October 05, 2026 – BID ISSUE

CSL CHARTER SCHOOL
BUILDING ADDITION AND RENOVATIONS
345 Lakeside Dr, Levittown, Pennsylvania 19054

For Center for Student Learning Charter School at Pennsbury
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SPECIFICATIONS
HSA Project No. 24-014

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DOCUMENT 000110

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SECTION 011000

SUMMARY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Contract description.
2. Work by Owner.
3. Contractor use of site.
4. Work sequence.
5. Owner occupancy.
6. Specifications conventions.
7. References.

1.2 CONTRACT DESCRIPTION

A. Project Work includes a phased construction approach for a new parking lot, building addition, building renovations, and additional site improvements.

B. Project Delivery Method: Multiple Prime.

C. Multiple Prime Contracts:
1. General Construction.
2. Plumbing.
3. Mechanical.
4. Electrical.
5. Fire Suppression.

1.3 WORK BY OWNER

A. Separate contracts include:

B. Items noted NIC Not in Contract or OFOI Owner Furnished, Owner Installed, will be furnished and installed by Owner or separate contractors hired by Owner.

C. Owner will remove the following before construction starts.
1. Furniture.

D. Coordinate separate contracts and Owner work to ensure efficient construction operations.

1.4 CONTRACTOR USE OF SITE

A. Limit use of site and existing facilities to areas shown on Drawings and designated by Owner.

B. Plan construction operations to accommodate:
   1. Owner occupancy.
   2. Owner safety and operational regulations.
   3. Emergency egress.
   4. Work by separate contracts.
   5. Work by Owner.
   6. access to existing facilities.

C. Prohibit smokeless tobacco, smoking, and vaping within buildings and within 25 feet of building exterior.
   1. Prohibited activities are permitted within designated areas only.

D. Prohibit controlled substances on site.

E. On-Site Work Hours: Per local regulation.

F. Utility Interruptions: Give Owner minimum 72 hour notice. Obtain Owner and Construction Manager written permission.

G. Disruptive Operations: Give Owner and Construction Manager minimum 72 hour notice before starting noisy, vibration causing, odorous, and other occupant disruptive operations. Obtain Owner and Construction Manager written permission before proceeding.

1.5 WORK SEQUENCE

A. Construct Work in multiple Work Packages to permit fast track construction.
   1. Coordinate with Owner and Architect to identify scope and schedule for each Work Package.

B. Construct Work in sequential and concurrent phases to accommodate Owner occupancy and operations.
   1. Complete each phase, ready for occupancy, by specified date.
   2. Coordinate schedule with Owner, Architect, and Construction Manager.

C. Phase Descriptions:
   1. Phase 1: Parking Lot. Refer to phasing drawings.
   2. Phase 2: Building Addition: Refer to phasing drawings.
   3. Phase 3: Building Renovation: Refer to phasing drawings.

1.6 OWNER OCCUPANCY

A. Owner will occupy site, existing building, and areas adjacent to construction area to conduct normal operations throughout construction.
   1. Minimize conflict with Owner operations.

2. Schedule Work to accommodate Owner occupancy.
3. Occupancy Interruptions: Give Owner minimum 72 hour notice. Obtain Owner written permission.

B. Owner will occupy Phase 1 by August 21, 2028.
1. Schedule Work to obtain Certificate of Occupancy.

C. Owner will occupy Phase 2 by August 21, 2028.
1. Schedule Work to obtain Certificate of Occupancy.

D. Owner will occupy Phase 3 by August 21, 2028.
1. Schedule Work to obtain Certificate of Occupancy.

E. Develop plan, in cooperation with Owner, for taking and returning control of Owner occupied spaces. Incorporate plan into construction schedule.
1. Return renovated areas to Owner for Owner occupancy.

1.7 SPECIFICATION CONVENTIONS

A. Specifications are written in imperative mood and streamlined form.
1. Imperative sentences are Contractor requirements.
2. Colons mean “shall be” in streamlined form sentences and phrases.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 011200

MULTIPLE PRIME CONTRACT SUMMARY

PART 1 – GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General Conditions and other Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY

A. Section includes a general summary, and not all inclusive, of each contract, including responsibilities for coordination and temporary facilities and controls.

B. Specific requirements for Work of each contract are also indicated in individual Specification Sections and on Drawings.

C. Related Requirements:

1. Section 011000 "Summary" for the Work covered by the Contract Documents, restrictions on use of Project site, phased construction and work restrictions.

2. Section 013100 "Project Management and Coordination" for general coordination

1.03 DEFINITIONS

A. Construction Manager as Advisor (CMa): Referred to herein as CMa or CM.

1.04 WORK BY OWNER

A. Moving services associated with temporary relocations of personnel.

B. Moving and temporary storage of furniture from work areas.

1.05 ACCESS TO SITE

A. General: Contractors shall have limited use of Project site for construction operations as indicated on Drawings by the Contract limits and as indicated by requirements of this Section.

B. Use of Site: Limit use of Project site to work in areas indicated. Do not use or disturb portions of Project site beyond areas in which the Work is indicated except as approved by Owner.

1. Limits: Refer to drawings and logistics plan(s).

    a. Coordinate the use of the available space onsite. If necessary, provide offsite storage of materials and equipment if space is not available on site.

2. Owner Activities & Operations:

    a. The existing building will be occupied during the school year and the contractor shall make every effort to not disturb or interfere with school operations. School drop-off times are approximately 8:30AM – 9:45AM and pick-up times are approximately 3:15PM – 4:00PM. Construction operations should be coordinated around these times as to not impact drop-off or pick-up.

C. Building Access

1. Refer to logistics plans included as an Appendix in the contract documents. The Logistics Plan is provided for informational purposes only and identifies minimum project requirements and known site constraints. The General Construction Prime shall develop, with input from all Prime Contractors, and submit their own detailed logistics and sequencing plans for review and approval by the CMa prior to the commencement of work.

2. The General Construction Prime Contractor shall provide and maintain signage, markings and other protection to distinguish access paths and provide appropriate warnings related to the flow of construction. The logistics plan shows the minimum signage required. Signage sizing should be large enough to be legible 50’ away and placed a minimum 48” from ground to bottom of sign. Signage should have reflective coating to ensure readability during low visibility hours.

3. Tools and Materials are to be contained within designed construction access areas except for tools and materials required for approved work outside designated construction access areas. Tools and materials found outside designated construction or approved construction access areas shall be promptly removed by the responsible Contractor. If not promptly removed after notice, such items may be removed or secured at the responsible Contractor's risk and expense. No tools shall be left unattended.

4. Access to the existing building during the school year is not permitted unless access is requested by the contractor and granted by the CMa and Owner. Requests must be submitted to the CMa and Owner at least 48 hours in advance.

D. See Section 01 50 00 Temporary Facilities and Controls for further information regarding use of stairs, driveways, walkways and entrances: Refer to Construction Logistics Plans included as an appendix document.

1. Schedule deliveries to minimize use of driveways and entrances by construction operations. School drop-off times are approximately 8:30AM – 9:45AM and pick-up times are approximately 3:15PM – 4:00PM. Deliveries are not allowed during these times without prior CMa/Owner approval.

2. Schedule deliveries to minimize space and time requirements for storage of materials and equipment on-site.

3. Where sidewalk and doorway closures are required provide protection of work areas and signage to clearly direct the public and building workers to alternative paths and points of access. Fencing adjacent to sidewalks shall be a water/sand fillable jersey barrier with fence totaling 6’ in height.

4. Hoisting is not permitted over walkways, exit doors and driveways without posting a signal person to prevent personnel or vehicle traffic from entering the area. A pre-lift meeting is required with CMa prior to any lifting operations.

5. Swinging loads over occupied buildings is not permitted.

1.06 COORDINATION WITH OCCUPANTS

A. The existing building will remain occupied and operational during portions of the Work, including periods when school staff, students, visitors, and Owner personnel may be present. Each Prime Contractor shall conduct its Work in a manner that maintains safe, clean, secure, and code-compliant access for occupants and minimizes disruption to school operations. Contractors shall coordinate all work that may affect occupied areas, public access, building entrances, exits, utilities, life-safety systems, noise, vibration, dust, odors, deliveries, or temporary separations with the Construction Manager as Advisor (CMa) and Owner in advance. Access to occupied areas shall not be permitted without prior approval from the CMa and Owner, and requests for access shall be submitted not less than 48 hours in advance unless otherwise approved. Contractors shall maintain physical separation between construction activities and occupied areas by means of temporary barriers, signage, access control, dust protection, housekeeping, and other measures required by the Contract Documents, authorities having jurisdiction, or as directed by the CMa. Existing means of egress, fire protection, fire alarm, security, lighting, toilet facilities, and other required building services serving occupied areas shall remain operational unless a shutdown or impairment has been requested, coordinated, and approved in writing. Each Prime Contractor shall immediately correct unsafe, disruptive, or non-compliant conditions caused by its Work and shall cooperate with the CMa, Owner, and other Prime Contractors to maintain continued school operations throughout the Project.

1.07 WORK RESTRICTIONS

A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and with other requirements of authorities having jurisdiction.

