug connection. Base shall provide break-off plastic tab that can be removed to engage the head/base locking mechanism. Provide terminals in the fixed base for connection to building wiring. No special tools shall be required to remove head once it has been locked. Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal at the control unit. Sensors shall include a communication transmitter and receiver in the mounting base having a unique identification and capability for status reporting to the FACU. Sensor address shall be located in base to eliminate false addressing when replacing sensors. Integral Addressable Module shall be arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Each sensor base shall contain an integral visual-indicating LED that will flash to provide power-on status each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor base LED shall be on steady. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base.][Quick Connect Arrangement: Photoelectric sensor and

electronics in a single piece construction which shall twist-lock onto a mounting base that attaches to a standard electrical box. Provide terminals in the fixed base for connection to building wiring. Sensors shall include an internal communication transmitter and receiver in the sensor having a unique identification and capability for status reporting to the FACU. Integral Addressable Module shall be arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit. Each sensor shall contain an integral visual-indicating LED that will flash to provide power-on status each time it is scanned by the Control Unit (once every 4 seconds). In alarm condition, the sensor LED shall be on steady. Sensor and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base.]

f. Each sensor base shall contain a magnetically actuated test switch to provide for easy pre-certification alarm testing at the sensor location.

g. Each sensor shall be scanned by the Control Unit for its type identification to prevent inadvertent substitution of another sensor type. Upon detection of a "wrong device", the control unit shall operate with the installed device at the default alarm settings for that sensor; 2.5% obscuration for photoelectric sensor, 135-deg F and 15-deg F rate-of-rise for the heat sensor, but shall indicate a "Wrong Device" trouble condition.

h. Unless otherwise indicated, detectors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit. Provide multiple levels of detection sensitivity for each sensor.

i. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACU.

j. The sensor's electronics shall be immune from nuisance alarms caused by EMI and RFI. Removal of the sensor head for cleaning shall not require the setting of addresses.

k. Bases: CO Sensor, relay output, sounder and isolator bases shall be supported alternatives to the standard base.

2. Addressable Sensor Bases

a. Standard base - Twist lock addressable base with address selection DIP switch accessible from front with sensor removed. Integral red LED for power-on (pulsing), or alarm or trouble (steady on). Locking anti-tamper design mounts on standard outlet box.

b. Sensor Base with remote device connection - All standard base features with wired connection for either a Remote LED alarm indicator or remote relay (relay is unsupervised and requires separate 24VDC)

c. Supervised Relay Bases - All standard base features and shall be available in either a 4-Wire Sensor Base to use with remote or locally mounted relay; requires separate 24 VDC, or as a 2-Wire Sensor Base to use with remote or locally mounted relay; no separate power required. Supervised relay operation shall be programmable and shall be manually operated from control panel.

d. Sensor base with built-in electronic alarm sounder - All standard base features and piezoelectric sounder shall provide high output (88 dBA) with low current requirements (20 mA). Sounder shall be synchronized via SLC communications or by the NAC if NAC powered, sounder shall operation shall be programmable and shall be manually operated from control panel.

e. 520 Hz Sensor base with built-in electronic low frequency sounder - All standard base features and piezoelectric sounder shall provide a low frequency 520 Hz Square Wave (85 dBA) with nominal current requirements (115 mA). Sounder shall be synchronized via SLC communications or by the NAC if NAC powered, sounder operation shall be programmable and shall be manually operated from control panel.

1) Emitted tone shall be a 520Hz Square Wave signal in compliance with the requirements of the 2010 edition of NFPA 72 for sleeping areas.

2) The 520Hz Sounder base shall be listed to UL 268 and UL464, Audible Signal Appliances.

C. Addressable Duct Smoke Sensor

1. Standard Addressable Duct Smoke Sensor Unit. Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Duct housing shall include relay or relay driver as required for fan shutdown.

a. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct smoke sensor shall be provided by the FACU.

b. The Duct Housing shall provide a supervised relay driver circuit for driving up to 15 relays with a single "Form C" contact rated at 7A@ 28VDC or 10A@ 120VAC. This auxiliary relay output shall be fully programmable independent of the sensor head for activation by other alarm initiating devices within the fire alarm system. Relay shall be mounted within 3 feet of HVAC control circuit.

c. Duct Housing shall provide a magnetic test area and Red sensor status LED and Duct Housing shall provide a relay control Yellow LED trouble indicator.

d. Duct Housing shall have a transparent cover to monitor for the presence of smoke. Cover shall secure to housing by means of four (4) captive fastening screws.

e. Duct Housing shall provide two (2) Test Ports for measuring airflow and for testing. These ports will allow aerosol injection in order to test the activation of the duct smoke sensor.

f. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.

g. Each duct smoke sensor shall be provided with a Remote Test Station with an alarm LED and test switch.

h. Where indicated provide a NEMA 4X weatherproof duct housing enclosure that shall provide for the circulation of conditioned air around the internally mounted addressable duct sensor housing to maintain the sensor housing at its rated temperature range. The housing shall be UL Listed to Standard 268A.

D. Addressable Heat Sensors

1. General Requirements for Heat Detectors: Comply with UL 521.

2. Thermal Sensor Combination type: Fixed-temperature and rate-of-rise unit with plug-in base and alarm indication lamp; Actuated by either a selected fixed temperature or a rate of rise that exceeds a preset amount per minute unless otherwise indicated.

3. Thermal sensor shall be of the epoxy encapsulated electronic design. It shall be thermistor-based, rate-compensated, self-restoring and shall not be affected by thermal lag. Selectable rate compensated, fixed temperature sensing with or without rate-of-rise operation.

4. Mounting: Twist-lock base interchangeable with smoke-sensor heads.

5. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

6. Sensor fixed temperature sensing shall be independent of rate-of-rise sensing and programmable to operate at [135-deg F or 155-deg F][135-deg F, 155-deg F or 190-deg F]. Sensor rate-of-rise temperature detection shall be selectable at the FACU for either 15-deg F or 20-deg F per minute.

7. Sensor shall have the capability to be programmed as a utility monitoring device to monitor for temperature extremes in the range from 32-deg F to 155-deg F.
8. Unless otherwise indicated, sensors shall be analog-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for temperature by fire-alarm control unit.
    a. Rate-of-rise temperature characteristic shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
    b. Fixed-temperature sensing shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at [135 or 155 deg F (57 or 68 deg C)][135-deg F, 155-deg F or 190-deg F. (57, 68 or 88 deg C.)].

E. Addressable Circuit Interface Modules
1. Addressable Circuit Interface Modules: Arrange to monitor or control one or more system components that are not otherwise equipped for addressable communication. Modules shall be used for monitoring of waterflow, valve tamper, non-addressable devices, and for control of AHU systems.
2. Addressable Circuit Interface Modules will be capable of mounting in a standard electric outlet box or be cabinet mounted using appropriate mounting to allow quick replacement. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line circuit or a separate two wire pair running from an appropriate power supply, as required.
3. There shall be the following types of modules:
    a. Type 1: Monitor Circuit Interface Module:
        1) For conventional 2-wire smoke detector and/or contact device monitoring with Class B or Class A wiring supervision. This module will communicate status (normal, alarm, trouble) to the FACU.
        2) For conventional 4-wire smoke detector with Class B wiring supervision. The module will provide detector reset capability and over-current power protection for the 4-wire detector. This module will communicate status (normal, alarm, trouble) to the FACU.
    b. Type 2: Line Powered Monitor Circuit Interface Module
        1) This type of module is an individually addressable module that has both its power and its communications supplied by the two wire signaling line circuit. It provides location specific addressability to an initiating device by monitoring normally open dry contacts. This module shall have the capability of communicating four zone status conditions (normal, alarm, current limited, trouble) to the FACU.
        2) This module shall provide location specific addressability for up to five initiating devices by monitoring normally closed or normally open dry contact security devices. The module shall communicate four zone status conditions (open, normal, abnormal, and short). The two-wire signaling line circuit shall supply power and communications to the module.
    c. Type 3: Single Address Multi-Point Interface Modules
        1) This multipoint module shall provide location specific addressability for four initiating circuits and control two output relays from a single address. Inputs shall provide supervised monitoring of normally open, dry contacts and be capable of communicating four zone status conditions (normal, open, current limited, and short). The input circuits and output relay operation shall be controlled independently and disabled separately.
        2) This dual point module shall provide a supervised multi-state input and a relay output, using a single address. The input shall provide supervised monitoring of

two normally open, dry contacts with a single point and be capable of communicating four zone status conditions (normal, open, current limited, and short). The two-wire signaling line circuit shall supply power and communications to the module.

3) This dual point module shall monitor an unsupervised normally open, dry contact with one point and control an output relay with the other point, using a single address. The two-wire signaling line circuit shall supply power and communications to the module.

d. Type 4: Line Powered Control Circuit Interface Module

1) This module shall provide control and status tracking of a Form "C" contact. The two-wire signaling line circuit shall supply power and communications to the module.

e. Type 5: 4-20 mA Analog Monitor Circuit Interface Module

1) This module shall communicate the status of a compatible 4-20 mA sensor to the FACU. The FACU shall annunciate up to three threshold levels, each with custom action message; display and archive actual sensor analog levels; and permit sensor calibration date recording.

4. All Circuit Interface Modules shall be supervised and uniquely identified by the control unit. Module identification shall be transmitted to the control unit for processing according to the program instructions. Modules shall have an on-board LED to provide an indication that the module is powered and communicating with the FACU. The LEDs shall provide a troubleshooting aid since the LED blinks on poll whenever the peripheral is powered and communicating.

2.05 ADDRESSABLE NOTIFICATION

A. Addressable Alarm Notification Appliances

1. Addressable Notification Appliances: The Contractor shall furnish and install Addressable Notification Appliances and accessories to operate on compatible signaling line circuits (SLC).

a. Addressable Notification appliance operation shall provide power, supervision and separate control of horns and strobes over a single pair of wires. The controlling channel (SLC) digitally communicates with each appliance and receives a response to verify the appliance's presence on the channel. The channel provides a digital command to control appliance operation. SLC channel wiring shall be unshielded twisted pair (UTP), with a capacitance rating of less than 60pf/ft and a minimum 3 twists (turns) per foot.

b. All Notification Appliances shall operate as a completely independent device allowing for specific location alerting of both fire alarm and Mass Notification functions. Each visible device (both clear fire alarm and amber mass notification) shall be capable of operating on multiple notification zones or completely separate from all other notification devices, this allows “On the fly” program operation changes for Mass Notification alerting and fire alarm notification.

c. All Notification Appliances shall operate as a completely independent device allowing for appliances in handicap accessible rooms and other locations to operate on the same SLC and to activate individually based on an alarm condition in a room or as part of a general alarm condition where all appliances activate together.

d. Individual Notification Appliances shall be able to be grouped into zones (or operational groups) by central programming at the main fire alarm control unit.

e. Notification Appliances shall provide for “unobtrusive” testing. Each Notification Appliance shall be tested for audible and visible operation on an individual basis at the device or from the main fire alarm control unit, allowing for minimal invasive impact.

f. Class B (Style 4) notification appliances shall be wired without requiring traditional in/out

wiring methods; addressable "T" Tapping shall be permitted. Up to 127 addresses can be supported on a single channel.

g. Each Addressable notification appliance shall contain an electronic module and a selectable address setting to allow it to occupy a unique location on the channel. This on-board module shall also allow the channel to perform appliance diagnostics that assist with installation and subsequent test operations. A visible LED on each appliance shall provide verification of communications and shall flash with the appliances address setting when locally requested using a magnetic test tool.

h. Each addressable notification appliance shall have electrical test point access without removing the device cover.

i. Both wall mount and ceiling mount devices shall be available along with weatherproof devices.

2. Addressable Horn: Addressable horn shall be listed to UL 464. Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. Horn appliances shall have a High/Low Setting, programmable by channel from the addressable controller or by appliance from the host FACU. The horn shall have a minimum sound pressure level of 83 or 89 dBA for steady) or of 79 or 85 dBA for coded operation. The horn device shall consist of three pieces; appliance, cover and mounting plate. For ease of installation the mounting plate shall mount directly to a standard single gang, double gang or 4" square electrical box, without the use of special adapter or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot.

3. Addressable Visible/Only: Addressable strobe shall be listed to UL 1971. The V/O device shall consist of a xenon flash tube and associated lens/reflector system, cover and mounting plate. For ease of installation the mounting plate shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The V/O appliance shall be provided with multiple minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135cd and 185cd. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance.

4. Addressable Audible/Visible: Addressable combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe device shall consist of a xenon flash tube and associated lens/reflector system, cover and mounting plate. For ease of installation audible/visible mounting plate shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. The strobe shall provide multiple minimum flash intensities of 15cd, 30cd, 75cd, 110cd, 135cd and 185cd. The Candela levels shall be settable from the fire alarm control unit or using a hardware selector on the appliance. The Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. The horn shall have a minimum sound pressure level of 83 or 89 dBA for steady or 79 or 85 dBA for coded operation. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Appliances shall be wired with UTP conductors, having a minimum of 3 twists per foot. The appliance shall be capable of two-wire synchronization with one of the following options:

a. Synchronized Strobe with Horn on steady.

b. Synchronized Strobe with Temporal Code Pattern on Horn.

c. Synchronized Strobe with March Time cadence on Horn.

d. Synchronized Strobe firing to NAC sync signal with Horn silenced.

5. Addressable Weatherproof Visible Only: Addressable weatherproof strobe shall be UL 1971 listed for indoor applications with strobe intensity selectable as 15 or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75) or 185 cd (WP185). The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The V/O device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof cover and weatherproof mounting box. The V/O appliance shall be provided with multiple minimum flash intensities of 15, 75, WP 75, or WP 185 candela. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance.

6. Addressable Weatherproof Audible/Visible: Addressable weatherproof horn/strobe shall be UL 464 and UL 1971 listed for indoor applications with strobe intensity selectable as 15 or 75 cd or UL 1638 listed for outdoor applications with strobe rated at 75 cd (WP75) or 185 cd (WP185).. The appliances shall be acceptable for indoor and outdoor, extended temperature and extended humidity applications. The A/V device shall consist of a xenon flash tube and associated lens/reflector system, weatherproof cover and weatherproof mounting box. The strobe appliance shall be provided with multiple minimum flash intensities of 15, 75, WP 75, or WP 185 candela. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance. The Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. The horn shall have a minimum sound pressure level of 81 or 87 dBA for steady or 80 or 87 dBA for coded operation.

7. Addressable LED Visible Only: Addressable LED visible strobe (V/O) shall be listed to UL 1971. The multi-candela LED V/O strobe device shall be available in low (15, 30, 75 cd) and high (110, 135, 185 cd) range candela. Models shall provide a small compact design with low current draw due to efficient strobe LED's. LED strobe device shall consist of two pieces; cover and appliance/mounting plate. For ease of installation the appliance/mounting plate shall mount directly to a standard single gang electrical box, without the use of special adapter or trim rings. Synchronized LED strobe operation shall be provided with other LED or Xenon strobe devices on the same circuit or the same panel on different circuits. LED strobe device shall meet the 20ms pulse width requirement in the 2016 Edition of NFPA 72. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. The Candela levels shall be settable from the fire alarm control unit or by using a hardware selector on the appliance. Weatherproof model shall mount to provided single gang weatherproof electrical box.

8. Addressable LED Audible/Visible: Addressable combination LED Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. Horn shall support Temporal Code 3, March Time (20, 60, or 120 BPM), Continuous, and Temporal Code 4 coding patterns. Horn shall have a High/Low Setting, selectable at the appliance or programmable from the addressable controller by appliance from the host FACU. The horn shall have a minimum sound pressure level of 85 or 87 dBA for steady) or of 81 or 83 dBA for coded operation. The multi-candela LED V/O strobe device shall be available in low (15, 30, 75 cd) and high (110, 135, 185 cd) range candela. Models shall provide a small compact design with low current draw due to efficient strobe LED's. Synchronized LED strobe operation shall be provided with other LED or Xenon strobe devices on the same circuit or the same panel on different circuits. LED strobe device shall meet the 20ms pulse width requirement in the 2016 Edition of NFPA 72. The A/V device shall consist of two pieces; cover and appliance/mounting plate. For ease of installation the appliance/mounting plate shall mount directly to a standard single gang electrical box, without the use of special adapter or trim rings. When the appliance is connected to an active circuit, the front cover of the appliance shall be removable without causing a trouble indication on the fire alarm control unit. Weatherproof model shall mount to provided single gang weatherproof electrical box.

9. Isolator Module: Isolator module provides short circuit isolation for addressable notification appliance SLC wiring. Isolator shall be listed to UL 864. The Isolator shall mount directly to

a minimum 2 1/8" deep, standard 4" square electrical box, without the use of special adapter or trim rings. Power and communications shall be supplied by the Addressable Controller channel SLC; dual port design shall accept communications and power from either port and shall automatically isolate one port from the other when a short circuit occurs. The following functionality shall be included in the Isolator module:

a. Report faults to the host FACU.

b. On-board Yellow LED provides module status.

c. After the wiring fault is repaired, the Isolator modules shall test the lines and automatically restore the connection.

10. Accessories: The contractor shall furnish the necessary accessories.

2.06 NAC POWER EXTENDER

A. The SLC NAC Power Extender panel shall be a stand-alone panel capable of powering a minimum of 4 notification appliance circuits. Notification appliance circuits shall be [Class B, Style Y] [Class A, Style Z] rated at 2 amps each. Panel shall provide capability to be expanded to 8 notification appliance circuits.

B. The internal power supply and battery charger shall be capable of charging up 12.7 Ah batteries internally mounted or 18Ah batteries mounted in an external cabinet.

C. The NAC extender panel may be mounted close to the host control unit or can be remotely located. The SLC Addressable NAC Extender Panel when connected to an addressable panel shall connect to the host panel via an SLC communications channel. Via the SLC channel each output NAC can be individually controlled for general alarm or selective area notification.

D. For SLC connected NAC extender panels up to five panels can be connected on a single SLC channel.

E. When connected to a conventional (non-addressable panel) one or two standard notification appliance circuits from the main control unit may be used to activate all the circuits on the NAC power extender panel.

F. Alarms from the host fire alarm control unit shall signal the NAC power extender panel to activate. The panel shall monitor itself and each of its NACs for trouble conditions and shall report trouble conditions to the host panel.

2.07 MAGNETIC DOOR HOLDERS

A. Description: Units shall be listed to UL 228. Units are equipped for wall or floor mounting as indicated and are complete with matching door plate. Unit shall operate from a 120VAC, a 24VAC or a 24VDC source, and develop a minimum of 25 lbs. holding force.

B. Material and Finish: Match door hardware.

2.08 EMERGENCY POWER SUPPLY

A. General: Components include battery, charger, and an automatic transfer switch.

B. Battery: Sealed lead-acid or nickel cadmium type. Provide sufficient capacity to operate the complete alarm system in normal or supervisory (non-alarm) mode for a period of 4 hours. Following this period of operation on battery power, the battery shall have sufficient capacity to operate all components of the system, including all alarm notification devices in alarm mode for a period of 15 minutes.

2.09 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.

2. Finish: Paint of color to match the protected device.

PART 3 – EXECUTION

3.01 INSTALLATION, GENERAL

A. Install system components and all associated devices in accordance with applicable NFPA Standards and manufacturer's recommendations.

B. Installation personnel shall be supervised by persons who are qualified and experienced in the installation, inspection, and testing of fire alarm systems. Examples of qualified personnel shall include, but not be limited to, the following:

1. Factory trained and certified personnel.
2. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.
3. Personnel licensed or certified by state or local authority.

3.02 EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm System as described herein and as shown on the plans. Include sufficient control unit(s), annunciator(s), manual stations, automatic fire detectors, smoke detectors, audible and visible notification appliances, wiring, terminations, electrical boxes, Ethernet drops, and all other necessary material for a complete operating system.

B. Existing Fire Alarm Equipment shall be maintained fully operational until the new equipment has been tested and accepted.

C. Equipment Removal: After acceptance of the new fire alarm system, disconnect and remove the existing fire alarm equipment and restore damaged surfaces. Package operational fire alarm and detection equipment that has been removed and deliver to the Client Agency. Remove from the site and legally dispose of the remainder of the existing material.

D. Water-Flow and Valve Supervisory Switches: Connect for each sprinkler valve required to be supervised.

E. Device Location-Indicating Lights: Locate in the public space immediately adjacent to the device they monitor.

F. Install manual station with operating handle 48 inches above floor. Install wall mounted audible and visual notification appliances not less than 80 inches above floor to bottom of lens and not greater than 96 inches above floor to bottom of lens.

G. Mount outlet box for electric door holder to withstand 80 pounds pulling force.

H. Make conduit and wiring connections to door release devices, sprinkler flow switches, sprinkler valve tamper switches, fire suppression system control units, duct smoke detectors.

I. Automatic Detector Installation: Conform to NFPA 72.

J. Ethernet Drop: A standard RJ-45 Ethernet connection to the Client Agency’s Ethernet network shall be provided at each fire alarm control unit as part of the contract.

3.03 PREPARATION

A. Coordinate work of this Section with other affected work and construction schedule.

3.04 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Division 8 Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Smoke dampers in air ducts of designated air-conditioning duct systems.

2. Alarm-initiating connection to activate emergency shutoffs for gas and fuel supplies.
3. Supervisory connections at valve supervisory switches.
4. Supervisory connections at low-air-pressure switch of each dry-pipe sprinkler system.

3.05 WIRING INSTALLATION

A. System Wiring: Wire and cable shall be a type listed for its intended use by an approval agency acceptable to the Authority Having Jurisdiction and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).

B. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable to be used for this installation. No deviation from the written instruction shall be made by the Contractor without the prior written approval of the Fire Alarm System Manufacturer.

C. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Use one color code for alarm initiating device circuits wiring and a different color code for supervisory circuits. Color-code notification appliance circuits differently from alarm-initiating circuits. Paint fire alarm system junction boxes and covers red.

D. Ethernet Circuits:
1. Ethernet circuits shall be provided to the Fire Alarm Control Unit as shown on the plans.
2. Where a dedicated Fire Alarm Ethernet LAN is specified only Agency Listed Fire Alarm Ethernet hardware shall be installed.
3. The electrical contractor shall coordinate and ensure proper Ethernet connections occur at the fire alarm control unit [and other designated equipment locations][none]prior to system turnover.

3.06 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

B. Install framed instructions in a location visible from fire-alarm control unit.

3.07 GROUNDING

A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.08 FIELD QUALITY CONTROL

A. Manufacturer's Field Services: Provide services of a factory-authorized service representative to supervise the field assembly and connection of components and the pretesting, testing, and adjustment of the system.

B. Service personnel shall be qualified and experienced in the inspection, testing, and maintenance of fire alarm systems. Examples of qualified personnel shall be permitted to include, but shall not be limited to, individuals with the following qualifications:
1. Factory trained and certified.
2. National Institute for Certification in Engineering Technologies (NICET) fire alarm certified.
3. International Municipal Signal Association (IMSA) fire alarm certified.
4. Certified by a state or local authority.
5. Trained and qualified personnel employed by an organization listed by a national testing laboratory for the servicing of fire alarm systems.

C. Pretesting: Determine, through pretesting, the conformance of the system to the requirements of the Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new and retest until satisfactory performance and conditions are achieved.

D. Inspection:

1. Inspect equipment installation, interconnection with system devices, mounting locations, and mounting methods.
2. Verify that units and controls are properly installed, connected, and labeled and that interconnecting wires and terminals are identified.

E. Acceptance Operational Tests:

1. Perform operational system tests to verify conformance with specifications:
   a. Each alarm initiating device installed shall be operationally tested. Each device shall be tested for alarm and trouble conditions. Contractor shall submit a written certification that the Fire Alarm System installation is complete including all punch-list items. Test battery operated emergency power supply. Test emergency power supply to minimum durations specified. Test Supervising Station Signal Transmitter. Coordinate testing with Supervising Station monitoring firm/entity.
   b. Test each Notification Appliance installed for proper operation. Submit written report indicating sound pressure levels at specified distances.
   c. Test Fire Alarm Control Unit and Remote Annunciator.
2. Provide minimum 10 days notice of acceptance test performance schedule to Client Agency, and local Authority Having Jurisdiction.

F. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets the Specifications and complies with applicable standards.

G. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Use NFPA 72 Forms for documentation.