2. On-Site Normal Work Hours: 7:00 AM – 4:30 PM Monday through Friday. Contractors intending to work outside normal work hours and/or weekends shall receive approval by the CMa or Owner.

3. Off Hours: 4:30 PM to 7:00 AM and weekends.

4. If second shift is required hours shall be: 1st shift – 7:00 AM – 4:30 PM / 2nd shift – 4:00 PM – 12:00 AM. Overlapping of shift schedules is required to ensure proper hand-off of in progress work.

B. Project Security, Background Checks and Badging Requirements

1. All Prime Contractors and their subcontractors and/or vendors who are on site will be required to submit verification of approved background checks. Access to the property will not be granted to individuals who do not submit background check information to the CMa. Required background checks, as applicable to the individual's assignment and the Owner's site-access requirements, are as follows:
   i. Pennsylvania Department of Human Services (DHS) Child Abuse History
   ii. Pennsylvania Access to Criminal History (PATCH)
   iii. Federal Criminal History Record Information (CHRI)
   iv. Pennsylvania Act 168 Sexual Misconduct/Abuse Disclosure Release form, when applicable under Pennsylvania law.

C. Existing Utility Interruptions: Coordinate with CMa and Owner prior to any utility interruptions.

1. Notify CMa not less than ten (10) business days in advance of proposed utility interruptions.

D. Obtain Owner's written permission before proceeding with utility interruptions.

E. Other General Provisions

1. The use of tobacco, alcohol, vaping, marijuana, illegal substances and/or other similar substances is prohibited. Workers found using these substances will be immediately removed from the project.

2. Weapons including but not limited to firearms, mace, explosives are prohibited on site. Any person found with weapons will be permanently removed.

1.08 PROJECT COORDINATION

A. All Prime Contractors shall each be fully responsible for the coordination of the work performed by their own forces and those of their contractors. Each of these Contractors is also responsible to cooperate with each other and with the CMa to coordinate the entire work insofar as their individual work affects the work of the others and the whole. See Section 013100 – Project Management and Coordination and Section 013200 Construction Progress Documentation for LEAN PROCEDURES which includes requirements for participation in specification coordination and scheduling activities.

B. MEP Coordination

1. All Prime contractors are required to fully participate in the MEP coordination process. Reference 01 31 00 for further requirements.

2. Mechanical Prime will be the lead for MEP coordination process.

3. Mechanical (HVAC) Prime will facilitate meetings and updates with all prime contractors.

4. General Contractor to participate in the 3D Modeling coordination by surveying and or measuring any architectural or structural elements that need to be VIF from a bench mark to inform the model and provide any required shop drawings in a timely manner as to not impede the coordination process.

5. General guidelines

    a. Provide clearances for ceiling construction, access doors, clearances for above ceiling equipment, valve access, filter change access, equipment maintenance, damper access

    b. Locate accessible items above accessible ceilings to the greatest extent possible.

C. Scheduling: Refer to specific requirements listed in specification 013100 & 013200. All Prime Contractors shall coordinate the scheduling activities of their work and to assist in preparation of an overall project schedule. Baseline schedule and monthly updates will be managed by CMa. Each Prime Contractor shall be fully responsible for the development and maintenance of a project schedule associated with their own work, updated as required to coordinate with the overall project schedule.

D. The CMa's coordination activities include, but are not limited to, the following:

1. Facilitate overall coordination of the Work.

2. Coordinate, schedule, and facilitate approval of interruptions of permanent and temporary utilities, including those necessary to make connections for temporary services.

3. Facilitate coordination of completion of interrelated punch list items.

4. Coordinate preparation of Project record documents if information from more than one contractor is to be integrated with information from other contractors to form one combined record.

5. Coordinate preparation of operation and maintenance manuals if information from more than one contractor is to be integrated with information from other contractors to form one combined record.

6. The CMa's coordination activities are facilitative only and do not relieve any Prime Contractor of its independent responsibility for coordination, sequencing, or performance of its Work.

1.09 GENERAL REQUIREMENTS OF CONTRACTS (ALL PRIMES)

A. Extent of Contract: Unless the Agreement contains a more specific description of the Work of each Contract, requirements indicated on Drawings and in Specification Sections determine which contract includes a specific element of the Project.

1. Contractor acknowledges and agrees that it has taken into account all items necessary to

complete the Work of each contract. The Work shall be provided in accordance with the Contract Documents and shall include, but not limited to all labor, supervision, material, supports, engineering, tools, equipment, access to work, hoisting, rigging, transportation, permits, taxes, insurance, fees, warranties and guarantees required to perform the complete Work as shown or described in this Summary and the Contract Documents. Contractor shall include all items necessary and/or implied but not necessarily detailed on the Contract Documents or as may be required by local codes and jurisdictions for complete and working systems. No extra compensation will be allowed for any errors or omissions on the part of the Contractor or its contractors and/or Suppliers.

2. It is the responsibility of each contractor to review all the Contract Documents provided. All Contract Drawings, Specifications, and supplemental information are part of each contract. Where the Contract Documents contain a conflict or ambiguity, the Contractor shall request a written interpretation from the Architect through the CMa before proceeding with the affected Work. Conflicts or ambiguities reasonably discoverable before bid shall be raised during the bidding period. No Contractor may rely on an interpretation that reduces its Work unless confirmed in writing through the procedures established by the Contract Documents.

3. Contractor has visited the site and is familiar with all work conditions. Contractor has reviewed existing conditions in the field and is familiar with security requirements, traffic regulations and other restrictions affecting access to the Work.

4. All prime and sub-tier contractors are required to be licensed with all jurisdictions required including but not limited to the State of Pennsylvania, Tullytown Borough, etc.

5. Contractor shall secure, pay for, and maintain all permits required to complete its scope of Work, except that the Owner shall be responsible for the actual cost of the general building permit only. Contractor-paid permits include, but are not limited to, street closures, sidewalk closures, lost parking revenue associated with such closures, utility tie-ins, temporary access permits, right-of-way permits, and permits required by authorities having jurisdiction for the Contractor’s means, methods, or scope of Work. The Contractor shall complete all required applications, forms, supporting documentation, submissions, and filing requirements for the general building permit with Tullytown Borough after award, advance payment for the general building permit, and submit proof of payment to the Owner for reimbursement. Reimbursement shall be limited to the actual general building permit fee paid to the authority having jurisdiction, with no markup, overhead, profit, administrative fee, bond, insurance, or other additional cost allowed.

6. All contractors are to use Procore (provided by the CMa) as the PMIS. All submittals, RFIs, Certified Payroll, and Invoicing must be submitted using this system. Training will be provided to the contractor upon request.

7. All Contractors are required to secure all tools, equipment, and materials at the end of each workday.

8. Provide labor and supervision to assist with all AHJ inspections and specialty inspections.

9. Contractor is fully knowledgeable of all applicable Tullytown Borough, Pennsylvania

Dept. of Transportation (PENNDOT) and Manual on Uniform Traffic Control Devices (MUTCD) requirements, and will comply with same throughout the duration of this project.

10. Contractor shall reference historical drawings, photographs and other information (if available) provided in conjunction with design documents to determine the full scope of work and means and methods necessary to complete the work of this bid package.

11. Contractor shall provide updated As Built CAD file at the completion of all improvements installed by this contract. This includes denoting active and abandoned utilities encountered. As builts related to utility and site improvements shall be completed by a licensed surveyor and all deviations from the design documents clearly noted.

12. Contractor is responsible to resolve labor disputes and jurisdictional claims for all work associated with this bid package.

13. Limited parking is available at the project site. Coordinate site access/parking with GC Prime. Reference Logistics Plan for contractor parking locations.

14. All street closures must be approved by the CMa and owner and permits must be obtained through the appropriate AHJ.

15. Delivery and Storage:

    a. Reference logistics plans provided for site storage and staging.

    b. All materials and equipment shall be delivered to the site and stored at locations coordinated with all other Contractors. Each Contractor shall be responsible for proper care and protection of materials stored on site and shall protect and be responsible for any damage to stored materials. If stored material impacts other contractors work, remove or relocate materials as necessary.

16. All Prime Contractors superintendents will accompany the AHJ and CMa during inspections. If re-inspection is required for incomplete work, the responsible Prime contractor will be required to compensate the CMa and AHJ for re-inspections.

17. Construction Cleaning

    a. General Contractor will provide and maintain dumpsters at the exterior of the building for all prime contractors use. Each Prime Contractor shall remove trash and construction debris DAILY throughout the construction duration, and each Prime Contractor shall provide means of transport for trash to the exterior dumpsters provided. Each prime contractor shall rough broom sweep work areas DAILY at the end of each shift.

    b. Access pathways shall be kept clean and free of debris.

    c. Areas that are not kept clean per the contract requirements or cleaned in a timely manner (DAILY) will be cleaned by others, as directed by the CMa at the Contractor’s expense.

d. All contractors are responsible for cleaning tools, work surfaces and all common surfaces as required to prevent and mitigate the spread of infectious diseases. Each prime and sub-tier contractor is required to develop and implement protocols to protect its workers including cleaning, temperature screening and other measures deemed necessary.

e. Any materials or debris that can be windblown must be secured at all times. Contractors must take into account the conditions and potential for high winds as work progresses and take all precautions necessary to prevent items from blowing off the project site. It is imperative that care be taken for trash not to leave the project site as the site is located in a residential area.