H. Final Test, Record of Completion, and Certificate of Occupancy:

1. Test the system as required by the Authority Having Jurisdiction in order to obtain a certificate of occupancy. Provide completed NFPA 72 Record of Completion form to Client Agency and AHJ.

3.09 DEMONSTRATION

A. Engage a factory-authorized service representative to train Client Agency's maintenance personnel to adjust, operate, and maintain fire-alarm system.

3.10 CLEANING AND ADJUSTING

A. Cleaning: Remove paint splatters and other spots, dirt, and debris. Clean unit internally using methods and materials recommended by manufacturer.

B. Occupancy Adjustments: When requested within one year of date of Substantial Completion, provide on-site assistance in adjusting sound pressure levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.11 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Client Agency's maintenance personnel as specified below.

1. Train Client Agency's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 8 hours' training.
2. Schedule training with the Client Agency at least seven days in advance.

END OF SECTION

SECTION 311000

SITE CLEARING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Protecting existing vegetation to remain.

2. Removing existing vegetation.

3. Clearing and grubbing.

4. Stripping and stockpiling topsoil.

5. Temporary erosion- and sedimentation-control measures.

1.3 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Client Agencies property, cleared materials shall become Contractor's property and shall be removed from Project site and disposed of in an approved manner. This includes but is not limited to removed vegetation, stumps, garbage, excess soils, etc.

1.4 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Client Agency and authorities having jurisdiction.

2. Provide alternate routes around closed or obstructed traffic ways if required by Client Agency or authorities having jurisdiction.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing. New Jersey One-Call System.

C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

D. Protect existing trees indicated to remain.

PART 2 - PRODUCTS – NOT USED.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Client Agency.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

C. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

D. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 TREE AND PLANT PROTECTION

A. Protection of Existing Trees and Vegetation: Protect existing trees and other vegetation indicated to remain in place, as shown on the plans, against unnecessary cutting, breaking or skinning of roots, skinning and bruising of bark, smothering of trees by stockpiling construction materials excavated materials within drip line, excess foot or vehicular traffic, or parking of vehicles within drip line. Provide temporary guards to protect trees and vegetation to be left standing.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect / Engineer.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.

1. Arrange with utility companies and College representatives to shut off indicated utilities.

3.5 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 8 inches or depth as determined by Geotechnical Inspector in a manner to prevent intermingling with underlying subsoil or other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.

3.6 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, and waste materials including trash and debris, and legally dispose of them off Client Agencies property.

END OF SECTION 31 10 00

SECTION 311001

SOIL EROSION AND SEDIMENTATION CONTROL

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Temporary erosion- and sedimentation-control measures.

1.3 REFERENCES

A. The New Jersey Standards for Soil Erosion and Sediment Control, Latest Edition

1.4 PROJECT CONDITIONS

A. All earth disturbance activities on this project shall be conducted in accordance with the term and conditions of the approved Erosion and Sediment Control Plan.

B. Utility Locator Service: Notify utility locator service for area where Project is located before site clearing. Pennsylvania One-Call System, Inc. design serial number is provided on the Drawings.

C. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

PART 2 - PRODUCTS

A. Products such as compost filter socks, erosion control blankets, rock construction entrance pads, and geotextiles shall be as indicated on the Drawings, or equal as approved by Professional.

PART 3 - EXECUTION

3.1 PERMIT CONDITIONS

A. Comply with permit construction sequencing, methods, and materials, as indicated on the Drawings.

3.2 GENERAL

A. Utilize erosion and sedimentation control practices as well as protect against the discharge of pollutants during construction.

B. Protect the soil by use of temporary vegetation, or seeding and mulch, or by accelerating the establishment or permanent vegetation. Complete and protect segments of work as rapidly as is consistent with construction schedules.

C. Retard the rate of runoff from the construction site and control disposal of runoff.

D. Utilize inlet silt bags or other sediment holding devices at inlets, cross drains, etc.

E. Trap sediment resulting from construction in temporary or permanent silt holding basins. This includes pump discharges resulting from dewatering operations.

F. Sprinkle or apply dust suppressor or otherwise keep dust within tolerable limits on haul roads and at the site.

G. Should construction operations be suspended for any appreciable length of time, temporary measure for control of erosion must be utilized.

3.3 MAINTENANCE OF EROSION AND SEDIMENTATION CONTROL

A. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

B. All controls shall be inspected weekly or after a storm event greater than 0.5 inches of rain.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.4 POST CONSTRUCTION STORMWATER MANAGEMENT

A. N/A

END OF SECTION

SECTION 312000

EARTHMOVING

PART 1 – GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.

2. Excavating and backfilling for buildings and structures.

3. Subbase course for cement concrete walks.

4. Subbase course and base course for asphalt paving.

5. Excavating and backfilling for utility trenches.

1.3 DEFINITIONS

A. Backfill: Soil material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.

2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

D. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.

1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect / Engineer. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect / Engineer. Unauthorized excavation, as well as remedial work directed by Architect / Engineer, shall be without additional compensation.

E. Fill: Soil materials used to raise existing grades.

F. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

G. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

H. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

I. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 REFERENCES

A. PADOT Standard Specifications for Road and Bridge Construction, 2019.

1.5 QUALITY ASSURANCE

A. Pre-excavation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations. Pennsylvania One-Call System, Inc. design serial number is provided on the Drawings.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487, or a combination of these groups; free of rock or gravel larger than 2 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; meeting the requirements of PADOT Standard Specifications for Road and Bridge Construction, 2007, Dense Graded Aggregate Base Course.

E. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

F. Bedding Course: Narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; AASHTO #57.

2.2 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic of core #10 wire encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Furnish, put in place, and maintain such sheeting, bracing, trench boxes, etc. as may be required to support the sides of the excavation and to prevent any movement of earth which could in any way diminish the width of the excavation below that necessary for proper construction or otherwise injure persons in or about the work or endanger the adjacent structures or delay the work.

3.3 HIGH ENERGY VIBRATORY PROOF-ROLLING

3.4 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

3.5 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: As indicated on the Drawings.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches to depths indicated on Drawings.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3. Cut and protect roots as required.

3.7 SUBGRADE INSPECTION

A. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired dump truck to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect / Engineer, without additional compensation.

3.8 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi, may be used when approved by Architect / Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect / Engineer.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Place and compact initial backfill of bedding course material, to a height of 12 inches over the pipe or conduit.

1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

D. Place and compact final backfill of satisfactory soil to final subgrade elevation.

E. Install warning tape directly above utilities, 6 inches below finished grade.

3.11 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:

1. Under grass and planted areas, use satisfactory soil material.

2. Under walks and pavements, use satisfactory soil material.

3. Under steps and ramps, use engineered fill.

4. Under building slabs, use engineered fill.

5. Under footings and foundations, use engineered fill.

3.12 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.

2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.

3.13 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth and compacted using a 5-ton minimum static-drum-weight vibratory compactor.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:

1. Under structures, building slabs, steps, and pavements, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill soil material at 95 percent.

2. Under walkways, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 95 percent.

3. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 92 percent.

4. For utility trenches located under walkways or pavements, compact each layer of initial and final backfill soil material at 95 percent for trenches in under turf or unpaved areas

5. For utility trenches located under turf or unpaved areas, compact each layer of initial and final backfill soil material at 85 percent.

3.14 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus, or minus 1 inch.

2. Walks: Plus, or minus 1 inch.

3. Pavements: Plus or minus ½ inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of ½ inch when tested with a 10-foot straightedge.

3.15 SUBBASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course under pavements and walks as follows:

1. Shape subbase course to required crown elevations and cross-slope grades.

2. Compact subbase course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 1557.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Client Agency will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect / Engineer.

D. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.17 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Client Agencies property.

END OF SECTION

SECTION 312319

DEWATERING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section includes construction dewatering.

1.3 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide temporary grading to facilitate dewatering and control of surface water.

B. Monitor dewatering systems continuously.

C. Protect and maintain temporary erosion and sedimentation controls, which are specified in Division 31 Section "Site Clearing" during dewatering operations.

D. Provide an adequate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Install sufficient dewatering equipment to drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-sump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.

END OF SECTION 312319

SECTION 321216

ASPHALT PAVING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Warm-mix asphalt paving.

2. Pavement-marking paint.

B. Related Sections:

1. Division 31 Section "Earth Moving" for aggregate subbase and base courses and for aggregate pavement shoulders.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.

1. Job-Mix Designs: Certification, by authorities having jurisdiction, of approval of each job mix proposed for the Work.

1.4 REFERENCES

A. Commonwealth of Pennsylvania Department of Transportation, Specification, Publication 408, latest issue; hereinafter referred to as “Specification, Publication 408.”

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by Pennsylvania Department of Transportation.

B. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of Specification, Publication 408 for asphalt paving work.

1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

C. Preinstallation Conference: Conduct conference at Project site.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Asphalt Base Course: Minimum surface temperature of 35 deg F and rising at time of placement.

2. Asphalt Surface Course: Minimum surface temperature of 40 deg F at time of placement.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature 50 deg F, and not exceeding 95 deg F.

PART 2 - PRODUCTS

2.1 SUPERPAVE BASE COURSE

A. Superpave base course shall meet the requirements of Specification, Publication 408, Section 311.2.

2.2 SUPERPAVE WEARING COURSE

A. Superpave wearing course shall meet the requirements of Specification, Publication 408, Section 411.2.

2.3 AUXILIARY MATERIALS

A. Latex Pavement-Marking Paint:

1. Marking paint shall meet the requirements of Specification, Publication 408, Section 962.2.

2. Color: As indicated on the Drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

3.3 PLACING SUPERPAVE BASE COURSE

A. Machine place in a manner that meets the requirements of Specification, Publication 408, Section 311.3.

3.4 PLACING SUPERPAVE WEARING COURSE

A. Machine place in a manner that meets the requirements of Specification, Publication 408, Section 411.3.

3.5 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

B. Construction joints shall meet the requirements of Specification, Publication 408, Section 409.3(k).

3.6 PAVEMENT MARKING

A. Do not apply pavement-marking paint until layout, colors, and placement have been verified with Architect/Engineer.

B. Allow paving to age for 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment in a manner that meets the requirements of Specification, Publication 408, Section 962.3.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Client Agency will engage a qualified testing agency to perform tests and inspections.

B. Replace and compact hot-mix asphalt where core tests were taken.

C. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

END OF SECTION 321216

SECTION 321313

CONCRETE PAVING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. This Section includes exterior cement concrete pavement for the following:

1. Concrete Curbs
2. Concrete Sidewalks and patios.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete pavement mixture.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Manufacturer of ready-mixed concrete products who complies with ASTM C 94/C 94M requirements for production facilities and equipment.

B. ACI Publications: Comply with ACI 301, "Specification for Structural Concrete," unless modified by requirements in the Contract Documents.

C. Establish and maintain required lines and elevations.

D. Obtain cementation materials from same source throughout.

1.5 REFERENCES

A. American Concrete Institute (ACI) Latest Edition
301 Specifications for Structural Concrete for Buildings
304R Guide for Measuring Mixing, Transporting and Placing Concrete
308 Standard Practice for Curing Concrete

B. American Society for Testing and Materials (ASTM) latest edition
A 185 Steel Welded Wire Fabric, Plain for Concrete for Buildings
C497 Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
A615 Deformed and Plain Billet-Steel for Concrete Reinforcement C33
Concrete Aggregates

C 94 Ready-Mixed Concrete
C 150 Portland Cement
C 260 Air-Entraining Admixtures for Concrete
D 309 Liquid Membrane-Forming Compounds for Curing Concrete
C494 Chemical Admixtures for Concrete
C1751 Performed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)

C. Commonwealth of Pennsylvania Department of Transportation, Publication 408 Specifications, latest issue; hereinafter referred to as "PennDOT Specification."

PART 2 - PRODUCTS

2.1 MATERIALS

A. Forms: Steel, wood, or other suitable material of size and strength to resist movement during concrete placement and to retain horizontal and vertical alignment until removal. Use straight forms, free of distortion and defects. Use flexible spring steel forms or laminated boards to form radius bends as required. Forms shall be of depth equal to depth of curbing or sidewalk, and so designed as to permit secure fastening together at tops. Coat forms with nonstaining type of coating that will not discolor or deface surface of concrete.

B. Plain-Steel Welded Wire Reinforcement: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

C. Deformed-Steel Welded Wire Reinforcement: ASTM A 497, flat sheet.

D. Reinforcing Bars: ASTM A 615/A 615M, Grade 60; deformed.

E. Plain Steel Wire: ASTM A 82, as drawn.

F. Deformed-Steel Wire: ASTM A 496.

G. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice."

2.2 CONCRETE MATERIALS

A. Cementitious Material: Provide in accordance with PennDOT Specification Publication 408, Section 704, Latest Edition

B. Water: ASTM C 94/C 94M.

C. Air-Entraining Admixture: ASTM C 260.

D. Chemical Admixtures: ASTM C 494/C 494M, of type suitable for application, certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

2.3 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder: Waterborne, monomolecular film forming; manufactured for application to fresh concrete.

E. Clear Waterborne Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.4 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751 fiberboard units or ASTM D 1752, cork or self-expanding cork.

B. Penetrating Anti-Spalling Sealer (For exterior concrete sidewalks and curbs)

1. The sealer shall be a siloxane-based compound which has a 96% chloride-ion screen and a repellency factor of 92% when tested in accordance with NCHARP #244, Test Method. In addition, the sealer-treated concrete must exhibit no scaling when exposed to 120 cycles of freezing and thawing in accordance with ASTM C 672. The tests must be made by an independent testing laboratory. The manufacturer shall offer a three-year warranty bond issued by an insurance company in the amount agreed upon by the Manufacturer and the Client Agency.

2. The product shall be “Euco-Guard” by the Euclid Chemical Co. or approved equal.

3. The slab must be cured by a continuous moisturizing method approved by the Architect/Engineer or by using “Kurez DR” by the Euclid Chemical Co.

2.5 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according PennDOT Specifications Publication 408, Section 704, latest edition, with the following properties:

1. Compressive Strength (28 Days): 3300 psi.
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.50.
3. Slump Limit: 1 inch to 3 inch, plus or minus 1 inch.
4. Air Content: 5-1/2 percent plus or minus 1.5 percent.

2.6 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the Work.

PART 3 - EXECUTION

3.1 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides for pavement to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.2 STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

3.3 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edgings true to line with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline, unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of pavement and at locations where pavement operations are stopped for more than one-half hour unless pavement terminates at isolation joints.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, walks, other fixed objects, and where indicated.

D. Contraction Joints: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of the concrete thickness.

E. Edging: Tool edges of pavement, gutters, curbs, and joints in concrete after initial floating with an edging tool to a 1/4-inch radius. Repeat tooling of edges after applying surface finishes. Eliminate tool marks on concrete surfaces.

3.4 CONCRETE PLACEMENT

A. Place concrete in accordance with requirements of PennDOT Specifications.

B. Moisten subbase to provide a uniform dampened condition at time concrete is placed.

C. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

D. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

E. Screed pavement surfaces with a straightedge and strike off.

F. Commence initial floating using bull floats or darbies to impart an open textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

3.5 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats, or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Burlap Finish: Drag a seamless strip of damp burlap across float-finished concrete, perpendicular to line of traffic, to provide a uniform, gritty texture.
2. Medium-to-Fine-Textured Broom Finish: Draw a soft bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture.
3. Medium-to-Coarse-Textured Broom Finish: Provide a coarse finish by striating float-finished concrete surface 1/16 to 1/8 inch deep with a stiff-bristled broom, perpendicular to line of traffic.

3.6 CONCRETE PROTECTION AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures.

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by moisture curing moisture-retaining-cover curing curing compound or a combination of these methods.

3.7 EXPANSION JOINTS

A. Work to meet the requirements of requirements of PennDOT Specifications

B. Expansion joints sealant to be placed every 20’ or as indicated on the drawings and installed per manufacturer’s recommendations.

3.8 REPAIRS AND PROTECTION

A. Remove and replace concrete pavement that is broken, damaged, or defective or that does not comply with requirements in this Section.

B. Protect concrete from damage. Exclude traffic from pavement for at least 14 days after placement.

C. Maintain concrete pavement free of stains, discoloration, dirt, and other foreign material. Sweep concrete pavement not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 321313

SECTION 321373

CONCRETE PAVING JOINT SEALANTS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Cold-applied joint sealants.
2. Joint-sealant backer materials.
3. Primers.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Concrete pavement joint sealants.
2. Joint-sealant backer materials.

B. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for each type of joint sealant.

C. Samples for Verification: Actual sample of finished products for each kind and color of joint sealant required.

1. Size: Joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer .

1.5 QUALITY ASSURANCE

A. Qualifications:

1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing: Performed by a qualified testing agency.

1.7 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backer materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pecora
   b. Sika
   c. W. R. Meadows, Inc.
   d. Or equal as approved by the Professional.

2.3 JOINT-SEALANT BACKER MATERIALS

A. Joint-Sealant Backer Materials: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by joint-sealant manufacturer, based on field experience and laboratory testing.

B. Backer Strips for Cold- and Hot-Applied Joint Sealants: ASTM D5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.4 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine joints to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Cleaning of Joints: Before installing joint sealants, clean out joints immediately to comply with joint-sealant manufacturer's written instructions.

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions.

C. Install joint-sealant backers to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backer materials.
2. Do not stretch, twist, puncture, or tear joint-sealant backer materials.
3. Remove absorbent joint-sealant backer materials that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants immediately following backer material installation, using proven techniques that comply with the following:

1. Place joint sealants so they fully contact joint substrates.
2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants in accordance with the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING AND PROTECTION

A. Clean off excess joint sealant as the Work progresses, by methods and with cleaning materials approved in writing by joint-sealant manufacturers.

B. Protect joint sealants, during and after curing period, from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately and replace with joint sealant so installations in repaired areas are indistinguishable from the original work.

3.5 PAVING-JOINT-SEALANT SCHEDULE

A. Joints within concrete paving:

1. Joint Location:
   a. Expansion and isolation joints in concrete paving.
   b. Contraction joints in concrete paving.
   c. Other joints as indicated.
2. Joint Sealant: Single component, pourable, urethane, elastomeric joint sealant .
3. Joint-Sealant Color: Manufacturer's standard As selected by Architect from manufacturer's full range. .

END OF SECTION 321373

SECTION 32 3200

SEGMENTAL RETAINING WALL SYSTEMS

PART 1: GENERAL

1.01 STIPULATIONS

A. The specifications sections "General Conditions of the Construction Contract", "Special Conditions", and "Division 1 - General Requirements" form a part of this Section by this reference thereto, and shall have the same force and effect as if printed herewith in full.

1.02 REFERENCE STANDARDS

A. Segmental Retaining Wall Units

1. ASTM C 140 – Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units
2. ASTM C 1372 – Standard Specification for Dry-Cast Segmental Retaining Wall Units

B. Geosynthetic Reinforcement

1. ASTM D 4595 – Standard Test Method for Tensile Properties of Geotextiles by the Wide-Width Strip Method
2. ASTM D 5262 – Standard Test Method for Evaluating the Unconfined Tension Creep and Creep Rupture Behavior of Geosynthetics
3. ASTM D 5321 – Standard Test Method for Determining the Shear Strength of Soil-Geosynthetic and Geosynthetic-Geosynthetic Interfaces by Direct Shear
4. ASTM D 5818 – Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics
5. ASTM D 6706 – Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil

C. Soils

1. ASTM D 698 – Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
2. ASTM D 2487 – Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)
3. ASTM D 422 – Standard Test Method for Particle-Size Analysis of Soils
4. ASTM D 4318 – Standard Test Methods for Liquid Limit, Plastic Limit and Plasticity Index of Soils
5. ASTM G 51 – Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing

D. Drainage Pipe

1. ASTM F 758 – Standard Specification for Smooth-Wall Polyvinyl Chloride (PVC) Plastic Underdrain Systems for Highway, Airport or Similar Drainage
2. ASTM F 405 – Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings

E. Engineering Design

1. “NCMA Design Manual for Segmental Retaining Walls,” 3rd Edition, 2009.

F. Where specifications and reference documents conflict, the Wall Design Engineer shall make the final determination of applicable document.

1.03 SUBMITTALS

A. Materials Submittals: The Contractor shall submit manufacturers' certifications two weeks prior to start of work stating that the SRW units and geosynthetic reinforcement meet the requirements of Section 2 of this specification.

B. Design Submittal: The Contractor shall submit two sets of detailed design calculations and final retaining wall plans for approval at least two weeks prior to the beginning of wall construction. All calculations and drawings shall be prepared and sealed by a professional Civil Engineer (P.E.) – (Wall Design Engineer) experienced in SRW design and licensed in the state where the wall is to be built.

1.04 DELIVERY, STORAGE AND HANDLING

A. Contractor shall check materials upon delivery to ensure that the specified type and grade of materials have been received and proper color and texture of SRW units have been received.

B. Contractor shall store and handle materials in accordance with manufacturer’s recommendations and in a manner to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breaking, chipping or other causes.

C. Contractor shall prevent excessive mud, wet concrete, epoxies and similar materials that may affix themselves from coming in contact with materials.

D. Contractor shall protect materials from damage; no damaged material shall be incorporated into the segmental wall.

E. Geosynthetic shall be protected from UV exposure and the protective covering on geosynthetic shall remain until immediately before installation and shall be stored at temperatures above -10 degrees F.

PART 2: MATERIALS

2.01 SEGMENTAL RETAINING WALL UNITS

A. SRW units shall be machine-formed, Portland cement concrete blocks specifically designed for retaining wall applications, matching existing.

B. Color of SRW units shall match existing and shall be selected by Architect from manufacturer’s full range.

C. Finish of SRW units shall be weathered split-face. A weathered split-face is a straight-face unit that is mechanically finished to create rounded corners and edges similar in appearance to naturally worn stones or cobbles.

D. SRW unit faces shall be of straight geometry.

E. SRW units shall provide a minimum weight of 120 psf wall face area.

F. SRW units shall be solid through the full depth of the unit.

G. SRW units shall have a depth (front face to rear) to height ratio of 2:1, minimum.

H. SRW units shall be capable of being erected with the horizontal gap between adjacent units not exceeding 1/8 inch.

I. SRW units shall be interlocked with connection pins that provide ¾-inch setback or ¼-inch setback from unit below (yielding a 7-degree or 2-degree cant from vertical).

J. SRW units shall be sound and free of cracks or other defects that would interfere with the proper placing of the unit or significantly impair the strength or permanence of the structure. Any cracks or chips observed during construction shall fall within the guidelines outlined in ASTM C 1372.

K. Concrete SRW units shall conform to the requirements of ASTM C 1372 and have a minimum net average 28 days compressive strength of 3000 psi. Compressive strength test specimens shall conform to the saw-cut coupon provisions of ASTM C 140.

L. SRW units' molded dimensions shall not differ more than ± 1/8 inch from that specified, as measured in accordance with ASTM C 140. This tolerance does not apply to architectural surfaces, such as split-faces.

SRW cap units shall be matching solid units, 11 5/8 inches x 16 inches by 3" thick.

2.02 SEGMENTAL RETAINING WALL UNIT CONNECTION PINS

A. SRW units shall be interlocked with connection pins. The pins shall consist of glass-reinforced nylon made for the expressed use with the SRW units supplied.

2.03 GEOSYNTHETIC REINFORCEMENT

A. Geosynthetic reinforcement shall consist of high-tenacity PET geogrids, HDPE geogrids, or geotextiles manufactured for soil reinforcement applications. The type, strength and placement of the geosynthetic reinforcement shall be determined by procedures outlined in this specification and the "NCMA Design Manual for Segmental Retaining Walls," (3rd Edition, 2009), and materials shall be specified by Wall Design Engineer in their final wall plans and specifications. The manufacturers/suppliers of the geosynthetic reinforcement shall have demonstrated construction of similar size and types of segmental retaining walls on previous projects.

B. The type, strength and placement of the reinforcing geosynthetic shall be as determined by the Wall Design Engineer, as shown on the final, P.E.-sealed retaining wall plans.

2.04 LEVELING PAD

A. Material for leveling pad shall consist of compacted sand, gravel, or combination thereof (USCS soil types GP, GW, SP and SW) and shall be a minimum of 6 inches in depth. Lean concrete with a strength of 200-300 psi and 3 inches thick maximum may also be used as a leveling pad material. The leveling pad should extend laterally at least a distance of 6 inches from the toe and heel of the lowermost SRW unit.