18. Contractor understands temporary lighting will be provided at the levels required by OSHA by the Electrical Prime once the addition is enclosed (roof and walls are in place). If additional lighting is required to perform work of this bid package, each Prime Contractor will provide the additional temporary lighting needed. If power is not available while demolition or other activities are occurring provide portable battery operated lighting to keep the work progressing.

19. All contractors are responsible to provide their own temporary power until the temporary power distribution is completed by the Electrical Prime Contractor.

20. All contractors are responsible for providing the necessary startup support for their respective equipment as required by the manufacturer to ensure warranties are maintained.

21. Prime Contractors are required to submit a sample AIA G732 and G703 listed by project specifications (feature of work), along with a labor and material breakdown for approval by the CMa. The approved AIA Schedule of Values will be for the purpose of creating the Prime Contractor’s monthly Pencil Copy and Requisition. Please reference 012900 – Payment Procedures.

22. When submitting a change order or allowance adjustment, Prime Contractors are required to provide all subcontractor and material suppliers quotes and proposals with a labor and material breakdown. Indicate any potential schedule impacts associated with the submitted change order. The intent is to expediate the approval process. Please reference 012600 Contract Modification Procedures.

1.10 GENERAL SAFETY REQUIREMENTS

A. Each prime contractor is fully responsible for all aspects of safety for their scope of work including but not limited to supervision, planning, training, project orientations and coordination with other contractors. The Owner's or CMa's review of safety submittals, observation of the Work, participation in safety meetings, or direction to correct an observed unsafe condition shall not relieve the Contractor of responsibility for safety or constitute control over construction means, methods, techniques, sequences, or procedures.

B. Prime contractors and associated contractors working onsite shall comply with all applicable government regulations, specific client rules and regulations, and requirements dictated within the

project specification requirements. If any of these standards, requirements, rules or procedures conflict, the most stringent one will prevail.

C. It is the responsibility of ALL Prime Contractors to make sure their employees and contractors understand all job site rules, safety procedures and come to the site prepared to complete their scheduled work with clear direction from the Prime Contractor on the scope of the work, schedule, current drawings, specifications and sketches.

D. Minimum PPE will include hard hat, high visibility clothing, cut resistant gloves – minimum level 3, safety glasses and sturdy work boots/Foot protection & work attire including long pants and sleeved shirts. ANSI reflectivity requirements must be met when working in traffic and/or at night. It is the Prime Contractor's responsibility to provide additional PPE as required for their task. PPE shall be worn at all times.

E. Each prime shall submit a Project Specific Safety & Environmental Plan addressing the hazards of their scope of work and mitigation plans to control the hazards. Plan shall be submitted two weeks prior to the start of the prime's work for administrative review by the CMa and Owner for compliance with the submittal requirements. Such review shall not constitute approval of the adequacy of the Contractor's safety program or transfer any safety responsibility to the CMa or Owner. Contractors shall refer to the table contained below to reference minimum worker training requirements. The PSSP shall:

1. Identify each component of the work that the contractor is responsible for completing.

2. Identify hazards associated with the work and the proper equipment and tools to perform the work.

3. Plan adequate and sufficient controls to protect their work crews.

4. If the project specific safety plan needs revision due to scope of work changes, unanticipated or new hazards, other condition changes, etc., then all work pertaining to that work component will stop until a new project specific safety plan is completed.

PSSP Minimum Worker Training Requirements		
Topic	Who Needs Training	What Training is Needed
Project Specific Safety Orientation	All project management, supervision, and workers entering the project	Safety rules and procedures contained in the Safety & Health Management Program (SHMP), site-specific emergency action plan, each worker's responsibilities, disciplinary program, and warm up and stretching exercises

Hazard Communication	All workers entering the project	Hazard Communication Basic Training (Refer to Hazard Communication Program in this SHMP)
Hazardous Chemical or Substance	Workers exposed to a hazardous chemical or substance	Specific Hazard Communication Training (Refer to Hazard Communication Program in this SHMP)
Respiratory Protection	Workers required to wear respiratory protection, including common dust masks	OSHA 29 CFR 1910.134 & 139 or 1926.103
Fall Protection	Any worker who might be exposed to a fall hazard	• The nature of fall hazards • Procedures for erecting, disassembling, maintaining and inspecting fall protection systems. • Use and operation of guardrail systems, personal fall arrest systems, safety net systems, warning line systems, controlled access zones and other fall protection. • Procedures for handling equipment and erection of overhead protection • Fall protection standards. • Rescue Plan
PPE	Workers using PPE	Refer to section on PPE or regulatory standards
Forklifts	Operators of powered industrial trucks	• Types of trucks operated. • Hazards of the workplace • Hands-on performance evaluation
Confined Spaces	Any worker attending to, supervising,	• Hazards of the space • Duties of entrants, attendants, supervisors

	entering or working within a confined space	• Air monitoring
Permit-Required Confined Spaces	Any worker attending to, supervising, entering or working within a permit-required confined space	• Hazards of the space • Duties of entrants, attendants, supervisors • Measures used to eliminate or control hazards. • Air monitoring requirements • Emergency procedures/rescue equipment • Communications • Permitting procedure • PPE
Excavations/ Trenches	Workers entering or working within an excavation/trench	• Hazards of the space (slides, cave-ins, water accumulation, etc.) • Safe means of access/egress • Proper support system procedures (erection, maintenance, disassembly and inspection)
Lockout/Tagout	Workers affected by hazardous energy sources	• Nature of known hazardous energy sources. • Project-specific Lockout/Tagout procedures
Gas Welding & Cutting	Workers conducting gas welding and/or cutting	• The safe use of fuel gas
Arc Welding & Cutting	Workers conducting arc welding and/or cutting	• What to do with unattended machines and electrode holders • Operations around water • Shielding arc welding

Hot Work	Workers conducting hot work activities	• Hazards of the area • Permits • Duties of Fire Watch • How to use a fire extinguisher
Scaffolding	Workers working from scaffolding	• The nature of any known hazards • Proper erection, maintenance and disassembly of fall protection systems • Falling object protection • Material/equipment handling from scaffold. • Maximum load-carrying capacity • Scaffold tagging system. • Access and egress
Crane Baskets	Workers working from crane baskets	• Safe work rules • 100% fall protection • Lift plans contents • Emergency procedures
Silica	Workers potentially exposed to Respirable crystalline silica	• Hazards of Respirable crystalline silica • Understanding Table 1 • If needed, respiratory protection program

F. Crew Daily Pre-Task Safety & Hazard Analysis Planning (DHA)

1. A Daily Pre-Task Safety & Hazard Analysis Plan will be completed daily by each crew performing work on this project. The CMa will provide a template if requested by the

contractors.

2. Each foreman/first-line supervisor will analyze task(s) to be performed by their crew and identify the work sequences, hazards, training, controls and emergency action plans necessary to protect workers from the identified hazards.

3. The work will be broken down into individual steps (i.e., all the steps the work crew will have to take in order to complete that task); the known hazards associated with the work; and the hazard controls (tools, safety equipment, safety rules, safe work practices, etc.). This is a time for workers to provide input into the pre-task plan.

4. Foreman/first-line supervisors will review the plan with their respective work crew so that each worker is aware of what work activities will occur during the shift, what hazards to be aware of and how to properly control or eliminate those hazards. Each worker will sign the plan stating that they understand the work activities, hazards and controls. This is also an acknowledgement that each worker agrees to work according to the plan.

5. The completed pre-task plan shall be posted in a conspicuous location near the work activity.

6. Those tasks with similar work can use prior pre-task plans, but the plan must still be dated and reviewed with crewmembers at the beginning of the shift. If the scope of work changes or a new hazard appears during the work, the first-line supervisor will stop their crewmembers and revise the pre-task plan.

7. End of shift sign off. Each worker is required to sign off at the end of shift confirming that any injuries were reported.

8. Completed DHAs are to be submitted to the CMa weekly.

G. Hazardous Materials

1. A survey has been performed by the owner and included as part of the bidding documents. Each prime contractor and their subcontractors shall review the report and understand the hazardous materials that exist onsite.

   a. Removal of hazardous materials shall be performed by competent worker that meet the requirements of AHJ’s and in accordance with all applicable laws and regulations.

   b. Each contract shall provide awareness training to their workers prior to mobilizing onsite.

2. In the event unknown suspected hazardous materials are uncovered during the course of the work, all workers shall stop work and notify the CMa and Owner.

H. Each contractor will be held in strict accordance will all safety and environmental regulations and requirements. Any worker that fails to follow the policies will be dealt with in accordance with the disciplinary program as described below. Prime and/or contractor supervision (inclusive of onsite and office personnel) that oversee workers that have reoccurring safety or disciplinary infractions will be removed from the project site in addition to worker(s) violating the project

requirements.