2.05 DRAINAGE AGGREGATE

A. Drainage aggregate shall be angular, clean stone or granular fill meeting the following gradation as determined in accordance with ASTM D 422:

Sieve Size	Percent Passing
1 inch	100
3/4 inch	75-100
No. 4	0-60
No. 40	0-50
No. 200	0-5

2.06 DRAINAGE PIPE

A. The drainage collection pipe shall be a perforated or slotted PVC, or corrugated HDPE pipe. The drainage pipe shall be wrapped with a geotextile to function as a filter.

B. Drainage pipe shall be manufactured in accordance with ASTM F 405 or ASTM F 758.

2.07 REINFORCED BACKFILL SOIL

A. The reinforced soil material shall be free of debris. Unless otherwise noted on the final, P.E.-sealed, retaining wall plans prepared by the Wall Design Engineer, the reinforced material shall consist of the inorganic USCS soil types GP, GW, SW, SP and SM, meeting the following gradation, as determined in accordance with ASTM D 422:

Sieve Size	Percent Passing
1 inch	100
No. 4	20-100
No. 40	0-60
No. 200	0-35

B. The maximum particle size of poorly-graded gravels (GP) (no fines) should not exceed 3/4 inch unless expressly approved by the Wall Design Engineer and the long-term design strength (LTDS) of the geosynthetic is reduced to account for additional installation damage from particles larger than this maximum.

C. The plasticity of the fine fraction shall be less than 20.

D. The pH of the backfill material shall be between 3 and 9 when tested in accordance with ASTM G 51.

2.08 GEOTEXTILE FILTER

A. Drainage geotextile shall consist of geosynthetic specifically manufactured for use as a preamble soil filter that retains soil while still allowing water to pass throughout the life of the structure. The type and placement of the geotextile filter material shall be as required by the Wall Design Engineer in their final wall plans and specifications.

PART 3: EXECUTION

3.01 DESIGN

A. The design analysis for the final, P.E.-sealed retaining wall plans prepared by the Wall Design Engineer shall consider the external stability against sliding and overturning, internal stability and facial stability of the reinforced soil mass, and shall be in accordance with acceptable engineering practice and these specifications. The internal and external stability analysis shall be performed in accordance with the “NCMA Design Manual for Segmental Retaining Walls,” (3rd Edition, 2009), using the recommended minimum factors of safety in this manual.

B. While vertical spacing between geogrid layers may vary, it shall not exceed 2.0 feet maximum in the wall design.

C. The geosynthetic placement in the wall design shall have 100% continuous coverage parallel to the wall face. Gapping between horizontally adjacent layers of geosynthetic (partial coverage) will not be allowed.

3.02 EXCAVATION

A. Contractor shall excavate to the lines and grades shown on the project grading plans. Contractor shall take precautions to minimize over-excavation. Over-excavation shall be filled with compacted infill material, or as directed by the Wall Design Engineer, at the Contractor's expense.

B. Contractor shall verify location of existing structures and utilities prior to excavation. Contractor shall ensure all surrounding structures are protected from the effects of wall excavation. Excavation support, if required, is the responsibility of the Contractor.

3.03 Foundation Preparation

A. Soils not meeting the required strength shall be removed and replaced with infill soils.

B. Foundation soil shall be proof-rolled and compacted to 95% standard Proctor density prior to placement of leveling pad materials.

3.04 Leveling Pad Construction

A. Leveling pad shall be placed as shown on the final, P.E.-sealed retaining wall plans with a minimum thickness of 6 inches. The leveling pad should extend laterally at least a distance of 6 inches from the toe and heel of the lowermost SRW unit.

B. Granular leveling pad material shall be compacted to provide a firm, level bearing surface on which to place the first course of units. Well-graded sand can be used to smooth the top 1/4 inch to 1/2 inch of the leveling pad. Compaction will be with mechanical plate compactors to achieve 95% of maximum standard Proctor density (ASTM D 698).

3.05 SRW Unit Installation

A. All SRW units shall be installed at the proper elevation and orientation as shown on the final, P.E.-sealed wall plans and details or as directed by the Wall Design Engineer. The SRW units shall be installed in general accordance with the manufacturer's recommendations. The specifications and drawings shall govern in any conflict between the two requirements.

B. First course of SRW units shall be placed on the leveling pad. The units shall be leveled side-to-side, front-to-rear and with adjacent units, and aligned to ensure intimate contact with the leveling pad. The first course is the most important to ensure accurate and acceptable results. No gaps shall be left between the front of adjacent units. Alignment may be done by means of a string line or offset from base line to the back of the units.

C. All excess debris shall be cleaned from top of units and the next course of units installed on top of the units below.

D. Two connection pins shall be inserted through the pin holes of each upper-course unit into receiving slots in lower-course units. Pins shall be fully seated in the pin slot below. Units shall be pushed forward to remove any looseness in the unit-to-unit connection.

E. Prior to placement of next course, the level and alignment of the units shall be checked and corrected where needed.

F. Layout of curves and corners shall be installed in accordance with the wall plan details or in general accordance with SRW manufacturer’s installation guidelines. Walls meeting at corners shall be interlocked by overlapping successive courses.

G. Procedures C. through F. shall be repeated until reaching top of wall units, just below the height of the cap units. Geosynthetic reinforcement, drainage materials, and reinforced backfill shall be placed in sequence with unit installation.

3.06 Geosynthetic Reinforcement Placement

A. All geosynthetic reinforcement shall be installed at the proper elevation and orientation as shown on the final P.E.-sealed retaining wall plan profiles and details, or as directed by the Wall Design Engineer.

B. At the elevations shown on the final plans, (after the units, drainage material and backfill have been placed to this elevation) the geosynthetic reinforcement shall be laid horizontally on compacted infill and on top of the concrete SRW units, to within 1 inch of the front face of the unit below. Embedment of the geosynthetic in the SRW units shall be consistent with SRW manufacturer's recommendations. Correct orientation of the geosynthetic reinforcement shall be verified by the Contractor to be in accordance with the geosynthetic manufacturer's recommendations. The highest-strength direction of the geosynthetic must be perpendicular to the wall face.

C. Geosynthetic reinforcement layers shall be one continuous piece for their entire embedment length. Splicing of the geosynthetic in the design-strength direction (perpendicular to the wall face) shall not be permitted. Along the length of the wall, horizontally adjacent sections of geosynthetic reinforcement shall be butted in a manner to assure 100% coverage parallel to the wall face.

D. Tracked construction equipment shall not be operated directly on the geosynthetic reinforcement. A minimum of 6 inches of backfill is required prior to operation of tracked vehicles over the geosynthetic. Turning should be kept to a minimum. Rubber-tired equipment may pass over the geosynthetic reinforcement at slow speeds (less than 5 mph).

E. The geosynthetic reinforcement shall be free of wrinkles prior to placement of soil fill. The nominal tension shall be applied to the reinforcement and secured in place with staples, stakes or by hand tensioning until reinforcement is covered by 6 inches of fill.

3.07 Drainage Aggregate and Drainage Material Placement

A. Drainage aggregate shall be installed to the line, grades and sections shown on the final P.E.-sealed retaining wall plans. Drainage aggregate shall be placed to the minimum thickness shown on the construction plans between and behind units (a minimum of 1 cubic foot for each exposed square foot of wall face unless otherwise noted on the final wall plans).

B. Drainage collection pipes shall be installed to maintain gravity flow of water outside the reinforced-soil zone. The drainage collection pipe shall be installed at the locations shown on the final construction drawings. The drainage collection pipe shall daylight into a storm sewer or along a slope, at an elevation below the lowest point of the pipe within the aggregate drain. Drainage laterals shall be spaced at a maximum 50-foot spacing along the wall face.

3.08 Backfill Placement

A. The reinforced backfill shall be placed as shown in the final wall plans in the maximum compacted lift thickness of 8 inches and shall be compacted to a minimum of 95% of standard Proctor density (ASTM D 698) at a moisture content within -1% point to +3% points of optimum. The backfill shall be placed and spread in such a manner as to eliminate wrinkles or movement of the geosynthetic reinforcement and the SRW units.

B. Only hand-operated compaction equipment shall be allowed within 3 feet of the back of the wall units. Compaction within the 3 feet behind the wall units shall be achieved by at least three passes of a lightweight mechanical tamper, plate, or roller.

C. At the end of each day's operation, the Contractor shall slope the last level of backfill away from the wall facing and reinforced backfill to direct water runoff away from the wall face.

D. At completion of wall construction, backfill shall be placed level with final top of wall elevation. If final grading, paving, landscaping and/or storm drainage installation adjacent to the wall is not placed immediately after wall completion, temporary grading and drainage shall be provided to ensure water runoff is not directed at the wall nor allowed to collect or pond behind the wall until final construction adjacent to the wall is completed.

3.09 SRW Caps

A. SRW caps shall be properly aligned and glued to underlying units using a flexible, high-strength concrete adhesive. Rigid adhesive or mortar are not acceptable.

B. Caps shall overhang the top course of units by 3/4 inch to 1 inch. Slight variation in overhang is allowed to correct alignment at the top of the wall.

END OF SECTION

SECTION 32 92 00

TURF AND GRASSES

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

.

1.2 SUMMARY

A. This Section includes the following:

1. Fine grading and preparing seeded areas.
2. Spreading topsoil from stockpile.
3. Furnishing and applying topsoil.
4. Furnishing and applying soil amendments.
5. Furnishing and applying fertilizers.
6. Seeding & sod installation.
7. Turf renovation.
8. Reseeding and sod installation at unsatisfactory or damaged areas.
9. Mulch applications.
10. Erosion control blanket applications.

B. Related Sections Include (names and numbers may vary):
1. Division 31 Section “Erosion and Sedimentation Control”
2. Division 31 Section "Earth Moving
3. Division 32 Section “Plants”
4. Specifications on Civil Engineering Drawings – for any conflicts with this section, review with Landscape Architect, and follow stricter requirements unless otherwise approved by Landscape Architect.

1.3 DEFINITIONS

A. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

B. Finish Grade: Elevation of finished surface of planting soil.

C. Manufactured Topsoil: Soil produced off-site by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce topsoil or planting soil.

D. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator,

defoliant, or desiccant.

E. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include geese, deer, insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

F. 329200 Planting Soil: Standardized topsoil; existing, native surface topsoil; existing, in-place surface soil; imported topsoil; or manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

1. 329200 Planting Soil is NOT 329300 Planting Soil.

G. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or top surface of a fill or backfill before planting soil is placed.

H. Subsoil: All soil beneath the topsoil layer of the soil profile and typified by the lack of organic matter and soil organisms.

I. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil, but in disturbed areas such as urban environments, the surface soil can be subsoil.

J. Client Agencies Representative: Project Manager or Project Management Company employed by the Client Agency. The Client Agency may delegate specific Client Agency Representative responsibilities to the Architect, Landscape Architect and Engineer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1. Pesticides and Herbicides: Include product label and manufacturer's application instructions specific to this Project.

1.5 INFORMATIONAL SUBMITTALS

A. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

B. Certification of Grass Seed used in Sod: From seed vendor for each grass-seed monostand or mixture stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.

C. Qualification Data: For qualified landscape Installer.

D. Product Certificates: For soil amendments and fertilizers, from manufacturer.

E. Material Test Reports: For standardized ASTM D 5268 topsoil existing native surface topsoil existing in- place surface soil and imported or manufactured topsoil.

1. If existing subsoil will be used as a component of 329200 planting soil mix, then also provide Material Test Reports for the subsoil from the source being utilized.

F. Maintenance Instructions: Recommended procedures to be established by Client Agency for maintenance of turf and meadows during a calendar year. Submit before expiration of required Contractor's maintenance periods.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful turf and meadow establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Five years' experience in turf installation in addition to requirements in Section I – "Supplementary Conditions."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

   a. Certified Landscape Technician - Exterior, with installation maintenance specialty area(s), designated CLT-Exterior.
   b. Certified Turfgrass Professional, designated CTP.
   c. Certified Turfgrass Professional of Cool Season Lawns, designated CTP-CSL.
5. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent laboratory or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed, as well as the experience and capability to provide the recommendations and interpretations required.

1. Qualified independent soil-testing laboratories include, but are not limited to:

   a. Earth Works, Martins Creek, Pennsylvania; phone: 800-732-TURF, partnering with a soil testing agency.
      1) At a minimum, provide soil testing as required herein.
      2) Provide amendment recommendations for turf (and native meadow if applicable) for each soil source.

   b. Penn State College of Agricultural Sciences.
      1) At a minimum provide: Particle Size and Sand Sieve Test, Soil Fertility Test (including Organic Matter, Soluble Salts, Nitrate Nitrogen, Ammonium Nitrogen, Total Nitrogen Combustion, Total Carbon Combustion, and Micronutrients), gravel content test, heavy metals test, identification of deleterious materials, and other testing required herein.
      2) Provide amendment recommendations for turf (and native meadow if

applicable) for each soil source.

3) An independent soil scientist hired by the Contractor will be required for interpretation and recommendations if the lab does provide that service for each interpretation or recommendation required herein.

c. Rutgers New Jersey Agricultural Experiment Station, Soil Testing Laboratory.

1) At a minimum provide: Topsoil Evaluation test (soil fertility, soluble salt level, organic matter content, sand/silt/clay, textural class, and gravel content), Soil Health Test, heavy metals test, identification of deleterious materials, and other testing required herein

2) Provide amendment recommendations for turf (and native meadow if applicable) for each soil source.

3) An independent soil scientist hired by the Contractor will be required for interpretation and recommendations if the lab does provide that service for each interpretation or recommendation required herein.

C. Soil Analysis: For each unamended soil type, furnish soil analysis and a written report by a qualified soil- testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling, with depth, location, and number of samples to be taken per instructions from Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for turf growth, for each soil source.

a. Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory planting soil suitable for healthy, viable turf and grasses.

b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

D. Provide the Client Agency Representative and Landscape Architect with copies of soil test results a minimum of 60 days prior to any grading, seeding or sodding – for EACH SOIL SOURCE.

1. Soil test submittals must include complete lab recommendations.

E. The seed producer shall specialize in grass seed production with a minimum of 5 years' experience and shall be certified by the Pennsylvania Department of Agriculture as outline in Title 3 (Agriculture) of the Pennsylvania Consolidated Statures.

F. Seed must comply with Commonwealth of Pennsylvania seed certifications or equivalent State of New Jersey seed certifications.

G. Preinstallation Conference: Conduct conference at Project site, including Client Agencies

Representative and Landscape Architect.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws, as applicable.

B. Sod: Sod shall be reviewed by the Client Agencies Representative or Landscape Architect at the job site prior to installation. The Client agencies representative or Landscape Architect reserves the right to reject any sod they deem unacceptable.

1. Sod delivered from the supplier shall be installed on the same day as delivery.
2. Each palette, flat, or specified group of sod shall be labeled by the grower or manufacturer as separate items.
3. During delivery and storage, sod materials shall be protected from any drying or contamination by detrimental material.
4. Sod shall not be dropped or dumped from vehicles.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers, lime, and soil amendments with appropriate certificates.

1.8 PROJECT CONDITIONS

A. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with initial maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: 15 March to 15 May.
2. Fall Planting: 15 August to 15 October.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

1.9 MAINTENANCE SERVICE

A. Initial Turf Maintenance Service: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after each area is planted and continue until acceptable turf is established but for not less than the following

periods:

1. Initial Maintenance of Seeded Turf and Sod: 60 days from date of Substantial Completion issued for the overall project, or 60 days from date of Substantial Turf Completion as determined by Client Agencies Representative, or until initial acceptance to start the Maintenance and Guarantee Period, whichever is later.

    a. When initial maintenance period has not elapsed before November 1, or if turf is not fully established, continue maintenance during next growing season.

B. Maintenance Service During the 90-day Maintenance and Guarantee Period: Provide full maintenance by skilled employees of landscape Installer. Maintain as required in Part 3.

    a. When Maintenance and Guarantee Period has not elapsed before November 1, then extend as described in Part 3.

PART 2 - PRODUCTS

2.1 SEED – INCLUDE IN BASE SCOPE OF PROJECT

A. Grass Seed: Fresh, clean, dry, new-crop seed complying with AOSA's "Journal of Seed Technology; Rules for Testing Seeds" for purity and germination tolerances.

B. Seed Species for turf renovation, and alongside sod: as described on Drawings and as follows:

1. PennDOT Formula B, proportioned by weight as follows:

    a. 50 percent Kentucky bluegrass (Poa pratensis).
    b. 30 percent chewings red fescue (Festuca rubra variety).
    c. 20 percent perennial ryegrass (Lolium perenne).

2. The Client Agencies Representative may request or allow a turf-type tall fescue blend for areas next to turf-type tall fescue sod.

2.2 SOD

A. USE OF SOD IN LIEU OF SEED IS OPTIONAL PER CONTRACTOR’S MEANS AND METHODS FOR SCHEDULING PURPOSES, AND IS SUBJECT TO REVIEW BY LANDSCAPE ARCHITECT.
    1. SOD IN LIEU OF SEED WOULD BE AT NO ADDITIONAL COST TO CLIENT AGENCY.

B. The sod producer shall specialize in grass seed production with a minimum of 5 years’ experience and shall be certified by the Pennsylvania Department of Agriculture or the New Jersey Department of Agriculture.

C. Sod shall be a minimum of 18 months in age with root development that will support its own weight without tearing when suspended vertically by holding two adjacent corners.

D. Sod shall be field grown in same climatic conditions as that of the project site.

E. Sod shall be free of weeds and undesirable grasses.

F. Sod must be capable of growth and development when planted.

G. Sod shall be free of pests.

H. Composition of seed blend shall be a minimum of 3 different turf type tall fescue varieties, with a blended ratio of 20% to 40% of each variety for a total of 100%. Varieties shall represent the top 1/3 of performers in the most recent final or current year National Turfgrass Evaluation Program (www.ntep.org) for the Northeast USA. In addition, one of the varieties must be a rhizomatous type as advertised by the seed marketer.
   1. Blend may include up to 10% Kentucky Bluegrass for stability.

I. Sod shall be installed within 24 hours from the time it is cut.

J. Products:
   1. Tall Fescue sod as grown by Shan Gri La Sod Farm, Perkasee, PA,
   2. Tall Fescue sod as grown by Tuckahoe Sod Farms, Hammonton, NJ,
   3. Tall Fescue sod as grown by Sporting Valley Turf Farms, Manheim, PA,
   4. Or equal as approved by Professional.

2.3 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 80 percent calcium carbonate equivalent and as follows:

   1. Class: T, with a minimum of 99 percent passing through No. 8 (2.36-mm) sieve and a minimum of 75 percent passing through No. 60 (0.25-mm) sieve.
   2. Class: O, with a minimum of 95 percent passing through No. 8 (2.36-mm) sieve and a minimum of 55 percent passing through No. 60 (0.25-mm) sieve.
   3. Provide lime in form of ground dolomitic limestone.

B. Sulfur: Granular, biodegradable, containing a minimum of 90 percent sulfur, and with a minimum of 99 percent passing through No. 6 (3.35-mm) sieve and a maximum of 10 percent passing through No. 40 (0.425-mm) sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10 percent sulfur.

D. Aluminum Sulfate: Commercial grade, unadulterated.

E. Perlite: Horticultural perlite, soil amendment grade.

F. Agricultural Gypsum: Minimum 90 percent calcium sulfate, finely ground with 90 percent passing through No. 50 (0.30-mm) sieve.

G. Sand: Clean, washed, natural or manufactured, and free of toxic materials.

H. Diatomaceous Earth: Calcined, 90 percent silica, with approximately 140 percent water absorption capacity by weight.

I. Zeolites: Mineral clinoptilolite with at least 60 percent water absorption by weight.

2.4 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.5 to 8; moisture content 35 to 55 percent by weight; 100 percent passing through 3/4-inch (19-mm) sieve; soluble salt content of 5 to 10 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

1. Organic Matter Content: 50 to 60percent of dry weight.
2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Wood Derivatives: Decomposed, nitrogen-treated sawdust, ground bark, or wood waste; of uniform texture and free of chips, stones, sticks, soil, or toxic materials.

1. In lieu of decomposed wood derivatives, mix partially decomposed wood derivatives with ammonium nitrate at a minimum rate of 0.15 lb/cu. ft. (2.4 kg/cu. m) of loose sawdust or ground bark, or with ammonium sulfate at a minimum rate of 0.25 lb/cu. ft. (4 kg/cu. m) of loose sawdust or ground bark.

C. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, and material harmful to plant growth.

2.5 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1percent nitrogen and 10 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

2.6 PLANTING SOILS

A. 329200 Planting Soil: Existing, in-place surface soil. Verify suitability of existing surface soil to produce viable planting soil. Remove stones, roots, plants, sod, clods, clay lumps, pockets of

coarse sand, concrete slurry, concrete layers or chunks, cement, plaster, building debris, and other extraneous materials harmful to plant growth. Mix surface soil in the quantities recommended in soils reports for each planting type- lawn and/or meadow as applicable - from a qualified soil-testing laboratory and as directed by Landscape Architect to produce planting soil.

1. Supplement with another specified 329200 planting soil when quantities are insufficient.

B. 329200 Planting Soil (supplemental): Imported ASTM D 5268 topsoil and/or ASTM D 5268 manufactured topsoil from off-site sources, with 4% to 8% organic matter, with pH range of 6.0 to 7, free of extraneous materials harmful to plant growth. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

1. Additional Properties of Imported Topsoil and Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including but not limited to quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, bromegrass, Japanese knotweed, and giant reed; not infested with nematodes, grubs, other pests, pest eggs, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.

a. Texture Class: Loam – approximately 40% sand, 40% silt and 20% clay

1) Loam percentage limits: 23-52% sand, 28-50% silt, 7-27% clay

b. Or: Texture Class: Clay Loam – approximately 30% sand, 35% silt and 35% clay

1) Clay loam percentage limits: 20-45% sand, 15-53%% silt, 27-40% clay

2) Do NOT use Clay Loam for 329300 Planting Soil; see Division 32 Section “Plants” which is an imported planting soil mix(es).

2. Mix imported topsoil or manufactured topsoil in the quantities recommended in soils reports for each planting type- lawn and/or meadow as applicable- from a qualified soil-testing laboratory and as reviewed by Landscape Architect to produce planting soil.

2.7 MULCHES

A. Straw Mulch: Provide air-dry, clean, mildew- and seed-free, salt hay or threshed straw of wheat, rye, oats, or barley.

1. Hay is not acceptable.

B. Fiber Mulch: Biodegradable, dyed-wood, cellulose-fiber mulch; nontoxic and free of plant-growth or germination inhibitors; with a maximum moisture content of 15 percent and a pH range of 4.5 to 6.5.

C. Non-asphaltic Tackifier: Colloidal tackifier recommended by fiber-mulch manufacturer for slurry application; nontoxic and free of plant-growth or germination inhibitors.

D. Asphalt Emulsion: ASTM D 977, Grade SS-1; nontoxic and free of plant-growth or germination inhibitors.

2.8 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Non-Selective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Non-Selective): Effective for controlling weed growth that has already germinated.

2.9 EROSION-CONTROL MATERIALS

A. Erosion Control Blankets for Seeded Areas – as indicated on Drawings, or if not indicated, then the following:

1. At slopes 3:1 and steeper - NAG SC150 BN, or approved equal (no plastic netting).

2. At slopes less steep than 3:1 – NAG SC 75BN, or NAG SC150BN, or approved equal (no plastic netting).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required

results.

4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

1. Protect adjacent and adjoining areas from hydroseeding and hydromulching overspray.
2. Protect grade stakes set by others until directed to remove them.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil- bearing water runoff or airborne dust to adjacent properties and walkways.

C. Prior to grading and seeding, treat weed species with a systemic herbicide that does not have soil activity, to help prevent roots of persistent species from re-sprouting.

1. Persistent species include but are not limited to Giant Reed, Thistle, Mugwort, Japanese Knotweed, Oriental Bittersweet, Tree of Heaven and any non-native species that can re-sprout from roots.

2. Proceed with grading and seeding only after persistent weed species have been treated, and after the herbicide has taken effect.

a. Provide a waiting period as recommended by the manufacturer before re-seeding.

3.3 TURF AREA PREPARATION

A. Limit turf subgrade preparation to areas to be planted.

B. Newly Graded Subgrades: Loosen subgrade to a minimum depth of 8 inches (200 mm) .

1. Apply superphosphate fertilizer directly to subgrade before loosening.
2. Thoroughly blend planting soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer on surface, and thoroughly blend planting soil.

a. Delay mixing fertilizer with planting soil if planting will not proceed within a few days.
b. Mix lime with dry soil before mixing fertilizer.

3. Spread 329200 planting soil a minimum depth of 4 inches at areas that are exclusively lawn, but not less than required to meet finish grades after light rolling and natural settlement, Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

a. Follow requirements on Civil Engineering drawings if topsoil depths are indicated to be deeper.
b. Reduce elevation of planting soil to allow for soil thickness of sod.

C. Unchanged Subgrades: If turf is to be planted in areas unaltered or undisturbed by excavating, grading, or surface-soil stripping operations, prepare surface soil as follows:

1. Remove existing grass, vegetation, and turf. Do not mix into surface soil.
2. Loosen surface soil to a depth of at least 6 inches (150 mm). Apply soil amendments and fertilizers according to planting soil mix proportions and mix thoroughly into top 4 inches of soil. Till soil to a homogeneous mixture of fine texture.

a. Apply superphosphate fertilizer directly to surface soil before loosening.

3. Remove stones larger than 2 inches in any dimension and sticks, roots, trash, and other extraneous matter.
4. Legally dispose of waste material, including grass, vegetation, and turf, off Client Agencies property
a. Do not export soil from the Site Package areas; use on site as indicated.

D. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Grade to within plus or minus 1/2 inch of finish elevation. Roll and rake, remove ridges, and fill depressions to meet finish grades. Limit finish grading to areas that can be planted in the immediate future.

E. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

F. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.4 PREPARATION FOR EROSION-CONTROL MATERIALS

A. Prepare area as specified in "Turf Area Preparation" Article.

B. For erosion-control blanket or mesh, install from top of slope, working downward, and as recommended by material manufacturer for site conditions. Fasten as recommended by material manufacturer.

C. Moisten prepared area before planting if surface is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

3.5 SEEDING

A. Sow seed with spreader or seeding machine. Do not broadcast or drop seed when wind velocity exceeds 5 mph. Evenly distribute seed by sowing equal quantities in two directions at right angles to each other.

1. Do not use wet seed or seed that is moldy or otherwise damaged.

2. Do not seed against existing trees. Limit extent of seed to outside edge of planting saucer.

B. Sow seed at a the rate recommended by seed provider or state agency, whichever is denser.

C. Rake seed lightly into top 1/8 inch of soil, roll lightly, and water with fine spray.

D. Protect seeded areas with erosion-control blankets as follows:

1. At slopes 3:1 and steeper - NAG SC150 BN, or approved equal.

2. At slopes less steep than 3:1 – NAG SC 75BN, or NAG SC150BN, or approved equal.

3. Install according to manufacturer's written instructions.

E. Protect small seeded areas at sod interface with renovated lawn (maximum 10 square feet per area, maximum 12 inch width) with slopes not exceeding 1:6 by spreading straw mulch. Spread uniformly to form a continuous blanket 1-1/2 inches in loose thickness over seeded areas. Spread by hand.

1. Anchor straw mulch by crimping into soil with suitable mechanical equipment.
2. Bond straw mulch by spraying with asphalt emulsion at a rate of 10 to 13 gal./1000 sq. ft.. Take precautions to prevent damage or staining of structures or other plantings adjacent to mulched areas. Immediately clean damaged or stained areas.

F. Protect seeded areas from hot, dry weather or drying winds by applying compost mulch within 24 hours after completing seeding operations. Soak areas, scatter mulch uniformly to a thickness of 3/16 inch and roll surface smooth.

3.6 SOD INSTALLATION

A. Lay sod on the same day as delivery to prevent dehydration.

B. Lay sod tight with no open joints visible, and no overlapping. Stagger end joints 12 inches minimum. Do not stretch sod pieces.

C. Lay smooth and align with adjoining grass areas. Place top elevation of sod even with or slightly above adjoining edging, paving, or curbs to allow for settling.

1. At interface with existing grass areas, apply lawn seed to disturbed and bare portions of the existing lawn to a 2-foot maximum wide area.

D. On slopes exceeding 2 horizontal to 1 vertical (and as specified below), lay sod perpendicular to the slope and secure every row with biodegradable staples at maximum of 2 feet on center. Drive staples flush with soil portion of the sod.

1. Use same stapling pattern for sod on this project, regardless of slope.

E. Water sodded areas immediately after installation with enough moisture to ensure the entire rootmass and thatch areas are completely saturated.

F. After sod and soil have dried, roll sodded areas to ensure a good bond between sod and soil and to remove minor depressions and irregularities.

3.7 HYDROSEEDING

A. Hydroseeding: Mix specified seed, fertilizer, and fiber mulch in water, using equipment specifically designed for hydroseed application. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Mix slurry with non-asphaltic, asphalt-emulsion fiber-mulch manufacturer's recommended tackifier.
2. Apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that mulch component is deposited at not less than 1500-lb/acre (15.6-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate.
3. Apply slurry uniformly to all areas to be seeded in a two-step process. Apply first slurry coat at a rate so that mulch component is deposited at not less than 500-lb/acre (5.2-kg/92.9 sq. m) dry weight, and seed component is deposited at not less than the specified seed-sowing rate. Apply slurry cover coat of fiber mulch (hydromulching) at a rate of 1000 lb/acre (10.4 kg/92.9 sq. m).

3.8 TURF RENOVATION

A. Renovate existing turf damaged by Contractor's operations, such as storage of materials or equipment and movement of vehicles, and renovate existing turf in areas indicated on Drawings.

1. Reestablish turf where settlement or washouts occur or where minor regrading is required.
2. Install new planting soil as required.

B. Remove sod and vegetation from diseased or unsatisfactory turf areas; do not bury in soil.

C. Remove topsoil containing foreign materials such as oil drippings, fuel spills, stones, gravel, and other construction materials resulting from Contractor's operations, and replace with new planting soil.

D. Mow, dethatch, core aerate, and rake existing turf.

E. Remove weeds before seeding. Where weeds are extensive, apply selective herbicides as required. Do not use pre-emergence herbicides.

F. Remove waste and foreign materials, including weeds, soil cores, grass, vegetation, and turf, and legally dispose of them off Client Agencies property.

G. Till stripped, bare, and compacted areas thoroughly to a soil depth of 6 inches.

H. Apply soil amendments and initial fertilizers required for establishing new turf and mix thoroughly into top 4 inches of existing soil.

1. Install new planting soil to fill low spots and meet finish grades.

I. Apply seed and protect with straw mulch or erosion control blanket as required for new turf.

J. Water newly planted areas and keep moist until new turf is established.

3.9 TURF MAINTENANCE

A. Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.

1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch or blanket has been disturbed by wind or maintenance operations, add new mulch or blanket as specified for new turf and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

B. Watering: Install and maintain temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches.

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch per week unless rainfall precipitation is adequate.

C. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than 1/3 of grass height. Remove no more than 1/3 of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow lawn to a height of 2 inches when it reaches 3 inches.

D. Turf Postfertilization: Apply fertilizer after initial mowing and when grass is dry.

1. Use fertilizer that will provide actual nitrogen of at least 1 lb/1000 sq. ft. to turf area.

3.10 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Landscape Architect:

1. Satisfactory Seeded Turf: At end of maintenance period, a healthy, uniform, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. and bare spots not exceeding 2 by 2 inches; follow Erosion and Sedimentation Control requirements if stricter.
2. Satisfactory Sodded Turf: At end of maintenance period, a healthy, well-rooted, even-

colored, viable turf has been established, free of weeds, open joints, dead edges, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements and continue maintenance until turf is satisfactory.

3.11 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents in accordance with requirements of authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Client Agencies operations and others in proximity to the Work. Notify Client Agency before each application is performed.

B. Post-Emergent Herbicides (Selective and Non-Selective): Apply only as necessary to treat already- germinated weeds and in accordance with manufacturer's written recommendations.

3.12 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout initial maintenance period and remove after plantings are established.

C. Remove nondegradable erosion-control measures after grass establishment period.

3.13 MAINTENANCE PRIOR TO THE INSPECTION TO DETERMINE BEGINNING OF MAINTENANCE AND GUARANTEE PERIOD.

A. Contractor shall maintain all seeded and sodded areas by properly mowing, watering, weeding and similar care to keep the completed work and uncompleted work in a clean and neat condition at all times. Sweep adjacent walks clean. Advise the Client Agencies Representative and Landscape Architect, in writing, when completed and maintained work is in proper condition to meet requirements for beginning of the Maintenance and Guarantee Period. The Client Agencies Representative and Landscape Architect, at their discretion, may segregate the maintenance period start date for the lawn areas from the maintenance period start date for other plantings.

1. Mow when the lawn reaches 3 to 4 inches height, and mow to 2 to 3 inches height, removing no more than 1/3 of the grass blades. Mow only with reel-type mower, and use string-trimmers along edges.

3.14 INSPECTION OF THE WORK TO DETERMINE BEGINNING OF MAINTENANCE AND GUARANTEE PERIOD.

A. The guarantee period will commence when the lawn areas have germinated properly, and sod has been installed properly and is thriving, and it is determined by the Landscape Architect that there is a reasonably full stand of turf and that it has been maintained properly. The Landscape Architect will approve lawn areas as acceptable to begin the 90 day maintenance and guarantee period.

1. When all work, except maintenance work during the guarantee period, is completed, notify the Client Agencies Representative and Landscape Architect that the work is ready to be inspected for initial acceptance.
2. When all work, except maintenance work during the guarantee period, is approved for initial acceptance, the date of the approval shall be the date that the maintenance and guarantee period commences.

3.15 MAINTENANCE OF LAWN AREAS DURING THE MAINTENANCE AND GUARANTEE PERIOD

A. Contractor shall provide all maintenance work, including watering, mowing, trimming and weed control, throughout the period of their guarantee of the work.
1. Mow grass when it reaches 3 to 4 inch height; cut to 2-3” height by cutting no more than 1/3 of the blade height.
2. Remove trash and debris prior to mowing.
3. Maintenance work required during the Maintenance and Guarantee Period shall include mowing, watering, remedial work, such as repair of eroded areas and reseeding, if required. Provide general clean-up of stakes, strings, and temporary signs. Other work shall be included as maintenance work as necessary, such as additional lawn feeding, grub control, weeding, etc., as deemed required by Contractor in support of their guarantee, or as may be pointed out to Contractor by the Client Agencies Representative or Landscape Architect during the guarantee period.
4. Maintenance and Guarantee Period is 90 days, adjusted as follows:
    a. Maintenance and guarantee period is extended when that period overlaps with the months of November, December, January, February and March; the counting of days pauses November 1 and restarts April 1.

3.16 CONDITION OF GUARANTEE OF LAWN AREAS.

A. Contractor shall guarantee the lawn areas developed under this Contract to be in vigorous and thriving condition by the end of the guarantee period, free of objectionable quantities of weeds and other undesirable growth. Maximum percentage of scattered bare spots shall not exceed 2% of the final lawn areas, and each bare or dead spot shall not be larger than 3 inches by 3 inches for seeded areas, and shall not be larger than 1 inch by 1 inche for sod, and shall not be larger than one-half-inch wide for sod edges.

3.17 FINAL INSPECTION AND FINAL ACCEPTANCE

A. Toward the end of the Maintenance and Guarantee Period, establish and give notice, in writing, to the Client Agencies Representative and Landscape Architect stating the desired date for final inspection.

B. At time of final inspection, the work shall be in the condition required by the guarantee specified hereinbefore, and shall be placed by Contractor in neatly trimmed condition with all adjacent paved areas cleaned.

C. If work is accepted at time of final inspection, the guarantee shall be considered fulfilled and terminated and final payment shall be due and payable per General Conditions of the Contract. Should any work need replacement at time of final inspection, the guarantee period shall be continued until such replacement is made and deemed acceptable, and no portion of the final payment shall become due until after final acceptance.

3.18 EXCLUSIONS FROM GUARANTEE

A. During the maintenance and guarantee period, damage to the areas not caused by the Contractor shall be excluded from the guarantee. Such damage shall include ruts caused by driving vehicles over lawns, burned mulch, whether accidentally or intentionally burned, excavation and backfill work in areas, and acts of vandalism.

B. Where evidence of such damage exists, advise Client Agency and Landscape Architect, in writing, stating location of the damage. The Client Agencies Representative, upon receipt of notice, may order the Contractor to correct the damage at the Client Agencies expense, or exclude the damaged areas from the guarantee provision and correct the damage by any arrangement deemed by the Client Agency in its best interest.

END OF SECTION

SECTION 32 93 00
PLANTS

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Trees.
2. Shrubs.
3. Ground Cover.
4. Plants & Plant Plugs.
5. Geotextile Fabric.
6. Drip Strip.
7. Planting & Mulching.
8. 329300 Planting Soil – independent of Planting Soil described in Division 32 Section “Turf and Grasses”
9. Maintenance & Warranties.

B. Related Sections Include (names and numbers may vary):
1. Division 1 Section “Summary”
2. Division 1 Section “Alternates”
3. Division 1 Section “Submittal Procedures”
4. Division 1 Section “Substitutions”
5. Division 31 Section "Earth Moving."
6. Division 32 Section “Turf and Grasses”
7. Division 32 Section “Erosion and Sedimentation Control”
8. Division 32 Section “Tree and Shrub Transplanting”

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with ball size not less than sizes indicated and or diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than sizes indicated and or diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than minimum root spread according to ANSI Z60.1 for type and size of plant required.

E. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

F. Duff Layer: The surface layer of native topsoil that is composed of mostly decayed leaves, twigs, and detritus.

G. Fabric Bag-Grown Stock: Healthy, vigorous, well-rooted plants established and grown in-ground in a porous fabric bag with well-established root system reaching sides of fabric bag. Fabric bag size is not less than diameter, depth, and volume required by ANSI Z60.1 for type and size of plant.

H. Finish Grade: Elevation of finished surface of 329300 Planting Soil.

I. Manufactured Topsoil: Soil produced off-site, or in-situ with imported materials, by homogeneously blending mineral soils or sand with stabilized organic soil amendments to produce 329300 Planting Soil.

J. Client Agencies Representative: Project Manager or Project Management Company employed by the Client Agency. The Client Agency may delegate specific Client Agencies Representative responsibilities to the Architect, Landscape Architect and Engineer.

K. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. This includes insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. It also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

L. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. These include geese, deer, insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

M. Planting Area: Areas to be planted.

N. 329300 Planting Soil: Imported topsoil or imported manufactured topsoil that is modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth of specified trees, shrubs, herbaceous perennials, and groundcover.

O. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

P. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

Q. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

R. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before 329300 Planting Soil is placed.

S. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

T. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

1.4 SUBMITTALS - GENERAL

A. General: Provide each submittal according to the Conditions of the Contract and Division 1 Specification Sections, and as described below.

1. Label each submittal with the Specification number and line-item number(s).
2. Do not combine submittals from different Sections.

B. Planting Submittals Tracking List: Submit spreadsheet indicating each submittal required by this Section, labeled by name and Specification line-item number, with columns for each submittal indicating dates of submittals, reviews, and completion of reviews/revisions process.

1. Submit to Client Agencies Representative and Landscape Architect no later than three months after project start date, or two months prior to planting, whichever is earlier.
2. Update and submit monthly during months of preparation, purchasing, planting, maintenance, and close-out.
3. Provide copies of each correspondence to Project Landscape Architect, ThinkGreen LLC.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, including soils.

1. Plant Materials: Include quantities, sizes, quality, and sources for plant materials.
   a. Include information for any nurseries that will provide additional potting, growing and care for plants specified; see Drawings for more information.
2. Plant Photographs: Include color photographs in 3- by 5-inch print or as high quality digital format of each required species and size of plant material as it will be furnished to the Project. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

B. Product Certificates: For each type of manufactured product, signed by product manufacturer, and complying with the following:

1. Manufacturer's certified analysis for standard products.
2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Samples: For each of the following:

1. 2 lb 329300 Planting Soil mixes for each soil type tested, in labeled plastic bags.
2. Organic amendment: duplicate samples of 1 quart.
3. 2 lb of organic mulch for each color and texture required, in labeled plastic bags.

D. Qualification Data: For Landscape Installer.

E. Material Test Reports: For each 329300 Planting Soil mixes.
1. 329300 Planting Soil Mixes: 1 material test report for each 100 cubic yards of material from random samples.
2. Tests must include lab recommendations for amendments for 329300 Planting Soil for native trees and shrubs; submittals with only lab recommendations for lawn or turf will be rejected.
3. Follow qualifications, submittals and testing requirements in Division 32 Section “Turf and Grasses” if stricter than herein, except lab recommendations must be for native trees and shrubs, targeting the pH indicated herein.

F. Planting Schedule: Indicating anticipated planting dates for exterior plants, in each area of the site.

1. Submit no later than two months prior to planting.
2. Submit update one week prior to completion of planting markouts.
3. Submit update one week prior to start of planting.
4. Provide copies directly to Project Landscape Architect, ThinkGreen LLC.

G. Plant Sources: Indicating nursery locations and list of plants supplied by each nursery.

1. Submit, in writing, a plant list outlining the source for all plants, their estimated delivery date, and length of time plants are to be stored at an off-site location.
2. Provide a copy directly to Project Landscape Architect, ThinkGreen LLC.
3. Refer to Drawings for additional requirements for purchasing material soon after the start of the Contract in order to grow, repot and maintain specified species so they are available during the installation period.
    a. Submit, in writing, the nursery(ies) that will care for plants that are purchased early in the construction schedule.

H. Maintenance Instructions: Recommended procedures to be established by Client Agency for maintenance of exterior plants during a calendar year. Submit before expiration of required maintenance periods.
1. Edit and update per review of Landscape Architect.

I. Plant Substitutions Requests: Plant substitutions will be permitted only upon written approval by the Landscape Architect.

1. Submit no later than one month prior to anticipated purchasing unless stricter requirements are indicated on Drawings.
2. Provide a copy directly to Project Landscape Architect, ThinkGreen LLC.
3. Refer to Drawings for additional restrictions on substitutions.

1.6 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape Installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network, the American Nursery and Landscape Association and or have landscape installation credentials to be reviewed by Landscape Architect.
2. Experience: Five years' experience in landscape installation in addition to requirements in Division 01 Section "Quality Requirements."
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.
4. Personnel Certifications: Installer's field supervisor shall have certification in one of the following categories from the Professional Landcare Network:

    a. Certified Landscape Technician - Exterior, with installation, maintenance and irrigation specialty area(s), designated CLT-Exterior.
    b. Certified Landscape Technician - Interior, designated CLT-Interior.
    c. Certified Ornamental Landscape Professional, designated COLP.

5. Pesticide Applicator: State licensed, commercial.

B. Soil-Testing Laboratory Qualifications: An independent or university laboratory, recognized by the State Department of Agriculture, with the experience and capability to conduct the testing indicated and that specializes in types of tests to be performed.
1. Refer to Division 32 Specification “Turf and Grasses” for additional lab qualifications.

C. Certificates: Provide certificates required by authorities having jurisdiction, including any composted materials containing sewage sludge. Approval as EPA Type 1 “exceptional quality” is required as well as well standards for application of composted organic materials by the Commonwealth of New Jersey.

D. Sources for Soil Components and 329300 Planting Soil Mixes: Submit information identifying sources for all soil components and the contractor responsible for mixing of 329300 Planting Soil mixes.
1. Landscape Architect and Client Agencies Representative shall have the right to reject any soil supplier.
2. Soil mix supplier shall have a minimum of five years experience at supplying custom planting soil mixes and as follows
    a. Manufactured soil shall be manufacturered by Laurel Valley Soils or approved equal.

3. Submit supplier name, address, telephone and fax numbers and contact name. The soil scientist can assist in locating acceptable suppliers within the area.
4. Submit certification that the accepted supplier is able to provide sufficient quantities of materials and mixes for the entire project. Indicate quantity and type of material from each supplier.

E. Soil Analysis for 329300 Planting Soil Mix(es) including imported topsoil and imported manufactured soil: For each unamended soil type, furnish soil analysis and a written report by a qualified soil-testing laboratory stating percentages of organic matter; gradation of sand, silt, and clay content; cation exchange capacity; sodium absorption ratio; deleterious material; pH; and mineral and plant-nutrient content of the soil.

1. Testing methods and written recommendations shall comply with USDA's Handbook No. 60.
2. The soil-testing laboratory shall oversee soil sampling; with depth, location, and number of samples to be taken per instructions from Landscape Architect. A minimum of three representative samples shall be taken from varied locations for each soil to be used or amended for planting purposes.
3. Report suitability of tested soil for plant growth – native trees, shrubs and perennials.

    a. Based upon the test results, state recommendations for soil treatments and soil amendments to be incorporated. State recommendations in weight per 1000 sq. ft. or volume per cu. yd. for nitrogen, phosphorus, and potash nutrients and soil amendments to be added to produce satisfactory 329300 Planting Soil suitable for healthy, viable plants.
    b. Report presence of problem salts, minerals, or heavy metals, including aluminum, arsenic, barium, cadmium, chromium, cobalt, lead, lithium, and vanadium. If such problem materials are present, provide additional recommendations for corrective action.

F. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1., “American Standard for Nursery Stock.”

1. Selection of plants may be made by the Landscape Architect, who may tag plants at their place of growth before they are prepared for transplanting.

G. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrub Measurements: Measure according to ANSI Z60.1 with branches and trunks or canes in their normal position. Do not prune to obtain required sizes. Take height measurements from or near the top of the root flare for field-grown stock and container grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

H. Plant Material Observation: Landscape Architect may observe plant material either at place of growth and/or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect retains right to observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and to reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Tree tagging with Landscape Architect at Nursery locations is required with three days notice minimum.
2. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

I. Preinstallation Conference: Conduct conference at project site to review planting intent with Landscape Architect.

1.8 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall contact the Landscape Architect and Client Agencies Representative 24 hours prior to the delivery of any plant material.

B. The Contractor is responsible for having the planting plan, grading plan, plant list, and all applicable installation details on site at all times so that it can be reviewed by the Client Agencies Representative.

C. Plant material shall be inspected by the Landscape Architect at the job site upon delivery. Only plants approved by the Landscape Architect shall be stored or planted. The Landscape Architect reserves the right to refuse plant material they deem unacceptable. Rejected plant materials shall be removed from the job site on the day of rejection.

D. Each tree, shrub, groundcover flat, container of fertilizer or other construction material shall be labeled by grower or manufacturer as separate items.

1. Plant identification labels shall be durable and waterproof. Labels shall be securely attached to plants, bundlers, or containers of plants and shall state the correct botanical plant name and size. Labels shall not be removed from the plants until final acceptance.

E. Bulk deliveries of mulch, topsoil, and inert material shall be accompanied with delivery tickets showing weight, origin, and composition and stored in such a manner as to prevent the inclusion of foreign materials.

F. Plant Storage: Trees, shrubs, and groundcovers not installed on the day of delivery to the site shall be stored and protected.

1. No plants shall be stored on the site for a period greater than 5 business days.

2. Storage locations shall be continually shaded and protected from the wind.

3. Plants stored on the project site shall be protected from drying at all times by covering the balls or roots with moist woodchips, shredded bark, peat moss or other suitable heel-in material.

4. If planting is delayed more than six hours after delivery, protect from weather and mechanical damage, and keep roots moist.

5. Do not remove container-grown stock from containers before time of planting.

6. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly-wet condition.

G. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of conformance with state and federal laws if applicable.

H. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

I. Deliver plants freshly dug.

J. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

K. Handle planting stock by root ball.

L. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

1.9 PROJECT CONDITIONS

A. Planting areas shall be free of waste or debris developed by other trades. Any discrepancy from such conditions shall be reported to the Landscape Architect before beginning any installation.

B. Planting areas shall be free of weeds, and free of alive roots of persistent species.

C. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

D. Interruption of Existing Services or Utilities: Do not interrupt services or utilities to facilities occupied by Client agency or others unless permitted under the following conditions and then only after arranging to provide temporary services or utilities according to requirements indicated:

1. Notify Client Agencies Representative no fewer than five days in advance of proposed interruption of each service or utility.
2. Do not proceed with interruption of services or utilities without Client Agencies Representative’s written permission.