1. Disciplinary Program

    a. At-risk behavior on this project that could contribute to an incident or injury will not be tolerated. Each worker has an individual responsibility to work safely, and each first-line supervisor is responsible to correct at-risk behavior of workers under their direction.

    b. At-risk behaviors considered Immediately Dangerous to Life or Health that may result in immediate termination from the project, include, but are not limited to:

        i. Failure to follow the Fall Protection Policy

        ii. Failure to follow the Substance Abuse Policy

        iii. Possession of firearms, explosives or dangerous weapons

        iv. Theft and other criminal activity

        v. Entering or allowing to enter an unprotected trench or excavation.

        vi. Failure to follow lockout/tagout procedures.

        vii. Fighting, horseplay, or practical joking

        viii. Entering or allowing to enter, a confined space without following procedures.

        ix. Unsafe and/or reckless operation of motorized vehicles or equipment

    c. For those acts or practices not considered Immediately Dangerous to Life or Health the following will apply:

        i. First occurrence: Verbal, written warning, and/or re-training by the prime contractor

        ii. Second occurrence: Written warning, re-training, suspension, or termination from the project

        iii. Third occurrence: Termination from the project

I. No work will be performed on any energized electrical circuit, buss-bars, equipment, or panels unless an approved written work plan is developed in accordance with Chapter 1 of NFPA 70E and submitted to Skanska for review prior to performance of work.

J. Electrical equipment and tools used on this project shall be inspected by a competent person to prevent any worker from receiving an accidental electrical shock. This rule will apply to all cord sets, portable electrical equipment, tools and appliances not part of any permanent building or structural electrical systems.

K. All temporary cords will be three wire, 16 gauge or heavier, with a hard or extra hard duty rating.

L. Electrical Cord Management

1. All cord sets will be elevated above the work surface when practical.

2. Wire, nails, or other conductive material will not be used to hang or attach cord sets or welding leads.

3. Cord sets that cross roadways will be protected from damage by vehicle and equipment traffic by devices such as hose bridges.

M. General Electrical Requirements

1. Light stringers and halogen lamps will have the lamps protected from accidental contact or breakage and will be hung per manufacturer specifications.

2. UL approved covers are required on all panels, load centers, pull boxes, etc. prior to energizing. Necessary steps will be taken to prevent unauthorized or unqualified workers access to energized electrical parts or equipment.

3. Additional Fall Protection Requirements

a. Prime contractors, subcontractors, vendors, or other third-party individuals will take all practical measures to eliminate, prevent, and control fall hazards. All work will be planned with the intent to eliminate identified fall hazards. When a fall hazard has been identified and cannot be eliminated, then effective means of fall protection will be implemented. Acceptable fall protection systems included the following:

a. Guardrail systems

b. Safety netting

c. Covers for floor, roof and wall openings.

d. Positioning device systems

e. Protection from falling objects.

f. Personal fall arrest systems

4. Retractable lifelines shall be utilized with personal fall arrest systems; lanyards will not be acceptable.

5. 100% Fall Protection Required. All employees will be 100 percent protected while working six feet or higher off the ground or when hazards below six feet dictate enforcement at a lesser height. This policy will apply to all contractors, even when OSHA allows for exceptions. In the event where local statutes require fall protection at less than six feet the more stringent standard will apply.

6. Workers engaged in steel erection activities, including but not limited to connecting, decking, and bolt up, are not exempt from the 100 percent fall protection requirements when working from heights of six feet or greater.

N. Fire Protection and Prevention

1. Prime contractors shall develop and provide a Fire Protection Plan in accordance with OSHA 29 CFR 1926 Subpart F.

2. All activities that require welding, cutting or an open flame is present require a minimum of 2-hour fire watch. Provide continuous fire watch, including off hours, for temporary heating using open flame units. Refer to specification 01 50 00 Temporary Facilities & Controls for further fire watch requirements.

3. Any temporary structures or protection shall be construction of non-combustible material or have a fire resistance rating of one (1) hour.

4. Hot work is defined as the use of open flames, other heat sources, and/or spark producing devices in areas where combustible or flammable materials are present and/or where there is potential for explosion or fire. Hot work activities include burning, welding, cutting, grinding or other operations that produce a flame, heat, or sparks.

   a. Prior to performing “Hot Work” operations, workers shall notify the CMa in accordance with requirements set forth in the contract documents. The CMa will coordinate with the owner’s activities and provide written confirmation before any hot work can commence.

O. Flammable Liquid Storage & Dispensing

1. Storage of flammable liquids are to be stored in fireproof containers as required by OSHA.

2. No flammable, combustible, or explosive gasses or liquids are permitted to be stored on the roof over night.

3. Gas powered generators are not permitted on the roof.

P. Prime Contractor Safety Personnel

1. Each contractor shall designate an experienced and fully trained member of the Contractor’s organization at the Project Site whose duty shall include the prevention of accidents and the enforcement of the project safety requirements relating the contractor’s work.

   a. Contactors shall coordinate, through the Construction Manager, and conduct, weekly onsite safety inspections. Prime Contractors shall designated safety representative, with a focus on the contractor’s safety duties and responsibilities. Contractors shall submit a formal report of their findings, within one day, and advise the owner and CMa for corrective actions to address any issues identified during the walk through.

2. Contractors that have less than thirty (30) workers on-site (including tiered subcontractors)

will designate a safety representative prior to mobilization. This on-site safety representative will be a competent worker who has completed at least 30 hours of OSHA awareness training and who may have other on-site duties. This worker must be onsite at all times to serve in this capacity.

a. Contractors that have thirty (30) or more workers (including tiered subcontractors) will provide a full-time on-site safety professional upon mobilization. This person shall have no other responsibilities.

b. Contractors will submit the resume of their proposed safety professional or representative to be reviewed by the CMa. The CMa may review the submitted qualifications for compliance with the stated minimum requirements; such review shall not constitute an independent determination of competency or relieve the Contractor of responsibility for selection and performance of its safety personnel. This person will have the authority and responsibility to ensure the proper implementation of safety requirements stipulated within their PSSP and project requirements.

c. Contractor safety professionals and representatives will have the full authority to implement safety corrections and recommendations. Subcontractor safety professionals and representatives will have authority to stop any work they deem unsafe.

3. When prime contractor crew sizes are larger than 30 workers, inclusive of sub tier contractors, the contractor shall employ a full-time on-site safety professional. This individual shall be dedicated to safety oversight and not have a dual role. The safety professional shall have the following minimum qualifications:

a. Five years construction experience, one year of which includes on-site construction safety responsibilities.

b. Specialized training relevant to scope of work.

c. OSHA 30-hour construction safety awareness course.

d. Working knowledge of safety regulations and hazard control methods.

e. Demonstrated ability to conduct safety training.

f. The minimum duties of the designated safety professional and/or representative will be:

i. Investigate any incident or near miss and report the findings to Skanska.

ii. Attend safety meetings as required by CMa.

iii. Conduct regular safety meetings with workers to instruct them on project safety practices and requirements.

iv. Conduct written daily safety inspections of their work activities and make available to Skanska for review to ensure compliance with safe work practices and this Safety & Health Management Program.

Q. Take prompt action to correct or abate hazards identified by the Owner or CMa. Such identification or direction does not relieve the Contractor of its independent safety responsibilities or transfer control of construction means, methods, techniques, sequences, or procedures to the Owner or CMa.

R. Safety Meetings

1. Safety personnel are required to attend all meetings stipulated in the "Lean Procedures" including but not limited to Last Planner and Daily Huddles.

2. The CMa will conduct safety meetings monthly. These meetings will last one (1) hour and review all aspects of safety onsite. Each prime contractor safety personnel and key subcontractors shall attend.

S. Silica- if there is a potential for silica exposure, the contractor shall submit a Silica Control Plan. If the contractor opts not to follow Table 1 from OSHA 1926.1153 Respirable crystalline Silica standard, historical data must be provided.

T. Radios, headphones, and other music devices are prohibited. Any contractor employee using these devices will be removed from the project.

U. Testing and Inspections

1. All Prime Contractors shall fully cooperate with any Testing and Inspection agencies retained by the owner including implementation of any remedial work recommended as a result of such inspections. It will be the responsibility of the Contractors to provide proper coordination and timely notification to the testing agency, inspecting authorities, etc. Reference the design specifications provided for further information.

2. All re-inspection cost due to failures and non-conformance will be the responsibility of contractor. Any and all specialized testing and/or inspections needed for temporary or permanent construction methodologies, not described in the design specifications, are the responsibility of the appropriate Prime or sub-tier contractor.

3. All Prime Contractors shall fully cooperate with any local and/or State inspection authority and coordinate inspections including any remedial work recommended as a result of such inspections. Any premium labor costs associated with such inspections will be the responsibility of the Contractor. Contractors shall identify inspection dates on weekly work schedule.

4. Prime Contractors will provide labor to assist in inspections by the AHJ and independent testing agencies.

V. Hazardous Materials

1. The Owner performed a hazard survey of the existing building. The report is part of the

bidding documents and the Prime Contractors are responsible to review the report and its findings. The General Contractor is responsible for the hazardous material abatement, should any be required, and shall follow all applicable EPA and OSHA regulations. The GC shall understand the potential for mold at the exterior walls caused from water infiltration. The proper regulations and guidelines shall be followed when removing the exterior façade and interior partitions.