E. No plants are to be planted when the ground is frozen or during days of extreme heat (≥80 degrees). No plants shall be installed before March 1st or after the ground freezes.
   1. If work must be performed outside of these parameters, the Landscape Architect must be contacted.

F. Planting Restrictions: Within the limitations stated above, plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Planting Completion.

   1. Trees and Shrubs:
      a. Spring Planting: March 1 to May 1
      b. Fall Planting: September 1 to November 1
   2. Plugs and Herbaceous Plants
      a. Spring Planting: March 1 to May 1
      b. Fall Planting: September 1 to October 15
   3. Bulbs
      a. Fall Planting: September 1 to October 15
   4. Contractor shall schedule tree selection and digging operations so as to comply with nursery industry recognition of 'Spring Dig Only' or 'Fall Hazard' plant materials. No substitutions of plant materials will be allowed for fall planting based on unavailability due to 'Spring Dig Only' or 'Fall Hazard' restrictions.

G. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

H. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

   1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.10 ACCEPTANCE

A. Conditions at end of Maintenance Period: If plant material is reviewed when it is in full leaf, leaves shall be plump with water with a shape indicative of the species and shall be free of insect, pest and disease damage. Twigs shall have living cambium for their full length. Twigs and branches shall have a full bud set for their full length, including terminal buds. Trunks and branches shall be free of frost cracks, sunscald, damage due to insect, pests and disease, structural defects, and damage resulting from machinery or tools. Plant materials inspected and reviewed when the plants are not in full leaf shall have twigs, branches and trunks meeting the above requirements. All plants regardless of the season of review shall have a minimum of 75 percent healthy, balanced branching structure with a healthy terminal leader(s) with viable terminal bud(s).

B. If any number of plants do not meet these Acceptance Standards at the time of inspection, or if in the Landscape Architect's opinion, workmanship is unacceptable, written notice will be given by the Landscape Architect to the Contractor in the form of a punch list, which itemizes necessary planting replacements and/or other deficiencies to be remedied. The Contractor's responsibility for maintenance of all plants shall be extended until replacements are made or

other deficiencies are corrected. Plants that do meet these Acceptance Standards shall be removed from the project within seven days of receipt of punch list. Replacements shall conform in all respects to the Specifications for new plants and shall be planted in the same manner.

C. Following the correction of all punch list deficiencies, the Contractor shall request in writing that the Landscape Architect formally inspect the planting work. If plant materials and workmanship are acceptable, the Client Agencies Representative will issue a written Initial Acceptance and date of Substantial Planting Completion.

1.11 WARRANTY

A. Special Warranty: Installer agrees to warrant, repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Client Agency, or incidents that are beyond Contractor's control.
b. Structural failures including plantings falling or blowing over.

2. Warranty Periods begin from Date of Substantial Planting Completion:
a. Refer to Establishment Period article in this Specification.

3. Include the following remedial actions as a minimum:

a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
1) Keep a record of removals, including species, size and location, and provide that information to the Landscape Architect.
b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period, as determined at sole discretion of the Landscape Architect.
c. A limit of one replacement of each plant will be required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

4. Exclusions from Warranty: Where evidence exists of damage that is beyond the control of the Landscape Contractor, advise Client Agency’s Representative and Landscape Architect in writing, stating location and nature of Damage. The Client Agencies Representative, upon receipt of such notice, may order the Landscape Contractor to correct the damage at Client Agencies expense, or exclude the damaged areas from the warranty and correct the damage by any arrangement deemed appropriate by the Client Agency

1.12 MAINTENANCE SERVICE FOR TREES, SHRUBS, GROUNDCOVERS & PLANTS

A. Initial Maintenance Service: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after plants are installed and continue until Initial Acceptance for Substantial Planting Completion (which is the beginning of the Establishment Period).

B. Maintenance Service during the Establishment Period: Provide maintenance by skilled employees of landscape Installer. Maintain as required in Part 3. Begin maintenance immediately after initial acceptance and date of Substantial Planting Completion and continue through the Establishment Period.

C. Watering: Provide water, and water the plants for healthy plant growth and survival.
   1. Once the water spigots are installed and functional, or the campus water infrastructure is allowed to be used, then there may be water available for the Contractor's use for watering plants, otherwise use imported water.

   2. During the Establishment Period, review the contractor's watering operations with the Landscape Architect.
      a. Limit interruptions to public use of the site.
      b. Provide hand-watering and do not depend upon sprinkler systems and automatic temporary irrigation.
      c. Keep spigots locked when not in use, and at the end of each day.

D. During the Maintenance Periods, any decline in the condition of plantings shall require the contractor to take immediate action to identify potential problems and undertake corrective measures. If required, the Contractor shall engage professional arborists and/or horticulturists to inspect plant materials, identify problems, and recommend corrective measures. The Client Agencies Representative and Landscape Architect shall be notified immediately of such actions.
   1. Client Agency is responsible for weeding during the Establishment Period unless otherwise indicated. Observe periodically and notify Client Agency promptly if lack of weeding could stunt plant establishment; provide photographic evidence to Client Agency and Landscape Architect.
      a. Contractor is responsible for watering and other plant maintenance during the establishment period.

E. If Client Agency chooses to perform all or part of the maintenance during the warranty period, submit maintenance instructions to be performed by the Client Agency and set up a schedule for regular on-site review to assure compliance. Submit instructions and schedule before date of Substantial Planting Completion.

   1. Client Agencies performance of maintenance during the warranty period shall not limit Contractor's obligations under provisions of the warranty.

1.13 CHEMICAL SPRAYING PROGRAM

A. Follow requirements as specified in Section 329200 Turf and Grasses.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant Schedule or Plant Legend shown on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch in diameter; or with stem girdling roots will be rejected.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which shall begin at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant as shown on Drawings.

E. If formal arrangements or consecutive order of plants is shown on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. Annuals and Biennials: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 SHADE AND FLOWERING TREES

A. Shade Trees: Single-Stem trees with straight trunk, well-balanced crown, and intact leader, of height and caliper indicated, complying with ANSI Z60.1
1. Provide balled and burlapped trees.

B. Small Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
1. Stem Form: Single stem or, as indicated, multistem, with multiple stems.
2. Provide balled and burlapped trees.

C. Multistem Trees: Branched or pruned naturally according to species and type, with relationship of caliper, height, and branching according to ANSI Z60.1; stem form as follows:
1. Stem Form: Clump and shrub unless otherwise indicated.
2. Provide balled and burlapped trees.

D. Herbaceous Plants: according to ANSI Z60.1.

2.3 DECIDUOUS SHRUBS & EVERGREEN SHRUBS

A. Form and Size: Deciduous shrubs with not less than the minimum number of canes required by and measured according to ANSI Z60.1 for type, shape, and height of shrub.
   1. Provide balled and burlapped or, if indicated or allowed, container-grown shrubs.

2.4 GROUND COVER PLANTS

A. Ground Cover: Provide ground cover of species indicated, established and well rooted in pots or similar containers, and complying with ANSI Z60.1.

2.5 ORGANIC SOIL AMENDMENTS

A. Compost: Well-composted, stable, and weed-free organic matter, pH range of 5.8 to 7; moisture content 35 to 55 percent by weight; 100 percent passing through 1/2-inch sieve; soluble salt content of 2 to 5 decisiemens/m; not exceeding 0.5 percent inert contaminants and free of substances toxic to plantings; and as follows:

   1. Organic Matter Content: 25 -55% percent of dry weight.
   2. Feedstock: Agricultural, food, or industrial residuals; biosolids; yard trimmings; or source-separated or compostable mixed solid waste.

B. Manure: Well-rotted, unleached, stable or cattle manure containing not more than 25 percent by volume of straw, sawdust, or other bedding materials; free of toxic substances, stones, sticks, soil, weed seed, debris, and material harmful to plant growth.

2.6 FERTILIZERS

A. Bonemeal: Commercial, raw or steamed, finely ground; a minimum of 1 percent nitrogen and 10 percent phosphoric acid.

B. Superphosphate: Commercial, phosphate mixture, soluble; a minimum of 20 percent available phosphoric acid.

C. Commercial Fertilizer: Commercial-grade complete fertilizer of neutral character, consisting of fast- and slow-release nitrogen, 50 percent derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

   1. Composition: 1 lb/1000 sq. ft. of actual nitrogen, 4 percent phosphorous, and 2 percent potassium, by weight. Follow soil test requirements.
   2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

D. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:

   1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified soil-testing laboratory.

E. Planting Tablets: Tightly compressed chip type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

F. Chelated Iron: Commercial-grade FeEDDHA for dicots and woody plants, and commercial-grade FeDTPA for ornamental grasses and monocots.

2.7 329300 PLANTING SOILS

A. 329300 Planting Soil (Plant Beds and Individual Trees): Imported ASTM D 5268 topsoil and/or ASTM D 5268 manufactured topsoil from off-site sources, with 4% to 8% organic matter, with pH range of 5.8 to 6.5, free of extraneous materials harmful to plant growth. Obtain topsoil displaced from naturally well-drained construction or mining sites where topsoil occurs at least 4 inches deep; do not obtain from agricultural land, bogs or marshes.

1. Additional Properties of Imported Topsoil and Manufactured Topsoil: Screened and free of stones 1 inch or larger in any dimension; free of roots, plants, sod, clods, clay lumps, pockets of coarse sand, paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials harmful to plant growth; free of obnoxious weeds and invasive plants including but not limited to quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, bromegrass, Japanese knotweed, giant reed, and lesser celandine; not infested with nematodes, grubs, other pests, pest eggs, jumping worms, or other undesirable organisms and disease-causing plant pathogens; friable and with sufficient structure to give good tilth and aeration. Continuous, air-filled, pore-space content on a volume/volume basis shall be at least 15 percent when moisture is present at field capacity. Soil shall have a field capacity of at least 15 percent on a dry weight basis.

a. Texture Class: Loam – approximately 40% sand, 40% silt and 20% clay

1) Loam percentage limits: 23-52% sand, 28-50% silt, 7-27% clay

b. Optional Texture Class: Sandy Loam – approximately 60% sand, 25% silt and 15% clay

1) Sandy Loam percentage limits: 43-85% sand, 0-50% silt, 0-20% clay

2. Mix imported topsoil or manufactured topsoil in the quantities recommended in soils reports for each planting type- native plants- from a qualified soil-testing laboratory and as reviewed by Landscape Architect to produce 329300 Planting Soil.

3. Follow Lab Recommendations for the following and as also specified herein.

   a. Ratio of Loose Compost to Topsoil by Volume: per required soil tests and recommendations.
   b. Weight of Bonemeal per required soil tests and recommendations.
   c. Weight of Superphosphate per required soil tests and recommendations.
   d. Weight of Commercial Fertilizer per required soil tests and recommendations.
   e. Weight of Slow-Release Fertilizer per required soil tests and recommendations.

2.8 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, subject to approval of Landscape Architect, consisting of the following:

1. Type: Triple Shredded hardwood.
2. Size Range: 3 inches maximum, 1/2 inch minimum.
3. Color: Natural.

2.9 STAKING AND GUYING:

A. Tree stakes shall be two 2”x2” stakes, a minimum of 6 feet long with 2 feet in ground. Guying shall consist of nylon straps wrapped loosely around the trunk. Provide additional stakes if required for proper stabilization – the project site is windy.

2.10 Non-woven Geotextile: PennDOT 735 Class 4 Type A, with AOS 70-100 Sieve.

2.11 Mineral Mulch: size as indicated, in gray-blue-tan range typical of Delaware River type – refer to Delaware Quarries River Jacks color range.

2.12 Edge Restraint: as indicated, or approved equal.

A. Include stakes manufactured by edge restraint manufacturer.

B. Include manufactured corners if available from manufacturer.

C. Twenty (20) foot long pieces if available from the manufacturer, or if not available, then next highest length.

D. Color: as indicated.

2.13 PESTICIDES

A. General: Pesticide, registered and approved by EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless au-

thorized in writing by authorities having jurisdiction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants for compliance with requirements and conditions affecting installation and performance.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Do not mix or place soils and soil amendments in frozen, wet, or muddy conditions.
3. Suspend soil spreading, grading, and tilling operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
4. Uniformly moisten excessively dry soil that is not workable and which is too dusty.

B. Treat and remove weeds prior to planting.
1. Treat persistent weed species with systemic herbicide (herbicide without soil activity) to kill persistent species including but not limited to Thistle, Japanese Knotweed, Mugwort, tree of Heaven, and Giant Reed, to deter resprouts from weed roots.
a. Wait for herbicide to take effect prior to disturbing the persistent species.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

D. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Client Agencies Representative and replace with new 329300 Planting Soil.

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Mark existing and proposed underground utilities, and maintain markouts throughout operations.

C. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

D. Lay out individual tree, and shrub locations, and lay out outlines of each species grouping of herbaceous plants and groundcovers. Adjust locations and outlines when requested by Landscape Architect, and obtain Landscape Architect's acceptance of layout before excavating

or planting. Make minor adjustments as required. Notify Landscape Architect two weeks and then three days prior to layout and staking.

1. Shift proposed tree locations a minimum of five feet away from underground utilities, to locations approved by the Landscape Architect.

3.3 PLANTING AREA ESTABLISHMENT

A. Prior to commencing any finished grading, the Contractor shall notify the Landscape Architect allowing enough time for a thorough inspection of the subgrade.

B. Do not remove any existing topsoil from the project site; re-use in planting and lawn areas.

C. Perform all finished grading necessary to bring site to required finished elevations indicated on the grading plan and to allow for positive drainage.

D. Use topsoil stockpiled on the site during earthwork operations and provide any additional topsoil required. Refer to Section 329200 Turf and Grasses for additional requirements.

E. Topsoil shall not be placed when the subgrade is frozen, excessively wet, or extremely dry, and no topsoil shall be handled when in a frozen or muddy condition.

F. Loosen subgrade of planting areas (at changed grades) to a minimum depth of 12 inches after spreading 1 inch of compost and blending into subgrade. Remove stones larger than 1 inch in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Client Agencies property.

1. Apply fertilizer directly to subgrade before loosening, only if required by soil tests.
2. Thoroughly blend manufactured 329300 Planting Soil off-site before spreading or spread topsoil, apply soil amendments and fertilizer as directed or required by soil tests on surface, and thoroughly blend Planting Soil.

    a. Delay mixing fertilizer with Planting Soil if planting will not proceed within a few days.

3. Spread 329300 Planting Soil to a depth of 12 inches at trees, shrubs and herbaceous plants but not less than required to meet finish grades after natural settlement. Do not spread if planting soil or subgrade is frozen, muddy, or excessively wet.

    a. Spread approximately three (3) inches of 329300 Planting Soil over loosened subgrade. Mix thoroughly into top six (6) inches of subgrade. Spread remainder of 329300 Planting Soil.

    b. For top 6-inches of planting soil, do not compact except by light foot traffic; for planting soil below that (and blended subgrade and planting soil zone) limit compaction to 85% of maximum dry density per ASTM D1557.

G. Finish Grading: Grade planting areas to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.

H. Leave finish graded area clean, well raked, and ready for planting.

I. Keep vehicles and heavy equipment off planting soils; use only light equipment such as wheelbarrows, tree carts.
   1. Sequence building construction and hardscape construction in coordination with planting soil placement to avoid compaction of planting soils.

J. Before planting, restore planting areas if eroded, compacted, or otherwise disturbed after finish grading.

3.4 PLANTING LAYOUT:

A. Layout of plants prior to planting shall be verified by the Landscape Architect. Any alterations to the planned planting layout must be approved by the Landscape Architect.

3.5 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits & Trenches: Excavate circular planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are not acceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that tree root balls will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

   1. Excavate approximately three times as wide as ball diameter for balled and burlapped, balled and potted, container-grown stock.
      a. Excavate entire plant bed areas and dispose of the subsoil, or spread where allowed by Client Agencies Representative under planting soil at lawn areas.
      b. Salvage excavated topsoil and use at lawn areas and/or under the 12” of 329300 Planting Soil indicated herein; do not export topsoil.
   2. For bare-root stock, excavate at least 12 inches wider than root spread and deep enough to accommodate vertical roots.
   3. Do not excavate deeper than depth of the tree root ball, measured from the root flare to the bottom of the root ball.
   4. If area under the tree was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
   5. Maintain required angles of repose of adjacent materials as shown on the Drawings. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
   6. Maintain supervision of excavations during working hours.
   7. Keep excavations covered or otherwise protected overnight, after working hours and when unattended by Installer's personnel.
   8. If drain tile is shown on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Topsoil removed from excavations may not be used for 329300 Planting Soil, except as follows.
   1. At individual tree plantings in lawn areas, existing topsoil or placed topsoil or placed planting soil that meets the requirements of Division 32 Section “Turf and Grasses” may be used as tree pit backfill, however use pH adjustment amendment for pH adjustment to meet pH specified herein.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations, or if hardpan is encountered.

D. If an impervious, hard pan layer remains in the bottom of the pit after excavation the Landscape Architect shall be notified prior to any additional planting activities to inspect the excavation and develop an alternate course of action. The Landscape Architect may recommend the following action in item 1 below:

1. Hardpan Layer: Drill 6-inch- diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet , whichever is less, and backfill with free-draining material.

E. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

F. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.6 TREE AND SHRUB PLANTING

A. Before planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Set balled and burlapped stock plumb and in center of planting pit or trench with root flare 2 inches above adjacent finish grades.

1. Use 329300 Planting Soil for planting pit backfill and entire beds.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 3 inches from root tips; do not place tablets in bottom of the hole.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Set potted and container-grown stock plumb and in center of planting pit or trench with tree root flares 2 inches above adjacent finish grades, and shrub root flares 1” above adjacent finish grades or flush with adjacent finish grades.

1. Use 329300 Planting Soil throughout plant beds.
2. Carefully remove root ball from container without damaging root ball or plant
3. Cut root ball vertically at three or four locations to cut girdling roots, approximately 1” deep and as required to cut girdling roots.
4. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.

5. Place planting tablets in each planting pit when pit is approximately one-half filled; in amounts recommended in soil reports from soil-testing laboratory. Place tablets beside the root ball about 3 inches from root tips; do not place tablets in bottom of the hole.
6. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.7 GROUND COVER AND PLANT PLANTING (HERBACEOUS PLANTS)

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Landscape Plans & Details. Notify Landscape Architect three days prior to layout and staking.

B. Use 329300 Planting Soil throughout entire beds.

C. Dig holes large enough to allow spreading of roots.

D. Gently break up roots of any root-bound plants.

E. For rooted cutting plants supplied in flats, plant each in a manner that will minimally disturb the root system but to a depth not less than two nodes.

F. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

G. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

H. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.8 STAKING AND GUYING:

A. Stake and guy any trees susceptible to tipping in the wind.
1. The Cheyney project site is susceptible to wind.

B. Stake and guy transplanted trees.

C. Staking and guying shall be done immediately after trees are planted using specified staking materials.

D. Trees shall stand plumb prior to staking.

E. If unstaked trees start tipping from the wind then stake and guy all trees.

3.9 MINERAL MULCH AND EDGE RESTRAINT INSTALLATION:

A. Excavate and compact subgrade.

B. Set edge restraint with a stake at each stake slot.

C. Use full-length edge restraints wherever feasible.
   1. Do not use pieces shorter than 5-feet long.

D. Set edge restraint straight and true.
   1. Maximum deviation in horizontal alignment: ½" in 10 feet.
   2. Maximum deviation in vertical alignment: ½" in 10 feet.

E. Use manufacturers corners.

F. Follow manufacturers written installation instructions, except where more stringent requirements are described herein and on Contract Drawings.

G. Place geotextile and secure to sides of drip strip.
   1. Trim cleanly, hidden below mineral mulch surface; trim straight.

H. Place mineral mulch.

I. Protect from washout from adjacent mulch and soil areas until landscape planting operations are finished.

3.10 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

   1. Trees and Tree-like Shrubs in Turf Areas: Apply organic mulch ring of 3-inch average settled thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches of trunks or stems.
   2. Organic Mulch in Planting Areas: Apply 3-inch average settled thickness of organic mulch extending 12 inches beyond edge of individual planting pit or trench and over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.
   3. Existing plant beds: Apply 3-inch average settled thickness of organic mulch. Do not place mulch within 3 inches of trunks or stems.
   4. At plugs, reduce organic mulch depth to 2-inch average settled thickness. Do not place mulch within 2 inches of plug stems.

3.11 PLANT MAINTENANCE

A. The Contractor shall be responsible for providing the following maintenance on all newly planted trees, shrubs, groundcovers, and herbaceous perennials.
   1. Watering: During any 7 day period that yields less than 1 inch of rainfall - as measured by a nearby Weather Service station - the contractor shall water all plant material to maintain a constant suitable moisture level for adequate plant growth. The Contractor shall be responsible for providing all watering hoses, watering devices or other water delivery methods including tankers. The Contractor shall supply the water; the Client Agency may supply supplemental water once the exterior water spigots are installed and operational but if not, then the Contractor must supply the water.

a. Additionally, if any plant shows signs of drought stress or transplant shock, provide the proper amount of water as required for healthy plant growth, directly by hose to the root ball area.

2. Insect, Disease, and Weed Control: Weed control shall be by mechanical or hand weeding, as well as spot-treatment of herbicide on species with persistent roots. The use of herbicides, insecticides, fungicides, nematicides, fumigants or other chemicals are only acceptable upon approval by the Client Agency under the provisions of a Chemical Spraying Program approved by the Client Agencies Representative.

B. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings. Spray or treat as required to keep trees and shrubs free of insects and disease.

C. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

D. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated past management practices whenever possible to minimize the use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 ESTABLISHMENT PERIOD

A. The Establishment Period will begin upon notice of planting completion by the Contractor and inspection by the Landscape Architect for Initial Acceptance (setting the date of Substantial Planting Completion if the Landscape Architect approves the planting during the inspection) and will last for a total of 365 days.

B. Plants shall be guaranteed during the Establishment Period and shall be alive and in satisfactory growth at the end of that period. Plants which die within the establishment period will be removed by the Contractor within five (5) business days of notice or the Client Agency will remove the plants and bill the Contractor accordingly. Replacement plants may be installed during the next appropriate planting season for the species specified. All replacements shall be plants of the same species and size specified in the plant list. They shall be furnished and planted according to specifications and Drawings and shall be guaranteed through an additional 365 days, as outlined above. The cost of replacement shall be borne by the Contractor, except for possible replacements resulting from removal, loss or damage due to vandalism, or act of neglect on the part of others.

C. The Contractor is responsible for maintenance activities, including watering, weeding, selective herbicide treatment on persistent weeds (spot applications only), insect and disease control, and other methods required to insure the overall health of the plants during the Establishment Period.

3.13 FINAL INSPECTION AND FINAL ACCEPTANCE:

A. At the end of the Establishment Period, a final inspection will be made by the Landscape Architect, the Contractor, and Client Agencies Representative. Any plant determined to be of

insufficient quality or unsatisfactory growth, as determined the Landscape Architect, shall be removed from the site and replaced at the Contractor's expense.

3.14 CLEANUP AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition.

B. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

C. After installation and before Substantial Planting Completion, remove nursery tags (except leave one tag per species until the end of the Establishment Period), nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

3.15 DISPOSAL

A. Remove surplus and waste material including excess imported topsoil/329300 Planting Soil, trash, and debris and legally recycle or dispose of them off Client Agencies property.

B. Do not export existing topsoil – use it in lawn areas, or below the specified 12" depth for 329300 Planting Soil specified herein.

END OF SECTION

SECTION 331113

SITE WATER UTILITY DISTRIBUTION

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Furnish equipment, labor, materials, services, and other items required for accompanying the construction of the water systems. This shall include, but not be limited to the following: pipe and fittings for site water line including domestic water line and fire water line, and valves. Set lines, elevations, and grades for water distribution system work for duration of work including careful maintenance of benchmarks, property corners, monuments, or other reference points.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Field quality-control test reports.

C. Operation and maintenance data.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with requirements of authorities having jurisdiction for potable-water-service connections. Include tapping of water mains and backflow prevention.
2. Comply with standards of authorities having jurisdiction for potable-water-service piping, including materials, installation, testing, and disinfection.
3. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

B. Piping materials shall bear label, stamp, or other markings of specified testing agency.

C. Comply with FMG's "Approval Guide" or UL's "Fire Protection Equipment Directory" for fire-service-main products.

D. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-service-main piping for fire suppression.