2. If suspicious material is identified that potentially contains ACM or hazardous materials, the Prime Contractors shall notify the CMa and halt work operations immediately. The situation will be reviewed by the Owner and a course of action determined. If necessary, the Owner will perform additional testing of the suspicious materials.

W. Daily Construction Reports

1. Daily Construction Reports shall be submitted electronically to the CMa and should be completed per project specifications. Each Prime Contractor is required to complete and submit daily reports which shall be written and signed by the contractors lead supervisor or foreman on site within two (2) days of the day's completion. The CMa will verify the reports to ensure details are accurately documented. Payments may be withheld upon failure to submit these reports. All contractor's are to utilize the provided Procore Daily Report.

X. Site Condition Reports

1. Submit at time of discovery of differing conditions. All primes are responsible to review the project conditions prior to starting their work. Contractors shall report prior to the start of work any differing conditions and/or damages part of existing materials that are existing to remain. Issues that are not reported will be the responsibility of the prime contractor.

Y. Adjacent Buildings and Structures

1. Damages

a. All Contractors are cautioned that, because this work will be performed in close proximity and adjacent to existing occupied properties, all precautions, protection and care must be exercised to protect existing structures in accordance with good safety practices. This is particularly applicable to protection of pedestrians. The Contractor is responsible for any damage, which may occur to the property of the Owner or adjacent private or public properties which in any way results from the acts or neglect of his employees. In addition to repairing the damage at the expense of the Contractor, all damages thereto including damage to existing utilities and paving arising from operations under the Contract. Repair and protection is the Contractor's responsibility regardless of the assignment of responsibility for inspection, testing or similar services.

Z. Finished Work & Protection

1. All Contractors are wholly responsible for the protection of finished work, both their own and that of others, as may be required to perform their own work. Each Contractor is

responsible for any damage which may occur to the property of any other Contractor connected with the work or to adjacent private or public properties, or to any portion of the structure that in any way results from the acts of or neglect of his/her employees.

AA. Substitutions: Each contractor shall cooperate with other contractors involved to coordinate approved substitutions with remainder of the work.

BB. Temporary Facilities and Controls: In addition to specific responsibilities for temporary facilities and controls indicated in this Section and in Section 015000 "Temporary Facilities and Controls," each contractor is responsible for the following:

1. Plug-in electric power cords and extension cords, supplementary plug-in task lighting, and special lighting necessary exclusively for its own activities.

2. Computers, printers and office supplies necessary for its own activities.

3. Temporary enclosures for its own construction activities.

4. Staging and scaffolding for its own construction activities.

5. General hoisting facilities for its own construction activities.

6. Waste disposal facilities, including collection and legal disposal of its own hazardous, dangerous, unsanitary, or other harmful waste materials.

7. Progress cleaning of work areas affected by its operations on a daily basis.

8. Secure lockup of its own tools, materials, and equipment.

9. Construction aids and miscellaneous services and facilities necessary exclusively for its own construction activities.

CC. Each Contractor must inspect the roof areas daily for material and debris that can be blown from roof and take all measures to prevent same.

2.00 GENERAL CONSTRUCTION CONTRACT

The work of the General Construction Prime Contract Package includes, but is not limited to, the Work detailed by the following specification sections, as shown, implied and/or indicated on the drawings and as described in the contract description. The work is not restricted by the division of drawings or specifications. Unless otherwise specifically noted, all work to be performed shall consist of providing all labor, materials, equipment and other necessary requirements to complete the work in accordance with the specifications and applicable codes and governing jurisdictions.

Specification	Description
a) Division 00	Procurement and Contract Requirements
b) Division 01	General Requirements
c) Division 2	Existing Conditions
d) Division 3	Concrete
e) Division 4	Masonry
f) Division 5	Metals
g) Division 6	Wood, Plastics, and Composites
h) Division 7	Thermal and Moisture Protection
i) Division 8	Openings
j) Division 9	Finishes
k) Division 10	Specialties
l) Division 11	Equipment
m) Division 12	Furnishings
n) Division 31	Earthwork
o) Division 32	Exterior Improvements
p) Division 33	Utilities

1. The GC Prime Contractor shall provide a fully furnished, climate-controlled trailer with a minimum area of 700 square feet for shared use by the GC Prime and the CMa, available from the Notice to Proceed through one month beyond the scheduled completion date identified in the bid schedule.

The trailer shall include a dedicated office for the CMa furnished with two desks and two chairs, a conference room with a table and chairs for up to 12 people, and a 65-inch 4K television with a stand for meetings. The GC Prime shall also provide a full-size refrigerator and microwave, high-speed broadband internet capable of supporting video conferencing, and shall be responsible for all associated internet service costs. Two portable toilets and one handwashing station, designated exclusively for office staff, shall be provided, with the GC Prime responsible for potable water supply and bi-weekly cleaning of the portable toilets. Electrical power will be supplied by the Electrical Prime Contractor. The trailer shall be located in the vicinity shown on the logistics plan. The GC Prime shall secure the trailer, furnish a minimum of six keys to the CMa, and ensure all fencing and barriers include reflective signage and any impact protection devices required by the Authority Having Jurisdiction. The GC Prime shall obtain and maintain all necessary permits for this work, if required.

2. The GC Prime shall furnish, install, operate, maintain, and remove solar-powered light tower(s) for the temporary gravel parking lot for the full duration that the parking lot remains operational. Provide a minimum of one (1) solar-powered light tower and furnish additional units as necessary to provide safe and continuous illumination of all parking areas, pedestrian routes, and vehicular circulation paths during hours of darkness. Any determination by the Owner or CMa that additional lighting is required for safety or operational purposes shall be implemented by the GC Prime at no additional cost to the Owner.

3. Contractor has visited the site and reviewed all areas of disturbance related to work of this bid package. Any existing improvements that require removal, demolition, relocation and/or protection to perform the work are considered part of this Contractors scope of work.

4. GC Prime contractor to be fully involved with all aspects of the overhead coordination process.

5. Provide all layout for use by all contractors. Layout on the floor, finish walls, openings, soffits and built in items. General Contractor shall provide a perimeter offset line from the work area perimeter in and X and Y plane. The offset line shall be provided immediately following slab pour curing or prior to interior wall construction. The GC shall ensure the offset lines are maintained during construction. GC shall also establish and maintain a benchmark (horizontal control or “Z” plane) for all trades coordination in all work areas.

6. A hazardous materials survey identified asbestos-containing cementitious shingles located within a concealed area beneath a newer roofed structure. Based on the currently available information and anticipated scope of work, disturbance or removal of these materials is not expected and no abatement work is included in the Base Bid. Should work activities, unforeseen conditions, field investigations, or requirements of the Work necessitate disturbance, removal, or other impacts to these materials, such work shall be treated as a change in scope and addressed by Change Order in accordance with the Contract Documents.

7. The GC Prime shall remove all trees and shrubs identified for removal in the contract documents. In addition, the GC Prime is responsible for removing and replacing any trees, shrubs, or overgrowth that obstruct access to the site. Any plant material removed solely to facilitate construction access, and not explicitly indicated for removal in the contract documents, shall be replaced in kind upon completion of the work.

8. The GC Prime shall maintain all grass and planted areas to prevent the appearance of unsightly or overgrown vegetation throughout the duration of the project.

9. Contractors will coordinate overhead MEP rough-in, wall construction and ceiling framing to assure the ceiling heights indicated on the contract drawings are maintained. Notify the CM of any issues related to ceiling heights or overhead rough-in prior to installation.

10. In the event unknown suspected hazardous materials are uncovered during the course of the work, all workers shall stop work and notify the CMa and owner. The CMA will arrange for testing of materials uncovered that are not represented in the environmental assessment. If additional abatement is directed by the Owner, compensation for unforeseen hazardous materials shall be determined using established unit prices, if applicable, or otherwise in accordance with the Contract Documents governing changes in the Work.

11. Perimeter fencing shall consist of post-driven and temporary chain link fence. Gates shall be installed at the locations indicated on the logistics plan. All fencing and barriers shall include reflective signage and any impact protection devices required by the Authority Having Jurisdiction (AHJ). The contractor shall provide, maintain, and secure all necessary permits for this work, if required.

12. Contractor will provide site utility installation, utility relocation and utility removal/abandonment indicated. All utility work described will be documented for line and grade and updated on the on the as-built CAD file. Extend utilities through foundation wall and into the building to the first flange and cap provided by this Contractor. Provide water stop LINK SEAL at all building exterior wall subsurface penetrations. Provide testing, sterilizing and flushing for all installed utilities. Include sanitary, storm, domestic water and fire water installation.

13. Contractor will scan (GPR) for utilities in the vicinity of new structures and foundation work prior to excavating. Include soft dig and vacuum excavation to locate utilities. Inform the Architect and CMa of any utilities that could impact the foundation work for new construction.

14. The GC Prime Contractor will provide fall protection at the roof level for use by all trades.

15. The GC Prime Contractor will provide and maintain safe roof access for all Contractors use.

16. Provide and maintain three 20# multi use fire extinguishers on the ground floor and roof level. 6 TOTAL. Mount extinguishers on temporary stanchions or existing construction.

17. Contractor will provide snow removal. Remove snow when the snow event has substantially ended whether it is at night or weekends. Snow removal is required in all areas of construction, construction entrances, construction staging areas, temporary parking lot, and around construction office trailer(s) to include stairs. Spread calcium chloride on walking surfaces with ice.