E. NSF Compliance: Comply with NSF 61 for materials for water-service piping and specialties for domestic water.

1.5 PROJECT CONDITIONS

A. All work shall proceed in accordance with approved Erosion and Sedimentation Control plans and permits.

1.6 COORDINATION

A. Coordinate connection with the local water distribution company and Fire Chief.

PART 2 - PRODUCTS

2.1 PIPE AND FITTINGS

A. Mechanical-Joint, Ductile-Iron Pipe (3-inches or Greater): ANSI/AWWA C110/A21.10 and ANSI/AWWA C111/A21.11, Thickness Class 52, pressure rated for 350 psi with mechanical-joint bell and plain spigot end unless grooved or flanged ends are indicated. Exterior to be coated with bitumastic enamel and the inside double cement lined meeting the requirements of ANSI/AWWA C104/A21.4 (latest version) and ANSI/AWWA C151/A21.51.

1. Mechanical-Joint, Ductile-Iron Fittings (Megalugs): AWWA C110/A21.10-08, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern and rated for 350 psi.
2. Glands, Gaskets, and Bolts: AWWA C111, ductile- or gray-iron glands, rubber gaskets, and steel bolts.

B. Push-on-Joint, Ductile-Iron Pipe: AWWA C151, Pressure Class 350, Thickness Class 52, pressure rated for 350 psi with push-on-joint bell and plain spigot end unless grooved or flanged ends are indicated. Exterior to be coated with bitumastic enamel and the inside double cement lined.

1. Push-on-Joint, Ductile-Iron Fittings (American Pipe Flex-Ring/Field-Loc, Fast-Grip gasket or equal): AWWA C110/A21.10-08, ductile- or gray-iron standard pattern or AWWA C153/A21.53, ductile-iron compact pattern and rated for 350 psi.
2. Gaskets: AWWA C111, rubber.

C. High Density Polyethylene Pipe (HDPE) (Smaller than 3-inches) ANSI/AWWA C901 (latest version). Pressure Class 200 psi. Preferred installation is continuous section of pipe from the ductile iron isolation valve on the water main tap to the inside of the building. Underground splices shall be heat fusion connections.

2.2 JOINING MATERIALS

A. Refer to Division 22 Section "Common Work Results for Plumbing" for commonly used joining materials.

B. Brazing Filler Metals: AWS A5.8, BCuP Series.

2.3 PIPING SPECIALTIES

A. Transition Fittings: Manufactured fitting or coupling same size as, with pressure rating at least equal to and ends compatible with, piping to be joined.

B. Tubular-Sleeve Pipe Couplings:

1. Description: Metal, bolted, sleeve-type, reducing or transition coupling, with center sleeve, gaskets, end rings, and bolt fasteners and with ends of same sizes as piping to be joined.

a. Standard: AWWA C219.

2.4 VALVES

A. Resilient Seated Gate Valves:
1. Valve shall conform to the latest revision of AWWA Standard C509 covering resilient seated gate valves with nonrising stems for water supply service.
2. The direction to open shall be counterclockwise.
3. The sealing rubber shall be permanently bonded to the wedge per ASTM D429.
4. Valves shall be supplied with O-ring seals at all pressure retaining joints. No flat gaskets shall be allowed.
5. The valves shall be either non-rising stem opening by turning left or right, and provided with 2” square operating nut or a hand wheel with the word “Open” and an arrow to indicate the direction to open.
6. Stems shall be cast copper alloy with integral collars in full compliance with AWWA. All stems shall operate with copper alloy stem nuts independent of wedge and of stem (in NRS valves).
7. All stems shall have two O-rings locates above thrust collar and one O-ring below. Stem O-rings shall be replaceable with valve fully opened and subjected to full pressure. The stems shall also have a low torque thrust bearing located above and below the stem collar to reduce friction during operations.
8. Waterway shall be smooth, unobstructed and free of all pockets, cavities and depressions in the seat area. Valves shall accept a full size tapping cutter.
9. The body, bonnet and O-ring plate shall be fusion-bonded epoxy coated, both interior and exterior on body and bonnet. Epoxy shall be applied in accordance with AWW C550 and be NSF 61 certified.
10. Each valve shall have maker’s name, pressure rating, and year in which it was manufactured cast in the body. Prior to shipment from the factory, each valve shall be tested by hydrostatic pressure equal to the requirements of AWWA C509 and UL/FM where applicable.

2.5 GATE VALVE ACCESSORIES AND SPECIALTIES

A. Tapping-Sleeve Assemblies shall be as required by Construction Standards and PECO Specifications.:

1. Available Manufacturers: Subject to compliance with requirements, manufacturers

B. Valve Boxes: Comply with AWWA M44 for cast-iron valve boxes Valve boxes shall be cast iron of the three piece screw type installed over the bonnet and operating nut, and of sufficient length to reach the surface of the ground but not extend above the ground surface. The lid shall

be provided with the lettering "WATER," and bottom section with base that fits over valve and with a barrel approximately 5 inches in diameter.

1. Operating Wrenches: Steel, tee-handle with one pointed end, stem of length to operate deepest buried valve, and socket matching valve operating nut.

2.6 ACCESSORIES

A. Concrete for Thrust Restraints: Concrete type as specified in Construction Standards and PECO Specifications.

B. Backflow Preventer as specified in Construction Standards and PECO Specifications.

C. Meter: as specified in Construction Standards and PECO Specifications.

2.7 EARTHWORK

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

B. All work shall proceed in accordance with approved Erosion and Sedimentation Control plans and permits.

2.8 PIPING APPLICATIONS

A. General: Use pipe, fittings, and joining methods for piping systems according to the manufacturer's recommendations.

B. Transition couplings and special fittings with pressure ratings at least equal to piping pressure rating may be used, unless otherwise indicated.

2.9 VALVE APPLICATIONS

A. General Application: Use mechanical-joint-end valves for NPS 3 and larger underground installation. Use UL/FMG, nonrising-stem gate valves for installation with indicator posts.

B. Drawings indicate valve types to be used.

2.10 PIPING SYSTEMS - COMMON REQUIREMENTS

A. See Division 22 Section "Common Work Results for Plumbing" for piping-system common requirements.

2.11 PIPING INSTALLATION

Unless otherwise noted in PECO Specifications, follow instructions below:

A. Water-Main Connection: Tap water main according to requirements PECO requirements and of size and in location indicated.

B. Make connections with tapping machine according to the following:

1. Install tapping sleeve and tapping valve according to MSS SP-60.
2. Install tapping sleeve on pipe to be tapped. Position flanged outlet for gate valve.
3. Use tapping machine compatible with valve and tapping sleeve; cut hole in main. Remove tapping machine and connect water-service piping.
4. Install gate valve onto tapping sleeve. Comply with MSS SP-60. Install valve with stem pointing up and with valve box.

C. Comply with NFPA 24 for fire-service-main piping materials and installation.

D. Install ductile-iron, water-service piping according to AWWA C600 and AWWA M41.

E. Bury piping with depth of cover over top at least 48 inches.

F. Extend water-service piping and connect to water-supply source and building-water-piping systems at outside face of building wall in locations and pipe sizes indicated.

1. Terminate water-service piping at building wall until building-water-piping systems are installed. Terminate piping with caps, plugs, or flanges as required for piping material. Make connections to building-water-piping systems when those systems are installed.

G. Sleeves are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

H. Mechanical sleeve seals are specified in Division 22 Section "Sleeves and Sleeve Seals for Plumbing Piping."

I. Install underground piping with restrained joints at horizontal and vertical changes in direction. Use restrained-joint piping, thrust blocks, anchors, tie-rods and clamps, and other supports.

2.12 JOINT CONSTRUCTION

A. See Division 22 Section "Common Work Results for Plumbing" for basic piping joint construction.

B. Make pipe joints according to the following:

1. Ductile-Iron Piping, Gasketed Joints for Water-Service Piping: AWWA C600 and AWWA M41.
2. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

2.13 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints. Anchorages and restrained-joint types that may be used include the following:

1. Concrete thrust blocks.
2. Locking mechanical joints.
3. Set-screw mechanical retainer glands.
4. Bolted flanged joints.
5. Heat-fused joints.
6. Pipe clamps and tie rods.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches. Include anchorages for the following piping systems:

1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.
2. Fire-Service-Main Piping: According to NFPA 24.

C. Apply full coat of asphalt or other acceptable corrosion-resistant material to surfaces of installed ferrous anchorage devices.

2.14 VALVE INSTALLATION

A. AWWA Gate Valves: Comply with AWWA C600 and AWWA M44. Install each underground valve with stem pointing up and with valve box.

B. UL/FMG, Gate Valves: Comply with NFPA 24. Install each underground valve and valves in vaults with stem pointing up and with vertical cast-iron indicator post.

C. MSS Valves: Install as component of connected piping system.

D. Corporation Valves and Curb Valves: Install each underground curb valve with head pointed up and with service box.

E. Install precast concrete vaults according to ASTM C 891.

F. Piping Tests: Conduct piping tests as directed in FM Global Data Sheet 3-10.

G. Hydrostatic Tests: Test as directed in FM Global Data Sheet 3-10.

H. Prepare reports of testing activities as directed in FM Global Data Sheet 3-10.

I. Submit FM Global Form 85B, Contractor’s Material and Test Certificate for Underground Piping.

2.15 IDENTIFICATION

A. Install continuous underground warning tape during backfilling of trench for underground water-distribution piping. Locate below finished grade, directly over piping. Underground warning tapes are specified in Division 31 Section "Earth Moving."

2.16 CLEANING

A. Clean and disinfect water-distribution piping as directed in FM Global Data Sheet 3-10.

B. Prepare reports of purging and disinfecting activities as directed in FM Global Data Sheet 3-10.

C. Submit FM Global Form 85B, Contractor’s Material and Test Certificate for Underground Piping.

END OF SECTION 331113

SECTION 334100

STORM UTILITY DRAINAGE PIPING

PART 1 - GENERAL

1.1 STIPULATIONS

A. The specifications sections “General Conditions”, “Special Requirements” and “General Requirements” form a part of this section by this reference thereto and shall have the same force and effect as if printed herewith in full.

1.2 SUMMARY

A. Section Includes:

1. Pipe and fittings.

2. Stormwater manholes,

3. Area drains.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

1. Manholes, Catch basins, area drains, yard drains, and stormwater inlets. Include plans, elevations, sections, details, frames, covers, and grates.

C. Coordination Drawings: Show pipe sizes, locations, and elevations. Show other piping in same trench and clearances from storm drainage system piping. Indicate interface and spatial relationship between manholes, piping, and proximate structures.

D. Field quality-control reports.

1.4 REFERENCES:

A. American Association of State Highway and Transportation Officials:
1. AASHTO T180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18-in.) Drop.
2. AASHTO M36/M36M - Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
3. AASHTO M86 - Concrete, Sewer, Storm Drain, and Culvert Pipe
4. AASHTO M170 - Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.

5. AASHTO M196/M196M - Corrugated Aluminum Pipe for Sewers and Drains.
6. AASHTO M198 - Joints for Circular Concrete Sewer and Culvert Pipe Using Flexible Watertight Gaskets.
7. AASHTO M206 - Reinforced Concrete Arch Culvert Storm Drain, and Sewer Pipe.
8. AASHTO M207 - Reinforced Concrete Elliptical Culvert, Storm Drain and Sewer Pipe.
9. AASHTO M252 - Corrugated Polyethylene Drainage Tubing.
10. AASHTO M264 - Acrylonitrile-Butadiene-Styrene (ABS) and Poly Vinyl Chloride (PVC) Composite Sewer Piping.
11. AASHTO M278 - Class PS 50 Polyvinyl Chloride (PVC) Pipe.
12. AASHTO M288 - Geotextiles.
13. AASHTO M294 - Corrugated Polyethylene Pipe, 12- to 36-in Diameter

B. American Society for Testing and Materials (ASTM) latest edition.
1. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
2. ASTM A746 - Standard Specification for Ductile Iron Gravity Sewer Pipe.
3. ASTM C14 - Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
4. ASTM C76 - Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
5. ASTM C443 - Standard Specification for Joints for Concrete Pipe and Manholes, Using Rubber Gaskets.
6. ASTM C969 - Standard Practice for Infiltration and Exfiltration Acceptance Testing of installed Precast Concrete Pipe Sewer Lines.
7. ASTM C924 - Standard Practice for Testing Concrete Pipe Sewer Lines by LowPressure Air Test Method.
8. ASTM D698 - Standard Test Method for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3)).
9. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3)).
10. ASTM D2235 - Standard Specification for Solvent Cement for Acrylonitrile-ButadieneStyrene (ABS) Plastic Pipe and Fittings.
11. ASTM D2321 - Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications.
12. ASTM D2564 - Standard Specification for Solvent Cements for Poly (Vinyl Chloride) (PVC) Plastic Piping Systems.
13. ASTM D2729 - Standard Specification for Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
14. ASTM D2751 - Standard Specification for Acrylonitrile-Butadiene-Styrene (ABS) Sewer Pipe and Fittings.
15. ASTM D2855 - Standard Practice for Making Solvent-Cemented Joints with Poly (Vinyl Chloride) (PVC) Pipe and Fittings.
16. ASTM D2922 - Standard Test Method for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
17. ASTM D3017 - Standard Test Method for Water Content of Soil and Rock in Place by Nuclear Methods (Shallow Depth).
18. ASTM D3034 - Standard Specification for Type PSM Poly (Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
19. ASTM D3350 - Standard Specification for Polyethylene Plastics Pipe and Fittings Materials.
20. ASTM F405 - Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings.
21. ASTM F477 - Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
22. ASTM F667 - Standard Specification for Large Diameter Corrugated Polyethylene Pipe and Fittings.

23. ASTM D1785 - Standard Specification for Poly (Vinyl/Chloride) (PVC) Plastic Pipe, Schedule 40, 80, and 120.
24. ASTM D2467 - Standard Specification for Poly (Vinyl/Chloride) (PVC) Plastic Pipe fitting 80.

C. Pennsylvania Department of Transportation:
1. PennDOT Specifications, Publication 408, Latest Edition.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

A. Corrugated PE Drainage Pipe and Fittings NPS 3 to NPS 10 AASHTO M 252M, Type S, with smooth waterway for coupling joints.
1. All joints to be watertight in accordance with AASHTO M252M and ASTM D3212.
2. Gaskets shall meet the requirements of ASTM F477.
3. All bells shall be formed integrally with pipe
4. Provide lubricant as specified by manufacturer.
5. Joints shall contain a 10.8 psig rating.

B. Corrugated PE Pipe and Fittings NPS 12 to NPS 60: AASHTO M 294M, Type S, with smooth waterway for coupling joints.
1. All joints to be watertight in accordance with AASHTO M294M and ASTM D3212.
2. Gaskets shall meet the requirements of ASTM F477.
3. All bells shall be formed integrally with pipe
4. Provide lubricant as specified by manufacturer.
5. Joints shall contain a 10.8 psig rating.

2.2 PVC PIPE AND FITTINGS

A. PVC Sewer Piping:

1. Pipe: ASTM D 3034, SDR 35 PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.

2. Fittings: ASTM D 3034, PVC with bell ends.

3. Gaskets: ASTM F 477, elastomeric seals.

2.3 STORMWATER INLETS

A. Refer to Contract Drawings

B. Clear inside dimensions refer to Contact Drawings.

C. Standard Precast Concrete Inlets: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923 and in accordance with PennDOT Specifications, Publication 408, and Section 714.

D. Design Depth: As indicated. Allow for a minimum of four (4) inches of field adjustment.

E. Pipe Entry: Provide opening as required.

F. Stormwater Facility & Adjustment Rings: Precast concrete units constructed of Air-entrained cement concrete having minimum compressive strength of 3,300 psi at 28 days in accordance with PennDOT Specification Publication 408, Section 714, Latest Edition. Fabrication procedure to conform to PCI MNL-116S.

G. Bedding: Coarse Aggregate, PennDOT No. 2A in accordance with PennDOT Specifications, Publication 408, Section 703.2, Latest Edition.

H. Mortar and Grout: In accordance with PennDOT Specifications, Publication 408, Section 705.7, Latest Edition.

I. Reinforcement: In accordance with PennDOT Specifications, Publication 408, Section 709.3, Latest Edition.

J. Manhole and Structure Steps: In accordance with PennDOT Specifications, Publication 408, Section 605.2, Latest Edition, copolymer polypropylene plastic with ½" Grade 80 steel reinforcement.

K. Frames and Grates: shall meet the requirements of PennDOT Standard Specifications Publications 408, Section 605, latest edition.

2.4 STORMWATER MANHOLES

A. Manhole Base and Riser Sections: Reinforced precast concrete in accordance with ASTM C478 with gaskets in accordance with ASTM C923 and in accordance with PennDOT Specifications, Publication 408, Section 714.

B. Bedding: Coarse Aggregate, PennDOT No. 2A in accordance with PennDOT Specifications, Publication 408, Section 703.2, Latest Edition.

C. Mortar and Grout: In accordance with PennDOT Specifications, Publication 408, Section 705.7, Latest Edition.

D. Reinforcement: In accordance with PennDOT Specifications, Publication 408, Section 709.3, Latest Edition.

E. Manhole and Structure Steps: In accordance with PennDOT Specifications, Publication 408, Section 605.2, Latest Edition, copolymer polypropylene plastic with ½" Grade 80 steel reinforcement.

2.5 Frames and Grates: shall meet the requirements of PennDOT Standard Specifications Publications 408, Section 605, latest edition

2.6 ACCESSORIES

A. Filter Fabric: Class 1 Geotextile in accordance with PennDOT Specification Publication 408, Section 735, Latest Edition.

B. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic of core #10 wire encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored to comply with local practice or requirements of authorities having jurisdiction.

C. Connecting and Supporting Devices: Meet requirements of ASTM A36/A36M carbon steel or ASTM A666 stainless steel for plates, angles, inserts, other items cast into concrete conforming to PCI MNL-123

D. Grout: Non-shrink, Non-metallic, minimum yield strength of 7,000 psi at 28 days

E. Bolts, Nuts and Washers: Corrosion resistant chromium-nickel type

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated, to extent practical. Where specific installation is not indicated, follow piping manufacturer's written instructions.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install inlets/area drains for changes in direction unless fittings are indicated. Use fittings for branch connections unless direct tap into existing sewer is indicated.

D. Install proper size increasers, reducers, and couplings where different sizes or materials of pipes and fittings are connected. Reducing size of piping in direction of flow is prohibited.

E. Install gravity-flow, nonpressure drainage piping according to the following:

1. Install piping pitched down in direction of flow.

2. Install piping NPS 6 and larger with restrained joints at tee fittings and at changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.

3. Install piping with 24-inch minimum cover.

4. Install PE corrugated sewer piping according to ASTM D 2321.

5. Install PVC sewer piping according to ASTM D 2321 and ASTM F 1668.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:

1. Join corrugated PE piping according to ASTM D 3212 for push-on joints.

2. Join PVC sewer piping according to ASTM D 2321 for elastomeric-seal joints.

3.4 MANHOLE INSTALLATION

A. Install inlets, complete with appurtenances and accessories indicated.

B. Set frames and grates to elevations indicated.

3.5 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping in building's storm building drains specified in Division 22 Section "Facility Storm Drainage Piping."

B. Make connections to existing piping.

1. Make branch connections from side into existing piping by cutting into existing unit and creating an opening large enough to allow 3 inches of concrete to be packed around entering connection. Cut end of connection pipe passing through pipe or structure wall to conform to shape of and be flush with inside wall unless otherwise indicated. On outside of pipe, encase entering connection in 6 inches of concrete for minimum length of 12 inches to provide additional support of collar from connection to undisturbed ground.

a. Use concrete that will attain a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

b. Use epoxy-bonding compound as interface between new and existing concrete and piping materials.

2. Protect existing piping, manholes, and structures to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.6 IDENTIFICATION

A. Arrange for installation of warning tape directly over piping and at outside edge of underground structures.

1. Use detectable warning tape over nonferrous piping and over edges of underground structures.

2. Tape shall include #10 wire as indicated on the Drawings.

3.7 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches of backfill is in place, and again at completion of Project.

1. Submit separate reports for each system inspection.

2. Defects requiring correction include the following:

a. Alignment: Less than full diameter of inside of pipe is visible between structures.

b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.

c. Damage: Crushed, broken, cracked, or otherwise damaged piping.

d. Infiltration: Water leakage into piping.

e. Exfiltration: Water leakage from or around piping.

3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.

4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.

1. Do not enclose, cover, or put into service before inspection and approval.

2. Test completed piping systems according to requirements of authorities having jurisdiction.

3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

4. Submit separate report for each test.

5. Gravity-Flow Storm Drainage Piping: Test according to requirements of authorities having jurisdiction.

C. Leaks and loss in test pressure constitute defects that must be repaired.

D. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION

APPENDIX

ELEMENT ENVIRONMENTAL
SOLUTIONS

October 8, 2025

Mr. Michael Pentz
Project Architect
Kimmel Bogrette
482 Norristown Road, Suite 200
Blue Bell, PA 19422

RE: Hazardous Materials Investigation
Cheyney University – Ada S. Georges Dining Hall
E2S Project 1419.0005

Dear Mr. Pentz:

Element Environmental Solutions, Inc. (E2S) was contracted by Kimmel Bogrette to perform a hazardous materials investigation of the Ada S. Georges Dining Hall at Cheyney University, located at the corner of Creek Road and Alumni Drive on the Cheyney University Campus, Cheyney, Pennsylvania. The purpose of the investigation was to identify any hazardous materials that could be impacted by the proposed renovation to the building.

Introduction

Representatives from E2S were on site on Tuesday, September 30, 2025, to perform the hazardous materials investigation. The investigation included a visual inspection and sampling for asbestos-containing materials (ACM), radon sampling, a visual inspection for mercury and PCB-containing devices and equipment, and any other potentially hazardous or environmentally regulated materials. Our representatives, Messrs. Michael Seifrit and Boston Patton are Environmental Protection Agency (EPA) certified Asbestos Building Inspectors and are licensed as such by the Pennsylvania Department of Labor and Industry (Pa DLI). See **Appendix C** for copies of licenses.

Summary

E2S representatives performed an initial walkthrough of the existing building, interior and exterior, to locate suspect ACM, and documented all findings on field data forms. Based upon the visual inspection, bulk samples were collected of suspect ACM and were submitted to an accredited laboratory for asbestos analysis by Polarized Light Microscopy (PLM). The scope of work also included radon sampling; and was performed following the guidelines and parameters detailed in the US EPA screening test protocols. The laboratory utilized for this project was: EMSL Analytical, Inc. located in Cinnaminson, New Jersey. EMSL is an American Industrial Hygiene Association (AIHA) and National Voluntary and Lead Laboratory Accreditation Program (NVLAP/NLLAP) accredited laboratory for PLM analysis. A.B.E Radiation Measurement Laboratories was utilized for radon testing and analysis. A.B.E is certified by the PA DEP for radon testing and radon laboratory analysis.

Asbestos

The following suspect material was identified, sampled, and determined to contain asbestos at EPA-regulated levels (> 1%):

- Dark Brown 1' x 1' Floor Tile Mastic (Black/Yellow)*
- Light Brown with Streaks 1' x 1' Floor Tile Mastic (Brown)*
- Light Brown with Streaks 1' x 1' Floor Tile Mastic (Brown/Black)*
- White with Blue Specks 1' x 1' Floor Tile Mastic (Black/Yellow)*

The following suspect material was identified, sampled, and determined to contain asbestos below EPA-regulated levels (< 1%):

- Light Brown with Gray 1' x 1' Floor Tile Mastic (Gray/Black/Yellow)*

The following suspect materials were identified, sampled, and determined **NOT** to contain asbestos:

- 2' x 2' Ceiling Tile
- Drywall
- Joint Compound
- Wall Plaster
- Ceiling Plaster – Skim Coat (White)
- Ceiling Plaster – Base Coat (Tan)
- Ceiling Plaster – Base Coat (Gray)
- Cove Base Mastic (Brown)
- Mastic End on Fiberglass Insulated Pipe
- Mud Fitting on Fiberglass Insulated Pipe
- Mud Fitting on Fiberglass Insulated Pipe Wrap
- Mud End on Fiberglass Insulated Pipe
- Mud Hanger Insulation on Fiberglass Insulated Pipe
- Dark Brown 1' x 1' Floor Tile
- Light Brown with Streaks 1' x 1' Floor Tile
- Gray and White 1' x 1' Floor Tile
- Gray and White 1' x 1' Floor Tile Mastic (Brown)*
- White with Blue Specks 1' x 1' Floor Tile
- Light Blue Sheet Vinyl Flooring
- Light Brown with Gray 1' x 1' Floor Tile
- Plaster Overhang – Skim Coat (White)
- Plaster Overhang – Base Coat (Tan)
- Door/Window Caulk
- Building Expansion Caulk

*Due to inconsistencies with results of flooring adhesives (mastic), it is assumed for the purpose of this report that all mastic is asbestos-containing, based on positive (>1%) samples in four (4) of the six (6) samples collected.