18. GC Prime will immediately remove standing water on slabs following any rain event or snow melt.

19. GC Prime contractor shall ensure that during all excavation activities around the building perimeter, the existing footings are fully supported and remain structurally sound. At no point shall excavation undermine or compromise the integrity of the existing footings. Appropriate shoring, bracing, or

other protective measures must be implemented as necessary to prevent any undermining or destabilization.

20. Provide dust protection and containment for any activity that may produce as such. Follow OSHA guidelines for working with, and exposure to, crystalline silica. Use of the OSHA Time Weighted Average for workers exposure over a short period of time is unacceptable. Protect workers and the public from exposure to crystalline silica during any work that could produce airborne silica dust.

21. Contractor must take necessary measures to protect the adjacent properties from damage resulting from work related to this bid package.

22. In addition to the PA one call, perform Ground Penetrating Radar (GPR) and soft dig to locate existing utilities prior to performing any excavation. Contractor will temporarily support and protect utilities that are encountered during excavation. Additional materials are to be available on site to immediately repair any utilities damaged while performing this work. Immediately notify the CM of unforeseen underground utilities encountered. Include vacuum excavation for all new utility trenches and utility locating.

23. Backfill all utility trenches to grade with compacted DGA (densely graded aggregate) and remove excavated material from site.

24. Before spoils are removed from the site, contractor will test materials for contaminates. Provide an add/deduct unit price per yard for contaminated material. Backfill with compacted DGA is already included and will not be calculated in the unit price.

25. Contractor will make arrangements with the AHJ for temporary sidewalk closure, signage and overhead protection for the duration of the project. Reference logistics plan provided. Include design, permits, signage, barricades, traffic markings and any miscellaneous items required by the AHJ. Maintain and remove when directed.

26. Contractor will provide DAILY Clean up for it’s work and workers and that of it’s Subcontractors. Provide dumpsters for legal disposal and recycling of trash and debris. Dumpsters provided by the GC Prime Contractor will be used by all Prime Contractors. Reference logistics plan.

27. Contractor will padlock and secure all gates and building entrances at the end of each shift. Provide 4 keys for locks to CM and 2 to each prime contractor. GC must keep construction areas secure off hours.

28. GC Prime Contractor will provide and maintain portable temporary sanitary facilities and hand wash stations with water for use of all Contractors. Provide soap, and disposable towels at hand wash stations. Portable toilets are to be cleaned and sanitized a minimum of two times a week. Provide sufficient items described as per OSHA requirements. These are in addition to the portable toilets dedicated for use at trailers. Placement of portable facilities are to be coordinated with the CMa if not shown on the logistics plan.

29. Coordinate installation of security hardware with the Electronic Security Systems Contractor and Electrical Prime Contractor.

30. GC Prime to install access panels for each Prime contractor. Assume five (5) access panels per prime. General Contractor will provide and install all wall and ceiling access panels shown on the architectural documents. The General Construction Contract will include layout, framing, blocking and finishing for the installation of access panels.

31. GC Prime is required to provide and install a Knox Box if required per the AHJ. Coordinate with the local Fire Marshall for model and specifications. EC Prime is required to provide any associated wiring if required.

32. GC is responsible for all in-wall blocking for equipment to be provided by others. Blocking requirements are based on all contract documents including but not limited to architectural, mechanical, electrical, plumbing, fire protection, audio-visual and interiors plans. GC Prime to include Fire-Rated plywood backing for all Electrical / Low-Voltage panels.

33. Contractor will expedite material and equipment submittals focusing on long lead items needed to meet the installation dates identified on the project schedule. Compensation will not be considered for delays related to materials.

34. Concrete housekeeping pads and concrete curbs shown on the drawings will be provided by the GC Prime Contractor. Review all drawings for concrete pad and curb locations. Any bases or pads needed but are not shown on the drawings will be provided by others. Coordinate locations with MEP Prime Contractors.

35. Provide and maintain temporary weather protection, temporary roofing, temporary enclosures, temporary heat, cooling, dehumidification, and ventilation per material manufacturer's installation requirements/recommendations if work is scheduled by this contractor which requires specified climatized spaces ahead of scheduled weather tight milestone date. MC Prime Contractor will provide temporary heat/cooling once building is weathertight.

36. All firestopping sealants shall be single-sourced and coordinated among all prime contractors. Installation and material selection shall comply with Section 07 84 00 – Firestopping. The GC Prime Contractor shall lead coordination efforts to ensure compatibility and continuity of firestopping systems across all trades.

37. GC Prime Contractor is responsible for reviewing all existing and new wall construction in the building for code compliance as related to but not limited to fire rating, sound rating, air barrier. Review all new and existing steel construction passing through CMU block and drywall walls to install code complaint firestopping and caulk sealants based on the required wall rating.

38. All painting indicated on the MEP drawings shall be performed by the GC Prime Contractor. This work shall be coordinated with the Mechanical, Electrical, and Plumbing Prime Contractors to ensure proper sequencing and access. All painting shall comply with the requirements outlined in Section 09 90 00 – Painting and Coating.

39. The GC Prime Contractor shall be responsible for waterproofing existing foundations when exposed during excavation. All waterproofing work shall be performed in accordance with the methods and materials specified in the applicable specification sections.

40. Provide temporary protection for materials installed by this contractor including, but not limited to, floors, roof system, walls, window systems, exterior skin materials, millwork/casework, doors and frames, elevator, until substantial completion and acceptance by the owner. Compensation will not be considered for replacement or repair of damaged materials prior to final acceptance.

41. All temporary construction provided by this bidder will be maintained, modified if necessary and removed when directed.

42. The GC Prime Contractor shall include a two-person paint crew available for up to forty (40) hours at the discretion of the CMa for touch-ups, corrections, or other painting needs identified during the project. The GC Prime shall keep all leftover paint available, properly labeled and stored, until the project punch list is complete to ensure color and finish consistency for any required touch-up work. All painting shall comply with Section 09 90 00 – Painting and Coating, including surface preparation, application methods, and material standards. Paint shall be stored in a secure, climate-appropriate location to prevent damage or degradation, and the GC Prime shall coordinate with other trades to avoid conflicts and ensure timely completion of painting tasks. Any unused paint shall be disposed of in accordance with local environmental regulations after final acceptance. This requirement does not relieve the GC Prime Contractor of the responsibility to correct any paint deficiencies caused by the GC Prime or its subcontractors and is separate from any punch list activities.

43. The General Construction (GC) Prime Contractor shall include 8 labor hours for a Carpenter Apprentice or Carpenter to perform repairs or replacements of damaged Acoustic Ceiling Tiles (ACT) that occur outside of the punch list process, at the discretion of the Construction Manager (CMa). All unused ceiling tiles provided under the contract shall be stored in a secure, accessible location on-site and remain available for this purpose until punch list activities are fully complete. Any replacement work shall match the existing ceiling system in size, color, and finish.

44. Provide all final cleaning labor, material, and equipment. Final cleaning will be provided at a standard that is acceptable for the Owner's occupancy. Submit cleaning products and materials satisfactory to manufacturer’s standards. Provide final cleaning for all interior and exterior areas and finishes including, BUT NOT LIMITED TO the following:

    a. Interior glazing system surfaces

    b. Exterior glazing system surfaces

    c. Floor finishes

    d. Millwork Casework

    e. Doors, frames and hardware.

    f. Wall surfaces

    g. mirrors

    h. Elevator

    i. Stairs and rails

j. MEP and specialty rooms

k. Restrooms, water closets, lavatories, utility closets

l. Plumbing fixtures

45. The GC Prime Contractor shall provide architectural work reasonably required to complete the final conditions shown in the Contract Documents, including incidental work necessary to make assemblies complete, finished, coordinated, and code-compliant. This includes work that is not individually tagged but is required by the details, schedules, notes, phasing diagrams, existing conditions, or coordination with new construction. Items clearly assigned to another prime contractor or Owner vendor are excluded only to the extent specifically stated in the Contract Documents.

46. The GC Prime Contractor shall provide selective architectural demolition necessary to install the new Work, including removals required by field conditions and coordination with the new construction drawings. Demolition shall not be limited only to specifically tagged demolition notes where additional removal is reasonably required to complete indicated new work. The GC shall protect construction to remain and repair damage caused by demolition or construction activities.

47. This bidder shall review demolition drawings, new construction drawings, reflected ceiling plans, finish plans, elevations, details, schedules, and MEP/FP drawings together when establishing demolition scope. Removals required to allow installation of new partitions, ceilings, finishes, doors, openings, equipment, MEP/FP devices, roof work, and exterior envelope work shall be included by the GC. Lack of a separate demolition tag shall not exclude demolition that is necessary to achieve the final condition shown.

48. The GC Prime Contractor shall provide architectural cutting, patching, infill, and finish restoration where existing or new architectural construction is disturbed by demolition, new work, or coordinated work by other prime contractors. This includes patching at walls, floors, ceilings, bases, slabs, roof areas, and finishes affected by removed devices, relocated devices, abandoned openings, new penetrations, or MEP/FP rough-ins. Finished patched areas shall be prepared to receive scheduled finishes and shall match adjacent construction unless otherwise indicated.

49. Architectural patching and finish restoration associated with MEP/FP removals, relocations, new devices, abandoned devices, penetrations, sleeves, wall openings, ceiling openings, floor openings, and roof penetrations shall be provided by the GC Prime Contractor unless specifically assigned otherwise. Other prime contractors shall coordinate required penetration locations, rough-in dimensions, and sequencing with the GC before work proceeds. The GC shall restore affected architectural surfaces to a finished condition suitable for occupancy and scheduled finishes.

50. The GC Prime Contractor shall provide preparation of existing substrates required to receive new finishes, including cleaning, grinding, leveling, patching, repair, skim coating, priming, and other surface preparation necessary for proper installation. Existing slabs, walls, ceilings, bases, and other surfaces shall be made suitable for the scheduled finishes. Conditions discovered after removal of existing finishes that require reasonable preparation for new finishes shall be included.

51. The GC Prime Contractor shall protect existing construction to remain, including finishes, structure, envelope systems, roofing, doors, frames, ceilings, floors, walls, equipment, and adjacent

occupied areas. Where existing construction to remain is damaged by demolition, temporary work, new construction, or GC operations, the GC shall repair or replace the affected construction to match adjacent existing conditions. Protection shall remain in place until the risk of damage has passed.

52. The GC Prime Contractor shall provide temporary measures required to maintain safe occupied school operations during construction. This includes temporary partitions, barriers, signage, protection, cleaning, dust control, noise control, access control, and separation of construction areas from occupied areas. The GC shall coordinate with the Owner and other prime contractors so that occupied areas remain safe, accessible, weather-tight, and code-compliant.

53. The GC Prime Contractor shall provide temporary construction and coordination required to support the phasing plan, including temporary access, temporary egress, temporary separations, barriers, protection, cleaning, and phased turnover requirements. Temporary entrances and egress routes required for Owner use or continued school operations shall be maintained by the GC. Additional protection, sequencing, and make-safe work required for partial occupancy or temporary certificate of occupancy conditions shall be included.

54. The GC Prime Contractor shall maintain the building in a water-tight and weather-tight condition during demolition and construction. Temporary closures, tarping, sheathing, flashing, sealing, and protection shall be provided at exterior wall openings, window openings, door openings, façade removals, roof openings, roof removals, and incomplete envelope work. Damage caused by water infiltration resulting from GC work or temporary conditions shall be corrected by the GC at no additional cost.

55. The GC Prime Contractor shall provide temporary shoring, bracing, support, and protection required to safely perform architectural demolition, cutting, modifications, infill, and new construction. Existing construction shall remain stable and safe during selective removals and installation of new work. Temporary support requirements shall be coordinated with structural work and other prime contractors before demolition or modification begins.

56. Where existing items are identified for salvage, reuse, relocation, or reinstallation, the GC Prime Contractor shall remove, protect, store, reinstall, adjust, and clean those items as required for a complete final condition. This includes associated anchors, fasteners, blocking, shims, trim, patching, hardware adjustment, and finish restoration. Salvaged items shall be protected from damage, loss, moisture, and deterioration until reinstalled or turned over as directed.

57. The GC Prime Contractor shall coordinate with the Owner before demolition to confirm items to be retained by the Owner. Items not specifically identified for Owner retention, reuse, relocation, or reinstallation shall be removed and disposed of by the GC. The GC shall provide reasonable handling, protection, and separation of Owner-retained items from demolition debris.

58. The GC Prime Contractor shall provide architectural roof work required to support the new construction and coordinated MEP/FP work, including roof patching, blocking, curbs, rails, crickets, walkway pads, flashing, counterflashing, tie-ins, sealants, and membrane transitions. Roof work shall be coordinated with rooftop equipment, ductwork, piping, conduit, supports, drains, overflow drains, scuppers, and access requirements. Final roof penetration sizes and locations shall be coordinated with the applicable prime contractors before cutting or installation.

59. Roofing work performed by the GC Prime Contractor shall be completed in a manner that maintains existing and new roof warranty requirements. Where required by the existing roof warranty or roofing manufacturer, work shall be performed by an authorized roofing contractor. The GC shall provide warranty-compliant tie-ins, flashings, repairs, certifications, and coordination necessary to maintain the roof warranty.

60. The GC Prime Contractor shall provide architectural work required at exterior wall and roof penetrations, including framing, blocking, patching, flashing, counterflashing, sealants, waterproofing, and finish restoration. Prime contractors requiring penetrations shall coordinate size, location, and sequencing with the GC before work proceeds. Completed penetrations shall maintain air barrier, water barrier, weatherproofing, fire rating, and finish continuity.

61. The GC Prime Contractor shall be responsible for continuity of the exterior envelope where multiple systems meet or where penetrations and attachments occur. This includes coordination of weather-resistive barriers, air barriers, vapor/moisture barriers, flashing, transition membranes, end dams, backer rod, sealants, trims, closures, and tie-ins between façade systems. Envelope transitions shall be completed so that the final installation is weather-tight and coordinated across roofing, masonry, EIFS, fiber cement panels, glazing, Kalwall, doors, frames, canopies, signage, and penetrations.

62. The GC Prime Contractor shall provide flashing, sealants, backer rod, counterflashing, transition membranes, end dams, and closure pieces required at exterior openings, penetrations, and material transitions. This includes conditions at windows, doors, storefront, Kalwall, masonry, EIFS, fiber cement panels, roof edges, canopies, signage attachments, and façade-mounted items. Sealant and flashing work shall be coordinated between exterior trades to provide a complete weather-tight installation.

63. The GC Prime Contractor shall coordinate and provide architectural supports, blocking, anchors, sealants, flashing, waterproofing, and finish restoration for façade-mounted items shown in the Architectural drawings. This includes building-mounted signage, dimensional lettering, canopy attachments, exterior accessories, and similar items attached to the exterior envelope. Attachments shall be installed without compromising air barrier, water barrier, façade system, or roofing performance.

64. The GC Prime Contractor shall coordinate doors, frames, and hardware with electrical, fire alarm, security, and access control work where those systems interface with architectural openings. This includes coordination of magnetic hold-opens, electric strikes, electric locks, panic hardware, card readers, power supplies, conduit rough-ins, templates, and operating devices. The GC shall provide architectural preparation, blocking, hardware coordination, and final adjustment required for complete door operation.

65. The GC Prime Contractor shall maintain fire-rated and smoke-rated assembly continuity at doors, frames, glazing, partitions, ceilings, floor interfaces, and penetrations shown or required by the Contract Documents. Rated openings shall include required labels, hardware, closers, latching, seals, gasketing, glazing, and coordinated fire alarm interfaces where applicable. Rated assemblies disturbed by demolition, cutting, patching, or new work shall be restored by the GC.

66. The GC Prime Contractor shall provide fire extinguisher cabinet relocation, replacement, blocking, patching, signage, and finish restoration where existing cabinets are reused or where new cabinets

are required by the Architectural/code drawings. Existing or relocated extinguishers and cabinets shall be verified for proper condition, and new units shall be provided where required by code or where existing units are insufficient. Locations shall be coordinated with partitions, rated walls, casework, doors, MEP/FP devices, signage, clearances, and accessibility requirements.

67. The GC Prime Contractor shall provide signage shown in the Architectural drawings unless specifically assigned otherwise, including coordination of mounting locations, blocking, substrates, fasteners, accessibility requirements, and Owner confirmation of final room names and numbers. Exterior signage and building-mounted lettering shall be coordinated with façade systems, weatherproofing, structural support, and electrical requirements where applicable. Sign installation shall include patching, sealing, and finish restoration associated with signage removal or installation.

68. Where the Architectural drawings indicate monument sign work and the scope is not assigned elsewhere, the GC Prime Contractor shall provide or coordinate the monument sign as part of the GC scope. This includes coordination of location, size, height, support requirements, finishes, adjacent site conditions, and any required electrical interface. If site/civil or electrical work is required, the GC shall coordinate the interface with the applicable prime contractor.

69. The GC Prime Contractor shall coordinate casework, countertops, sinks, access panels, scheduled equipment, plumbing rough-ins, electrical rough-ins, wall conditions, floor conditions, and adjacent finishes before fabrication or installation. Where casework interfaces with plumbing fixtures, drains, equipment, AV items, or Owner-provided items, the GC shall provide required openings, supports, blocking, filler panels, patching, sealants, and finish restoration. The GC shall field verify dimensions and equipment depths prior to fabrication.

70. The GC Prime Contractor shall provide blocking, backing, concealed supports, fire-rated blocking where required, anchors, and substrates for wall-mounted, ceiling-mounted, and casework-mounted items shown or scheduled. This includes supports for signage, toilet accessories, grab bars, handrails, casework, countertops, whiteboards, tack boards, bulletin boards, projector screens, AV displays, fire extinguisher cabinets, AED cabinets, athletic equipment, acoustic panels, and similar items. Blocking locations shall be coordinated before wall or ceiling close-in with other prime contractors and Owner vendors.