Note 1: It appeared that the existing roof system was currently being replaced was not sampled during this inspection (coordination w/licensed roofer required for core sampling and patching).

Note 2: The existing window panels (possible ACM transite panels) were not sampled during this inspection (possible destructive sampling method required).

Please refer to **Table 1** for a summary of asbestos bulk sample analytical results, **Table 2** for ACM locations, quantities, condition, and recommendations, and **Table 3** for a summary of findings and cost estimates for removal of asbestos-containing materials identified.

Radon

E2S contracted with A.B.E. Radiation Measurements for the radon sampling portion of this project; A.B.E. is certified by PA DEP for radon testing and radon laboratory analyses (Certification No. 0048 and No. 0050). Please refer to **Appendix A** for the radon sampling report dated October 3, 2025, submitted by A.B.E. Radiation Measurements Laboratory, a Division of Health Physics Associates, Inc. All sampling results were compared to the PA DEP screening guideline of 4.0 picocuries per liter (pCi/L). All samples were well below the PA DEP screening value of 4.0 pCi/l.

PCB's, Mercury, and Other Suspect Hazardous Materials

Light ballasts were randomly inspected, and ballasts visually checked were determined to be ballasts (Advance and Howard Industries) with the "No PCB's" notation, however not all ballasts were checked. The lighting systems were of various types, and types of ballasts varied depending on type of light fixtures. The ballasts which are demarcated as non-PCB containing may be recycled as non-PCB ballasts in accordance with applicable industry standards for those types of ballasts. PCB ballasts when encountered, should be recycled as PCB ballasts in a facility that accepts PCB ballasts as universal waste. Any leaking ballasts would need to be disposed of as hazardous waste unless testing is performed to classify the waste for PCB's.

Fluorescent light tubes were also visually inspected and those checked were determined to be the Philips alto, SLI Luxine, and Philips LED light tubes. It is assumed that the tubes still contain some amounts of mercury that could deem them "hazardous waste" for disposal purposes. E2S recommends that all tubes be removed prior to the renovation to the building and sent for recycling as universal waste, to a facility that accepts mercury-containing light tubes as part of their universal waste program. Please refer to Table 3 for a breakdown of estimated abatement costs for all hazardous materials identified including costs for PCB's and Mercury recycling/disposal. Estimated recycling/disposal costs for mercury and PCB containing items are based upon pricing and discussions with a reputable recycling facility located in Allentown, PA. We recommend a certified recycling facility is utilized to handle all mercury/PCB hazardous material recycling and disposal, as necessary.

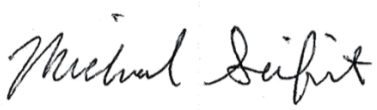
E2S visually inspected electrical and mechanical equipment and devices and identified one (1) dry type transformer (Cutler Hammer) located in Room 116 (Electrical Equipment Room). Dry-type transformers use air for cooling and do not contain PCBs. There were also a Cutler Hammer Unit Substation Transformer and switchboard in Room 116. Both electrical units could contain mercury (high voltage switch gear) or PCBs (unit substation transformer). E2S also identified numerous thermometers that are assumed to contain mercury and recommend that they be disposed of properly in accordance with applicable requirements, if recycling is not an option.

Please refer to Table 1 for a summary of asbestos bulk sampling and results, Table 2 for a summary of ACM locations, quantities, condition, and recommendations, and Table 3 for a summary of cost estimates for abatement of located hazardous materials.

Please refer to **Appendix A** for the radon sampling report dated October 3, 2025, submitted by A.B.E. Radiation Measurements Laboratory, a Division of Health Physics Associates, Inc. Laboratory analytical reports from EMSL Analytical, Inc. with PLM asbestos bulk sample analysis results and associated chain of custodies can be found in **Appendix B**, accreditations (certifications and licenses) for E2S representatives can be found in **Appendix C**.

Thank you for the opportunity to present Element Environmental Solutions (E2S) as a partner in your environmental management efforts. Should you have questions or require additional information, please contact me.

Sincerely,
E2S, Inc.



Michael Seifrit
Environmental Scientist, IAQ

Table 1 - Asbestos Bulk Sample Analytical Results - Cheyney University - Ada S. Georges Dining Hall

Sample Number	Location	Material Description	Analytical Result (PLM)
DH-9/30-01BK	Lobby 101E	2' x 2' Ceiling Tile	None Detected
DH-9/30-02BK	Presidents Dining Room 101W	2' x 2' Ceiling Tile	None Detected
DH-9/30-03BK-Drywall	Lobby 101E	Drywall	None Detected
DH-9/30-03BK-Joint Compund	Lobby 101E	Joint Compund	None Detected
DH-9/30-04BK-Drywall	Stair ST-5	Drywall	None Detected
DH-9/30-04BK-Joint Compund	Stair ST-5	Joint Compund	None Detected
DH-9/30-05BK	Lobby 101E	Wall Plaster	None Detected
DH-9/30-06BK-Skim Coat	Lobby 101E	Ceiling Plaster - Skim Coat (White)	None Detected
DH-9/30-06BK-Base Coat	Lobby 101E	Ceiling Plaster - Base Coat (Tan)	None Detected
DH-9/30-07BK	Storage 211	Wall Plaster	None Detected
DH-9/30-08BK-Skim Coat	Storage 211	Ceiling Plaster - Skim Coat (White)	None Detected
DH-9/30-08BK-Base Coat	Storage 211	Ceiling Plaster - Base Coat (Gray)	None Detected
DH-9/30-09BK	Lobby 101	Cove Base Mastic (Brown)	None Detected
DH-9/30-10BK	Dinning 200/202	Cove Base Mastic (Brown)	None Detected
DH-9/30-11BK	Mechanical Room 117	Mastic End on FGIP	None Detected
DH-9/30-12BK	Storage 211	Mastic End on FGIP	None Detected
DH-9/30-13BK-Mud Fitting	Receiving 120	Mud Fitting on FGIP	None Detected
DH-9/30-13BK-Wrap	Receiving 120	Mud Fitting on FGIP Wrap	None Detected
DH-9/30-14BK	Mechanical Room 117	Mud Fitting on FGIP	None Detected
DH-9/30-15BK-Mud Fitting	Passage 104	Mud Fitting on FGIP	None Detected
DH-9/30-15BK-Wrap	Passage 104	Mud Fitting on FGIP Wrap	None Detected
DH-9/30-16BK	Mechanical Room 117	Mud End on FGIP	None Detected
DH-9/30-17BK	Mechanical Room 117	Mud Hanger Insulation on FGIP	None Detected
DH-9/30-18BK-Floor Tile	Dinning 200/202	Dark Brown 1' x 1' Floor Tile	None Detected
DH-9/30-18BK-Mastic	**Dinning 200/202**	**Dark Brown 1' x 1' Floor Tile Mastic (Black/Yellow)**	**2% Chrysotile**
DH-9/30-19BK-Floor Tile	Storage 211	Light Brown with Streaks 1' x 1' Floor Tile	None Detected
DH-9/30-19BK-Mastic	**Storage 211**	**Light Brown with Streaks 1' x 1' Floor Tile Mastic (Brown)**	**2% Chrysotile**
DH-9/30-20BK-Floor Tile	Lobby 101	Light Brown with Streaks 1' x 1' Floor Tile	None Detected
DH-9/30-20BK-Mastic	**Lobby 101**	**Light Brown with Streaks 1' x 1' Floor Tile Mastic (Brown/Black)**	**3% Chrysotile**
DH-9/30-21BK-Floor Tile	Serving Hallway 216	Gray and White 1' x 1' Floor Tile	None Detected
DH-9/30-21BK-Mastic	Serving Hallway 216	Gray and White 1' x 1' Floor Tile Mastic (Brown)	None Detected
DH-9/30-22BK-Floor Tile	Lobby 101E	White with Blue Specks 1' x 1' Floor Tile	None Detected
DH-9/30-22BK-Mastic	**Lobby 101E**	**White with Blue Specks 1' x 1' Floor Tile Mastic (Black/Yellow)**	**2% Chrysotile**
DH-9/30-23BK	Linen 215	Light Blue Sheet Vinyl Flooring	None Detected
DH-9/30-24BK-Floor Tile	Passage 104	Light Brown with Gray 1' x 1' Floor Tile	None Detected
DH-9/30-24BK-Mastic	Passage 104	Light Brown with Gray 1' x 1' Floor Tile Mastic (Gray/Black/Yellow)	*< 1% Chrysotile*
DH-9/30-25BK-Skim Coat	Exterior	Plaster Overhang - Skim Coat (White)	None Detected
DH-9/30-25BK-Base Coat	Exterior	Plaster Overhang - Base Coat (Tan)	None Detected
DH-9/30-26BK	Exterior	Door/Window Caulk	None Detected
DH-9/30-27BK	Exterior	Building Expansion Caulk	None Detected

FGIP = Fiberglass Insulated Pipe

EPA definition of asbestos-containing material (ACM) = >1% asbestos (Line items BOLD)

E2S Project 1419.0005

10/9/2025

Table 2 - Asbestos Containing Materials - Cheyney University - Ada S. Georges Dining Hall

Location	Floor	Material Description	Quantity	Condition	Recommendations
Passage 104	1/2	Light Brown with Gray 1' x 1' Floor Tile Mastic	300 S.F.	Good	Remove prior to renovation if impacted
Stair ST-1	1/2	Light Brown with Gray 1' x 1' Floor Tile Mastic	300 S.F.	Good	Remove prior to renovation if impacted
Lobby 101E	1	White with Blue Specks 1' x 1' Floor Tile Mastic	1,930 S.F.	Good	Remove prior to renovation if impacted
Coat Room 106	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic	340 S.F.	Good	Remove prior to renovation if impacted
Lobby 101	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic	1,980 S.F.	Good	Remove prior to renovation if impacted
Coat Room 105	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic	340 S.F.	Good	Remove prior to renovation if impacted
Lobby 101W	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic	880 S.F.	Good	Remove prior to renovation if impacted
President's Dining Room 101W	1	Light Brown with Streaks 1' x 1' Floor Tile Mastic (Under Carpet)	870 S.F.	Good	Remove prior to renovation if impacted
Vestibule 203	2	Dark Brown 1' x 1' Floor Tile Mastic	365 S.F.	Good	Remove prior to renovation if impacted
Dining Room 200/202	2	Dark Brown 1' x 1' Floor Tile Mastic	6,120 S.F.	Good	Remove prior to renovation if impacted
Storage Room 204	2	Dark Brown 1' x 1' Floor Tile Mastic	320 S.F.	Good	Remove prior to renovation if impacted
Faculty Dining 205	2	Laminate Flooring Mastic	360 S.F.	Good	Remove prior to renovation if impacted
Linen 205	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	45 S.F.	Good	Remove prior to renovation if impacted
Serving 207	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	830 S.F.	Good	Remove prior to renovation if impacted
Hallway outside Vestibule 203	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	610 S.F.	Good	Remove prior to renovation if impacted
Serving 216	2	Gray and White 1' x 1' Floor Tile Mastic	850 S.F.	Good	Remove prior to renovation if impacted
Kitchen Office 220/221	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	280 S.F.	Good	Remove prior to renovation if impacted
Linen 215	2	Light Blue Sheet Vinyl Flooring Mastic	45 S.F.	Good	Remove prior to renovation if impacted
Dining Room 213/214	2	Gray and White 1' x 1' Floor Tile Mastic	7,200 S.F.	Good	Remove prior to renovation if impacted
Faculty Dining 212	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	360 S.F.	Good	Remove prior to renovation if impacted
Storage Room 211	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	370 S.F.	Good	Remove prior to renovation if impacted
Faculty Dining 210	2	Light Brown with Streaks 1' x 1' Floor Tile Mastic	360 S.F.	Good	Remove prior to renovation if impacted

Table 3 - Summary of Findings and Estimated Removal Costs - Cheyney University - Ada S. Georges Dining Hall

Location	Material Description	Estimated Quantity	Estimated Cost
Throughout	Asbestos-containing Mastic under various types of flooring	25,055 S.F.	$175,385.00
Mobilization Fee		1	$2,000.00
TOTAL - Asbestos Abatement - Estimated Removal Costs*			**$177,385.00**
Electrical Equipment Room 116	Cutler Hammer unit Substation Transformer (High Voltage Switches/Transformer)	Not Quantified	N/A
Mechanical Room 117	Thermometers	17 Each	$85.00
Throughout Building	Mercury-Containing Light Tubes (Assumed)	448 Tubes	$224.00
Throughout Building	Light Ballasts (No PCB's)	164 Ballasts	$328.00
TOTAL - Hazardous Materials (Recycling fees only, does not include labor for removal or transportation fees)			**$637.00**

Appendix A

Radon Sampling Report

A.B.E. Radiation Measurements Laboratory

A.B.E. Radiation Measurements Laboratory

Division of Health Physics Associates, Inc.
1005 Old 22 PO Box 214 Lenhartsville, PA 19534
(610) 756-4153 (610) 756-0042 (FAX) dee@radprotection.com

October 3, 2025

Dan Gensemer
Element Environmental Solutions
61 Willow Street
Adamstown, PA 19501
dan@e2s.us

re: **Radon Sampling**, Ada S. Georges Dining Hall,
1837 University Circle, Cheyney, PA 19319.
Date of test: September 30 to October 2, 2025
Test Placed & Retrieved by: Dolores LaMastra, ID# 8014
& Jeanette Steber, ID# 8834
Invoice #: 8379

Dear Mr. Gensemer:

The following is a report of the radon sampling conducted at the referenced university building. Radon sampling was performed over a 2-day period using activated charcoal manufactured by F & J, model RA40V, following US EPA screening test protocols. The charcoal analysis and testing procedures have passed the US EPA's Radon Measurement Proficiency Testing program and A.B.E. Radiation Measurements Lab is certified by the PA DEP for radon testing and radon laboratory analyses (certification numbers 0048 and 0050). Our last quality assurance spikes required by the PA DEP, which were sent to an approved DEP chamber showed a percent deviation of 5.2 %; May 17 to 19, 2025.

The attached table lists each sample location and the net radon concentrations in picocuries per liter (pCi/l). The term "picocuries per liter" is a measure of the radon gas concentration in the air. Proper screening testing in university buildings should be conducted under conditions simulating those occurring during normal occupied hours. However, ABE Radiation Measurements Laboratory has no control over the degree of ventilation in a building during the test or how the charcoal is treated in our absence.

All structures will contain some radon. Typically, ground and sub-ground level floors will have the highest levels in a multi-story building. Indoor concentrations will depend on the amount of radon seepage into the building and the air exchange rate of the ventilation system. Radon seepage into a building is variable, depending on atmospheric and indoor environmental conditions. Thus, indoor radon concentrations can fluctuate from day to day and over a 24-hour period. When samples are taken for a short time period, it is difficult to know if they represent the average or a high or low point in the range of fluctuation. However, the closed condition and the requirement of at least 25% fresh make-up air in school buildings generally results in short term tests being reasonably close to the annual average provided the wind and barometric pressure at the time of the test was reasonably average and that the HVAC system(s) were/was operated in an "occupied mode", and the windows were kept closed.

While the PA DEP and the US EPA do not have actual regulations limiting the amount of radon in university buildings, OSHA does have regulations (29 CFR 1910.1096(c)(1) setting occupational limits for radon in facilities in which they have regulatory authority. This is generally any facility having more than 10 employees; the limit is excessively high: 100 pCi/l. However, OSHA has a limit of 3 pCi/l (29 CFR 1910.1096(c)(2) if **employees** are under 18 years of age.

The US EPA and the PA DEP do suggest the guideline of 4 picocuries per liter (pCi/l) as the lower limit of its Remedial Action Guideline and recommend that radon concentrations of 4 pCi/l and above be reduced as far below this level as practicable. It should be noted that this guideline is based on a 75 percent occupancy rate. Thus, there is typically a lower total dose potential for schools, compared to residences for the same air concentrations because of lower occupancy times. However, because of public concern over radon and the fact that staff and students may have elevated radon levels in their homes, the university administration may want to follow the 4.0 pCi/l guideline used for private homes.

Radon is the second leading cause of lung cancer, after smoking. The U.S. EPA and the Surgeon General strongly recommend taking further action when the radon test results are 4.0 pCi/l or greater. The national average indoor radon level is about 1.3 pCi/l. The higher the radon level the greater the health risk. Even buildings with very high radon levels can usually be reduced below 4.0 pCi/l. For further information about reducing elevated radon levels please refer to the "Pennsylvania's Consumer's Guide to Radon Reduction."

CONCLUSIONS

There is no radon reduction system at this building.

The radon concentrations measured during the test were all below the PA DEP screening guideline of less than 4.0 pCi/l. Remedial action to reduce the radon concentration is not indicated based on the results of this test.

Testing was done under current building design and conditions. Changes to these factors may have an impact on the radon concentrations once the building modifications/renovations are made. It is recommended that occupied areas of the building be tested once all renovations are completed.

No tampering or deviation from required test conditions has been observed.

The results of this test are valid only for the date, time and conditions under which the test was conducted and only for the client ordering the test.

Should you wish to discuss additional testing or this report, please do not hesitate to contact us at (610) 756-4153. Thank you for the opportunity to serve you.

Sincerely,

A La Mastra

A. LaMastra
Certified Health Physicist

The Radon Certification Act requires that anyone who provides any radon-related service or product to the general public must be certified by the PA DEP. You are entitled to evidence of certification from any person who provides such services or products. You are also entitled to a price list of services or products offered. All radon measurements data will be sent to the Department as required in the act and will be kept confidential. If you have any questions, comments or complaints concerning persons who provide radon-related services, please contact the Department at the Bureau of Radiation Protection, DEP, PO Box 8469, Harrisburg, PA 17105-8469, 717-783-3594 or 800-237-2366.

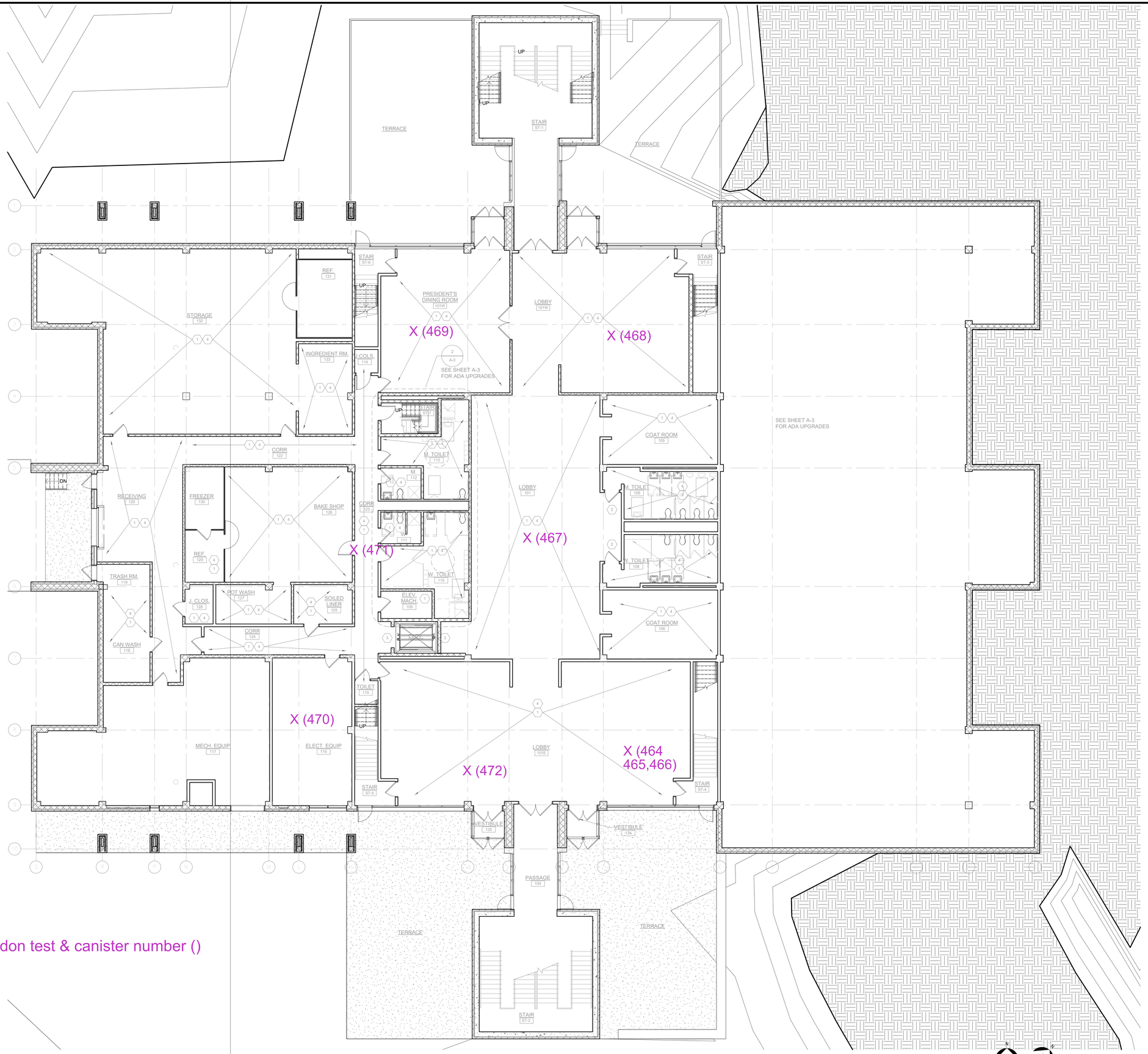
A.B.E. RADIATION MEASUREMENTS LABORATORY

RADON TESTING RESULTS

Ada Georges Dining Hall
Cheyney University
1837 University Circle
Cheyney, PA 19319

Test dates: September 30 to October 2, 2025

Canister Number	Location	Start Time	End Time	pCi/l	Duplicate Average
Level 1 1st Floor					
198464	Lobby 101E	10:35	10:19	<0.5	
198465	Lobby (duplicate)	10:35	10:19	0.5	0.5
198466	Blank	N/A	N/A	<0.5	
198467	Lobby 101	10:42	10:21	<0.5	
198468	Lounge	10:44	10:20	0.5	
198469	President D/R	10:45	10:19	0.5	
198470	Electrical Room	10:55	10:48	<0.5	
198471	Bake Rm Hall	11:00	10:25	<0.5	
198472	Lobby Reception Rm	11:08	10:21	<0.5	
Level 2 Main Level					
198473	Elevator	11:12	10:24	<0.5	
198474	Stair 5	11:17	10:41	<0.5	
198475	D/R 213 Area	11:21	10:41	<0.5	
198476	Storage 210	11:28	10:45	<0.5	
198477	Faculty D/R 212	11:32	10:44	<0.5	
198478	Fac. D/R (duplicate)	11:32	10:44	<0.5	<0.5
198479	D/R 214 Area	11:37	10:42	<0.5	
198480	Showdown Grill Area	11:41	10:52	<0.5	
198481	Stair 1	11:43	10:48	<0.5	
198482	Bakery Area	11:45	10:46	<0.5	
198483	D/R 200 Area	11:50	10:50	<0.5	
198484	Stair 3	11:52	10:54	0.5	
198485	Stair 4	11:54	10:52	<0.5	
198486	D/R 202 Area	11:57	10:51	0.5	
198487	Coordinator Office	11:58	10:57	<0.5	
198488	Stair 2	12:08	11:01	0.5	
198489	Kitchen Mngr Off.	12:23	10:50	<0.5	
198490	Stair 6	12:27	10:43	<0.5	



1 LEVEL 1 - EXISTING FLOOR PLAN
1/8" = 1'-0"

8/13/2025 5:41:35 PM

KIMMEL BOGRETTE
Architecture + Site
482 Norristown Rd., Suite 200
Blue Bell PA, 19422
Phone: 610.834.7805
Facsimile: 610.834.7815

© COPYRIGHT 2013 KIMMEL BOGRETTE ARCHITECTURE + SITE, INC. ALL RIGHTS RESERVED

NEW BUILDING, RENOVATIONS TO (OWNER NAME):
Ada S. Georges Lining Hall Infrastructure Improvements
PROJECT ADDRESS
25-021

ISSUED FOR XXXX

ISSUE DATE: Issue Date
DRAWN BY: Author
CHECKED BY: Checker
SCALE: AS NOTED

Existing First Floor

NO.	DESCRIPTION	DATE

X-01

X (481)

X (477 478)

X (479)

X (480)

X (482)

X (483)

X (484)

X (485)

X (486)

X (487)

X (488)

X (489)

X (490)

X (473)

X (474)

X (475)

X (476)

X = radon test & canister number ()

1 STEAM CLEAN ALL PIPING, DUCTS, CONDUIT, AND UNDERSIDE OF SLAB. PERFORM TESTING FOR QUALITY CLEANING ONCE STEAM CLEANING IS COMPLETE. REFER TO DUCT CLEANING AND SANITIZING

2 SUPPLY AND INSTALL NEW DOOR AND FRAME.

3 UPGRADE ELEVATOR CONTROLS TO MEET CURRENT ADA STANDARDS.

4 PATCH AND PAINT INTERIOR WALLS.

EXISTING WALL

NEW WALL

1 LEVEL 2 - EXISTING FLOOR PLAN
1/8" = 1'-0"

PROJECT NORTH

TRUE NORTH

8/13/2025 5:41:36 PM

KIMMEL BOGRETTE Architecture + Site
482 Norristown Rd., Suite 200
Blue Bell PA, 19422
Phone: 610.834.7805
Facsimile: 610.834.7815

© COPYRIGHT 2023. KIMMEL BOGRETTE ARCHITECTURE + SITE, INC. ALL RIGHTS RESERVED

NEW BUILDING - RENOVATIONS TO [OWNER NAME]:
Ada S. Georges Dining Hall Infrastructure Improvements
[PROJECT ADDRESS]
25-021

ISSUED FOR XXXX

ISSUE DATE: Issue Date
DRAWN BY: Author
CHECKED BY: Checker
SCALE: AS NOTED

Existing Main Level

NO.	DESCRIPTION	DATE

X-02

Appendix B

Laboratory Analytical Report – EMSL Analytical, Inc.

Asbestos Bulk - Polarized Light Microscopy (PLM)

EMSL Analytical, Inc.

200 Route 130 North Cinnaminson, NJ 08077
Tel/Fax: (800) 220-3675 / (856) 786-5974
http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order:	042519856
Customer ID:	ELES42
Customer PO:	1419.0005
Project ID:	

Attention:	David Bertsch	**Phone:**	(717) 484-5111
	Element Environmental Solutions, Inc.	**Fax:**	
	61 Willow Street	**Received Date:**	10/02/2025 9:30 AM
	PO Box 921	**Analysis Date:**	10/03/2025 - 10/06/2025
	Adamstown, PA 19501	**Collected Date:**	09/30/2025
Project:	Ada S. Georges Dining Hall		

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
DH-930-01BK *042519856-0001*	Lobby 101E - 2x2 Ceiling Tile	Tan Fibrous Homogeneous	70% Cellulose 20% Min. Wool	10% Non-fibrous (Other)	None Detected
DH-930-02BK *042519856-0002*	Presidents Dining Room 101W - 2x2 Ceiling Tile	White Fibrous Homogeneous	50% Cellulose 30% Min. Wool	20% Non-fibrous (Other)	None Detected
DH-930-03BK- Drywall *042519856-0003*	Lobby 101E - Drywall	White Fibrous Homogeneous	15% Cellulose 3% Glass	82% Non-fibrous (Other)	None Detected
DH-930-03BK- Joint Compound *042519856-0003A*	Lobby 101E - Joint Compound	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-04BK- Drywall *042519856-0004*	Stair ST-5 - Drywall	White Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-04BK- Joint Compound *042519856-0004A*	Stair ST-5 - Joint Compound	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-05BK *042519856-0005*	Lobby 101E - Wall Plaster	Tan/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-06BK-Skim Coat *042519856-0006*	Lobby 101E - Ceiling Plaster	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-06BK-Base Coat *042519856-0006A*	Lobby 101E - Ceiling Plaster	Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-07BK *042519856-0007*	Storage 211 - Wall Plaster	Tan/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-08BK-Skim Coat *042519856-0008*	Storage 211 - Ceiling Plaster	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-08BK-Base Coat *042519856-0008A*	Storage 211 - Ceiling Plaster	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-09BK *042519856-0009*	Lobby 101 - Cove Base Mastic	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-930-10BK *042519856-0010*	Dining 200/202 - Cove Base Mastic	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 10/07/2025 09:23:56

EMSL Analytical, Inc.
200 Route 130 North Cinnaminson, NJ 08077
Tel/Fax: (800) 220-3675 / (856) 786-5974
http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order:	042519856
Customer ID:	ELES42
Customer PO:	1419.0005
Project ID:	

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
DH-9/30-11BK *042519856-0011*	Mechanical Room 117 - Mastic End on FGIP	Tan/White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-12BK *042519856-0012*	Storage 211 - Mastic End on FGIP	White Non-Fibrous Homogeneous	5% Glass	95% Non-fibrous (Other)	None Detected
DH-9/30-13BK-Mud Fitting *042519856-0013*	Receiving 120 - Mud Fitting on FGIP	Gray Fibrous Homogeneous	40% Min. Wool	60% Non-fibrous (Other)	None Detected
DH-9/30-13BK-Wrap *042519856-0013A*	Receiving 120 - Wrap on FGIP	Tan/White Fibrous Homogeneous	60% Cellulose	40% Non-fibrous (Other)	None Detected
DH-9/30-14BK *042519856-0014*	Mechanical Room 117 - Mud Fitting on FGIP	Gray Fibrous Homogeneous	50% Min. Wool	50% Non-fibrous (Other)	None Detected
DH-9/30-15BK-Mud Fitting *042519856-0015*	Passage 104 - Mud Fitting on FGIP	Gray Non-Fibrous Homogeneous	40% Min. Wool	60% Non-fibrous (Other)	None Detected
DH-9/30-15BK-Wrap *042519856-0015A*	Passage 104 - Wrap on FGIP	Tan/Silver Fibrous Homogeneous	60% Cellulose	40% Non-fibrous (Other)	None Detected
DH-9/30-16BK *042519856-0016*	Mechanical Room 117 - Mud End on FGIP	Gray Fibrous Homogeneous	40% Min. Wool	60% Non-fibrous (Other)	None Detected
DH-9/30-17BK *042519856-0017*	Mechanical Room 117 - Mud Hanger Insulation on FGIP	Gray Fibrous Homogeneous	40% Min. Wool	60% Non-fibrous (Other)	None Detected
DH-9/30-18BK- Floor Tile *042519856-0018*	Dining 200/202 - Dark Brown 1X1 Floor Tile	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-18BK- Mastic *042519856-0018A*	Dining 200/202 - Floor Tile Mastic	Black/Yellow Non-Fibrous Heterogeneous		98% Non-fibrous (Other)	**2% Chrysotile**
DH-9/30-19BK- Floor Tile *042519856-0019*	Storage 211 - Light Brown with Streaks 1X1 Floor Tile	Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-19BK- Mastic *042519856-0019A*	Storage 211 - Floor Tile Mastic	Brown Non-Fibrous Homogeneous		98% Non-fibrous (Other)	**2% Chrysotile**
DH-9/30-20BK- Floor Tile *042519856-0020*	Lobby 101 - Light Brown with Streaks 1X1 Floor Tile	Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-20BK- Mastic *042519856-0020A*	Lobby 101 - Floor Tile Mastic	Brown/Black Non-Fibrous Homogeneous		97% Non-fibrous (Other)	**3% Chrysotile**
DH-9/30-21BK- Floor Tile *042519856-0021*	Serving Hallway 216 - Grey and White 1X1 Floor Tile	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-21BK- Mastic *042519856-0021A*	Serving Hallway 216 - Floor Tile Mastic	Brown Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Initial report from: 10/07/2025 09:23:56

EMSL Analytical, Inc.
200 Route 130 North Cinnaminson, NJ 08077
Tel/Fax: (800) 220-3675 / (856) 786-5974
http://www.EMSL.com / cinnasblab@EMSL.com

EMSL Order:	042519856
Customer ID:	ELES42
Customer PO:	1419.0005
Project ID:	

Test Report: Asbestos Analysis of Bulk Materials via AHERA Method 40CFR 763 Subpart E Appendix E supplemented with EPA 600/R-93/116 using Polarized Light Microscopy

			Non-Asbestos		Asbestos
Sample	**Description**	**Appearance**	**% Fibrous**	**% Non-Fibrous**	**% Type**
DH-9/30-22BK- Floor Tile *042519856-0022*	Lobby 101E - White with Blue Specks 1X1 Floor Tile	White/Blue Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-22BK- Mastic *042519856-0022A* *Result includes a small amount of inseparable attached material*	Lobby 101E - Floor Tile Mastic	Black/Yellow Non-Fibrous Heterogeneous		98% Non-fibrous (Other)	**2% Chrysotile**
DH-9/30-23BK *042519856-0023*	Linen 215 - Light Blue SVF	Brown/Blue Fibrous Homogeneous	25% Cellulose	75% Non-fibrous (Other)	None Detected
DH-9/30-24BK- Floor Tile *042519856-0024*	Passage 104 - Light Brown with Grey Specks 1X1 Floor Tile	Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-24BK- Mastic *042519856-0024A*	Passage 104 - Floor Tile Mastic	Gray/Black/Yellow Non-Fibrous Homogeneous		100% Non-fibrous (Other)	**<1% Chrysotile**
DH-9/30-25BK-Skim Coat *042519856-0025*	Exterior - Plaster Overhang	White Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-25BK-Base Coat *042519856-0025A*	Exterior - Plaster Overhang	Tan Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-26BK *042519856-0026*	Exterior - Door/Window Caulk	Gray/Black Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected
DH-9/30-27BK *042519856-0027*	Exterior - Building Expansion Caulk	Gray Non-Fibrous Homogeneous		100% Non-fibrous (Other)	None Detected

Analyst(s)

Amiri Lewis (31)
Kelsey Misra (9)

Samantha Sweeney

Samantha Sweeney, Laboratory Manager
or Other Approved Signatory

EMSL maintains liability limited to cost of analysis. Interpretation and use of test results are the responsibility of the client. This report relates only to the samples reported above, and may not be reproduced, except in full, without written approval by EMSL. EMSL bears no responsibility for sample collection activities or analytical method limitations. The report reflects the samples as received. Results are generated from the field sampling data (sampling volumes and areas, locations, etc.) provided by the client on the Chain of Custody. Samples are within quality control criteria and met method specifications unless otherwise noted. The above analyses were performed in general compliance with Appendix E to Subpart E of 40 CFR (previously EPA 600/M4-82-020 “Interim Method”) but augmented with procedures outlined in the 1993 (”final”) version of the method. This report must not be used by the client to claim product certification, approval, or endorsement by NVLAP, NIST or any agency of the federal government. Non-friable organically bound materials present a problem matrix and therefore EMSL recommends gravimetric reduction prior to analysis. Unless requested by the client, building materials manufactured with multiple layers (i.e. linoleum, wallboard, etc.) are reported as a single sample. Estimation of uncertainty is available on request.

Samples analyzed by EMSL Analytical, Inc. Cinnaminson, NJ NVLAP Lab Code 101048-0, AIHA LAP, LLC-IHLAP Lab 100194, PA ID# 68-00367, LA #04127

Initial report from: 10/07/2025 09:23:56

OrderID: 042519856

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

Asbestos Bulk Building Material Chain of Custody

EMSL Order Number *(Lab Use Only)*: 042519856

EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
FAX: (856) 786-5974

Company : Element Environmental Solutions	**EMSL-Bill to:** ☑ Same ☐ Different If Bill to is Different note instructions in Comments** *Third Party Billing requires written authorization from third party*
Street: 61 Willow Street PO Box 921	
City: Adamstown **State/Province:** PA	**Zip/Postal Code:** 19501 **Country:** United States
Report To (Name): David Bertsch	**Telephone #:** 717-484-5111
Email Address: IAQ@e2s.us	**Fax #:** **Purchase Order:** 1419.0005
Project Name/Number: Ada S. Georges Dining Hall	**Please Provide Results:** ☐ Fax ☑ Email ☐ Mail
U.S. State Samples Taken: PA	**CT Samples:** ☐ Commercial/Taxable ☐ Residential/Tax Exempt

Turnaround Time (TAT) Options* – Please Check

☐ 3 Hour ☐ 6 Hour ☐ 24 Hour ☒ 48 Hour ☐ 72 Hour ☐ 96 Hour ☐ 1 Week ☐ 2 Week

*For TEM Air 3 hr through 6 hr, please call ahead to schedule.*There is a premium charge for 3 Hour TEM AHERA or EPA Level II TAT. You will be asked to sign an authorization form for this service. Analysis completed in accordance with EMSL's Terms and Conditions located in the Analytical Price Guide.

PLM - Bulk (reporting limit)	TEM – Bulk
☒ PLM EPA 600/R-93/116 (<1%)	☐ TEM EPA NOB – EPA 600/R-93/116 Section 2.5.5.1
☐ PLM EPA NOB (<1%)	☐ NY ELAP Method 198.4 (TEM)
Point Count ☐ 400 (<0.25%) ☐ 1000 (<0.1%)	☐ Chatfield Protocol (semi-quantitative)
Point Count w/Gravimetric ☐ 400 (<0.25%) ☐ 1000 (<0.1%)	☐ TEM % by Mass – EPA 600/R-93/116 Section 2.5.5.2
☐ NIOSH 9002 (<1%)	☐ TEM Qualitative via Filtration Prep Technique
☐ NY ELAP Method 198.1 (friable in NY)	☐ TEM Qualitative via Drop Mount Prep Technique
☐ NY ELAP Method 198.6 NOB (non-friable-NY)	**Other**
☐ OSHA ID-191 Modified	☐
☐ Standard Addition Method	

RECEIVED
2025 OCT 2 A 11:42
EMSL
CINNAMINSON, NJ

☐ **Check For Positive Stop – Clearly Identify Homogenous Group** **Date Sampled:** 9/30/2025

Samplers Name: Michael Seifert **Samplers Signature:** Michael Seifert

Sample #	HA #	Sample Location	Material Description
DH-9/30	01BK	Lobby 101E	2x2 Ceiling Tile
-	02BK	Presidents Dining Room 101W	2x2 Ceiling Tile
-	03BK	Lobby 101E	Drywall / Joint Compound
-	04BK	Stair ST-5	Drywall / Joint Compound
-	05BK	Lobby 101E	Wall Plaster
-	06BK	Lobby 101E	Ceiling Plaster
-	07BK	Storage 211	Wall Plaster
-	08BK	Storage 211	Ceiling Plaster
-	09BK	Lobby 101	Cove Base Mastic
↓ - ↓	10BK	Dining 200/202	Cove Base Mastic

Client Sample # (s): - **Total # of Samples:** 27

Relinquished (Client): Michael Seifert **Date:** 10/1/2025 **Time:**

Received (Lab): EF+ **Date:** 10/2/25 **Time:** 930

Comments/Special Instructions:

27 EQ

EMSL ANALYTICAL, INC.
LABORATORY • PRODUCTS • TRAINING

EMSL Analytical, Inc.
200 Route 130 North
Cinnaminson, NJ 08077
PHONE: 1-800-220-3675
FAX: (856) 786-5974

Asbestos Bulk Building Material Chain of Custody

EMSL Order Number *(Lab Use Only)*: 042519856

Additional Pages of the Chain of Custody are only necessary if needed for additional sample information

Sample #	~~HA #~~	Sample Location	Material Description
DH-9/30	11 BK	Mechanical Room 117	Mastic End on FGIP
-	12 BK	Storage 211	Mastic End on FGIP
-	13 BK	Receiving 120	Mud Fitting on FGIP
-	14 BK	Mechanical Room 117	Mud Fitting on FGIP
-	15 BK	Passage 104	Mud Fitting on FGIP
-	16 BK	Mechanical Room 117	Mud End on FGIP
-	17 BK	Mechanical Room 117	Mud Hanger Insulation on FGIP
-	18 BK	Dining 200/202	Dark Brown 1x1 FT/M
-	19 BK	Storage 211	Light Brown with Streaks 1x1 FT/M
-	20 BK	Lobby 101	Light Brown with Streaks 1x1 FT/M
-	21 BK	Serving Hallway 216	Grey and White 1x1 FT/M
-	22 BK	Lobby 101 E	White with Blue Specks 1x1 FT/M
-	23 BK	Linen 215	Light Blue SVF
-	24 BK	Passage 104	Light Brown with Grey Specks 1x1 FT/M
-	25 BK	Exterior	Plaster Overhang
-	26 BK	Exterior	Door/Window Caulk
↓ - ↓	27 BK	Exterior	Building Expansion Caulk

*Comments/Special Instructions:

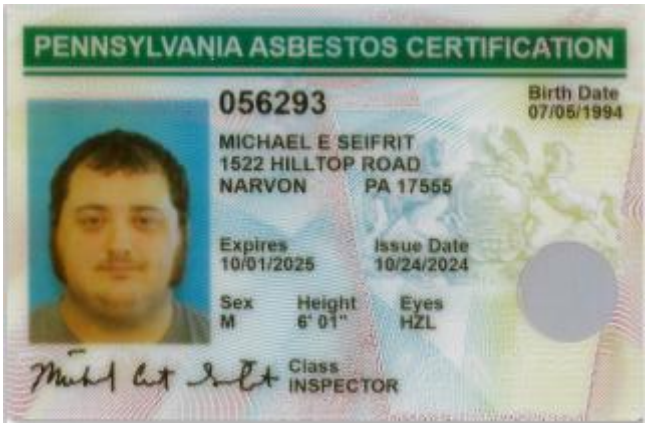
RECEIVED
EMSL
CINNAMINSON, NJ
2025 OCT -2 | A 11:43

Page 2 of 2 pages

Appendix C

Accreditations

Asbestos Building Inspector
Certification





Commonwealth of Pennsylvania

Public Works Employment Verification Form

Complete and return the form to the contracting Public Body prior to the award of the contract.

Company Legal Name: _____

Doing Business As: _____
(if different from Legal Name)

Mailing Address: _____
Street Address 1

_____
Street Address 2

_____
City State Zip Code

Check one: ☐ Contractor ☐ Subcontractor

Contracting Public Body: _____

Contract/Project Number: _____

Project Description: _____

Project Location: _____

Date Enrolled in E-Verify (MM/DD/YYYY): _____

As a contractor/subcontractor for the above referenced public works contract, I hereby affirm that as of the above date, our company is in compliance with the Public Works Employment Verification Act ('the Act') through utilization of the federal E-Verify Program (EVP) operated by the United States Department of Homeland Security. To the best of my/our knowledge, all employees hired are authorized to work in the United States.

It is also agreed to that all public works contractors/subcontractors will utilize the federal EVP to verify the employment eligibility of each new hire within five (5) business days of the employee start date throughout the duration of the public works contract. Documentation confirming the use of the federal EVP upon each new hire shall be maintained in the event of an investigation or audit.

I,_____, authorized representative of the company above, attest that the information contained in this verification form is true and correct and understand that the submission of false or misleading information in connection with the above verification shall be subject to sanctions provided by law.

_____ _____
Authorized Representative Signature **Date of Signature**

Printed Name: _____

Phone Number: _____ **Email:** _____

WORKER PROTECTION AND INVESTMENT CERTIFICATION FORM

A. Pursuant to Executive Order 2021-06, *Worker Protection and Investment* (October 21, 2021), the Commonwealth is responsible for ensuring that every worker in Pennsylvania has a safe and healthy work environment and the protections afforded them through labor laws. To that end, contractors of the Commonwealth must certify that they are in compliance with all applicable Pennsylvania state labor and workforce safety laws including, but not limited to:

1. Construction Workplace Misclassification Act
2. Employment of Minors Child Labor Act
3. Minimum Wage Act
4. Prevailing Wage Act
5. Equal Pay Law
6. Employer to Pay Employment medical Examination Fee Act
7. Seasonal Farm Labor Act
8. Wage Payment and Collection Law
9. Industrial Homework Law
10. Construction Industry Employee Verification Act
11. Act 102: Prohibition on Excessive Overtime in Healthcare
12. Apprenticeship and Training Act
13. Inspection of Employment Records Law

B. Pennsylvania law establishes penalties for providing false certifications, including civil penalties; contract termination; and three-year ineligibility to bid on contracts under 62 Pa. C.S. § 531 (Debarment or suspension).

CERTIFICATION

I, the official named below, certify I have read and understand this Worker Protection and Certification Form and I am duly authorized to execute this certification on behalf of the firm identified below, and the firm identified below is compliant with all applicable Pennsylvania state labor and workplace safety laws, including, but not limited to, those listed in Paragraph A, above. I understand that I must report any change in the firm's compliance status to the DGS Public Works immediately. I further confirm and understand that this Certification is subject to the provisions and penalties of 18 Pa. C.S. § 4904 (Unsworn falsification to authorities).

Signature	***Date***
Name (Printed)	
Firm Name (Printed)	
DGS Project Number	

Please Note:

Easily initiate a Bid Protest (PROT) on Cheyney University - Ada S. Georges Dining Hall Infrastructure Upgrades project. Follow these easy steps.

1. Fill out and save the form in Microsoft Word. Please note the file will not be accepted by e-Builder if modified in any other program.
2. When complete, email the file to **inbox@workflow.e-builder.net**.
3. We will notify you when e-Builder receives the file to inform you of the status.
4. If you receive an e-Builder document number, then you're all set. The workflow was successfully created.
5. If you receive an error message, please ensure the document was only edited in Microsoft Word and try again.

Pennsylvania
Department of General Services

Legend
* Required Field
Editable Field
Read Only Field

Bid Protest (PROT)

Project:	Cheyney University - Ada S. Georges Dining Hall Infrastructure Upgrades
Project Number:	C-0403-0087
Process:	Bid Protest

Protesting Party

This form must be saved as a word document and sent to the email address provided at the bottom of this form. Any and all documents associated with this Protest should be saved as a single PDF and attached to the same email as the protest form.

* Contact Name:	
* Contact Address:	
* Phone Number:	
* Contact Email:	
* Company:	
* Which Contract Point(s):	☐ .1 ☐ .1A ☐ .1B ☐ .1C ☐ .1D ☐ .1E ☐ .1F ☐ .2 ☐ .2A

	☐ .3 ☐ .4 ☐ .4A ☐ .5 ☐ .6 ☐ Commissioning Agent
* Basis for Protest:	

Comments

Please Note:

Easily initiate a Bid Withdrawal (BWITH) on Cheyney University - Ada S. Georges Dining Hall Infrastructure Upgrades project. Follow these easy steps.

1. Fill out and save the form in Microsoft Word. Please note the file will not be accepted by e-Builder if modified in any other program.
2. When complete, email the file to **inbox@workflow.e-builder.net**.
3. We will notify you when e-Builder receives the file to inform you of the status.
4. If you receive an e-Builder document number, then you're all set. The workflow was successfully created.
5. If you receive an error message, please ensure the document was only edited in Microsoft Word and try again.

Pennsylvania
Department of General Services

Legend
* Required Field
Editable Field
Read Only Field

Bid Withdrawal (BWITH)

Project:	Cheyney University - Ada S. Georges Dining Hall Infrastructure Upgrades
Project Number:	C-0403-0087
Process:	Bid Withdrawal

Bid Withdrawal

This form must be saved as a word document and sent to the email address provided at the bottom of this form. Any and all documents associated with this Withdrawal should be saved as a single PDF and attached to the same email as the withdrawal form.

* Company Name:	
* Contact Name:	
* Contact Email:	
* Contact Phone Number:	
* Contact Address:	
* Contract Point?:	-- Please select an option --
* Basis for Withdrawal:	
* Which Base Bid is Being	-- Please select an option --

Withdrawn?:	

Comments