71. Where the Architectural equipment schedule identifies items as provided by the Owner or vendor but installed by the GC, the GC Prime Contractor shall receive, unload, inspect, store, protect, layout, provide blocking/backing, install, anchor, adjust, and turn over those items. Power, data, AV, control wiring, and final connections shall be coordinated with the Electrical Prime, AV vendor, and Owner as applicable. The GC shall include access equipment, mounting hardware, anchorage, and field coordination required for the installation unless specifically assigned otherwise.

72. The GC Prime Contractor shall provide or install athletic and gym equipment identified in the Architectural equipment schedule as GC-provided or GC-installed. This includes coordination of supports, blocking, anchorage, ceiling conditions, wall conditions, electrical rough-ins, controls, access equipment, finishes, and manufacturer requirements. Installation shall be coordinated before close-in so required structure, backing, inserts, and power/data provisions are in place.

73. Where AV displays, projector screens, or similar equipment are identified as GC-installed, the GC Prime Contractor shall provide installation, mounting, anchorage, blocking, backing, protection, and coordination with AV and electrical rough-ins. Owner-provided or AV vendor-provided equipment shall be received, protected, and installed by the GC when scheduled as GC-installed. Final power, data, AV connections, and operational testing shall be coordinated with the appropriate prime contractor or vendor.

74. The GC Prime Contractor shall provide and coordinate toilet accessories and restroom specialties shown or scheduled, including blocking, mounting hardware, accessibility clearances, and installation with adjacent finishes. Accessories shall be coordinated with plumbing fixtures, toilet partitions, electrical rough-ins, tile, wall finishes, floor finishes, door swings, and clear floor spaces. Where plumbing fixture work under an alternate affects finishes or accessories, related GC patching and restoration shall be included.

75. The GC Prime Contractor shall coordinate toilet partitions with plumbing fixtures, grab bars, toilet accessories, floor slopes, wall finishes, door swings, and accessibility clearances. Anchors, supports, blocking, fasteners, floor repairs, wall repairs, and finish restoration associated with partition installation shall be provided by the GC. Partition layout shall be coordinated before installation to avoid conflicts with fixtures, accessories, and required clearances.

76. The GC Prime Contractor shall coordinate interior finishes with existing conditions, patching, MEP/FP devices, casework, doors, frames, glazing, signage, equipment, accessories, and other adjacent work. Finish transitions, reducers, thresholds, edge strips, bases, trims, sealants, and related accessories required for a complete finished condition shall be provided by the GC. Existing surfaces disrupted by demolition, new work, or coordinated prime contractor work shall be restored to receive scheduled finishes.

77. The GC Prime Contractor shall provide slab preparation, floor patching, leveling, cleaning, grinding, transition strips, reducers, thresholds, bases, and finish accessories required for flooring installations. Existing slab conditions exposed after finish removal shall be repaired as reasonably required to receive the new floor finishes. Flooring work shall be coordinated with doors, frames, ramps, floor drains, casework, plumbing fixtures, equipment, and adjacent finish materials.

78. The GC Prime Contractor shall coordinate finish work at floor drains, sloped slabs, epoxy flooring, tile, and adjacent flooring transitions. Slopes, transitions, patching, floor preparation, and finish terminations shall be coordinated with plumbing rough-ins and drain locations. The final floor condition shall be complete, serviceable, and coordinated with the scheduled finishes.

79. The GC Prime Contractor shall coordinate ceiling work with lighting, diffusers, sprinkler heads, fire alarm devices, speakers, access panels, equipment, and other MEP/FP ceiling-mounted items. Ceiling patching and restoration shall be provided where existing ceilings are disturbed by demolition, new work, or coordinated prime contractor work. Required supports, trims, access panels, transitions, and finish restoration shall be provided by the GC.

80. The GC Prime Contractor shall provide or install acoustic panels, acoustic ceiling elements, tack boards, bulletin boards, whiteboards, wall panels, and similar specialty finish items where shown or scheduled as GC work. This work shall include layout, blocking, backing, anchorage, access equipment, coordination with adjacent devices, and protection of completed finishes. Specialty

finish items shall be coordinated with ceilings, lighting, sprinklers, fire alarm devices, AV equipment, casework, and wall finishes.

81. The GC Prime Contractor shall coordinate rated assembly restoration where penetrations, openings, or removals affect fire-rated walls, floors, ceilings, shafts, or roof/floor assemblies. Penetrating prime contractors shall coordinate locations and requirements, but the GC shall provide architectural framing, patching, rated infill, and restoration of architectural rated assemblies unless specifically assigned otherwise. Firestopping interfaces shall be coordinated so required ratings are maintained at completion.

82. The GC Prime Contractor shall restore fireproofing or fire-resistive construction disturbed by demolition, cutting, patching, or new architectural work. Restoration shall occur at affected structural members, walls, floors, ceilings, and rated assemblies where required by the Contract Documents or code requirements. This work shall be coordinated with structural, mechanical, electrical, plumbing, and fire protection work.

83. The GC Prime Contractor shall provide civil/site demolition necessary to complete the proposed site improvements, including items shown as TBR and incidental removals required by the final layout, grading, utility, paving, stormwater, landscape, and site feature work. Demolition shall not be limited only to individually tagged removals where additional removal is reasonably required to achieve the final civil condition shown.

84. The GC Prime Contractor shall field verify the type, size, depth, horizontal location, and condition of underground utilities before excavation, demolition, grading, paving, or utility installation. Utility locations shown are approximate and shall not relieve this bidder from PA One Call coordination, test pits, utility company coordination, and protection of existing utilities to remain.

85. The GC Prime Contractor shall provide test pits at utility crossings, connection points, tie-ins, and locations where existing utility depth or alignment may affect the Work. Any conflict, inadequate clearance, unexpected utility, or field discrepancy shall be reported and resolved before the affected work proceeds.

86. The GC Prime Contractor shall coordinate all utility demolition, abandonment, relocation, capping, disconnection, and protection required by the civil demolition and utility plans. Utility shutdowns, abandonments, and relocations shall be coordinated with the applicable utility company and authority having jurisdiction, including required written confirmations where applicable.

87. The GC Prime Contractor shall verify all civil dimensions, grades, benchmarks, utility locations, property constraints, existing site features, and tie-in conditions before layout or construction. Rework resulting from failure to verify dimensions, grades, elevations, or existing site conditions shall be the responsibility of the GC.

88. The GC Prime Contractor shall obtain, maintain, and comply with permits, approvals, inspection requirements, agency notifications, and conditions of approval applicable to the Site/Civil Work. Required inspections and approvals shall be scheduled before work is covered or advanced, including utility, stormwater, E&S, paving, grading, and accessibility inspections.

89. The GC Prime Contractor shall provide excavation, fill, borrow, export, placement, compaction, and grading required to achieve the proposed site grades. This bidder shall import suitable fill or

export excess material as required and shall not assume a balanced site unless specifically stated. Any required material certifications are the responsibility of the GC.

90. The GC Prime Contractor shall remove and replace unsuitable soils, unstable subgrade, organic material, debris, soft areas, wet areas, or other material unsuitable for paving, sidewalks, utilities, curbs, stormwater facilities, and site improvements. Subgrade corrections shall be coordinated with the geotechnical engineer and documented through required testing or inspections.

91. The GC Prime Contractor shall provide dewatering, pumped water filtration, temporary conveyance, and protection measures required for excavation, utility installation, stormwater facility installation, grading, and subgrade preparation. Water encountered during construction shall be directed to approved E&S controls and shall not create erosion, sediment discharge, or damage to adjacent areas. The GC Prime shall comply with the NPDES permit at all times.

92. The GC Prime Contractor shall provide final grading that establishes positive drainage in paved areas, lawn areas, sidewalks, accessible routes, landscaped areas, and site tie-in locations. Localized depressions, birdbaths, reverse slopes, ponding, or drainage conditions inconsistent with the civil grading intent shall be corrected by the GC.

93. The GC Prime Contractor shall coordinate site improvements so bus, parent drop-off, fire truck, and garbage truck circulation shown in the vehicle circulation plans is maintained. Curbs, pavement edges, striping, signs, bollards, gates, trash enclosure, sidewalks, and landscaping shall not conflict with wheel paths, overhangs, turning radii, or access routes.

94. The GC Prime Contractor shall field coordinate fencing, gates, bollards, removable bollards, chain gates, posts, foundations, and sleeves with storm piping, utilities, tree roots, grading, accessibility, and vehicle circulation. Fence lines shown generally to avoid existing trees shall be adjusted in the field as required while maintaining the design intent and Owner/security requirements.

95. The GC Prime Contractor shall provide storm sewer installation, structures, pipe bedding, backfill, compaction, watertight connections, frames, grates, covers, and grade adjustments required by the civil drawings. Storm structures and piping shall be coordinated with utilities, paving, grading, stormwater facilities, required clearances, and authority requirements.

96. The GC Prime Contractor shall verify existing storm pipe locations, discharge points, structure rims, pipe sizes, pipe materials, and inverts before connecting proposed storm improvements. Existing yard drains, storm pipes, or discharge locations to be reused shall be inspected, cleaned as needed, and confirmed suitable for connection before new storm piping or structures are installed.

97. The GC Prime Contractor shall provide stormwater management facilities, including excavation, subgrade preparation, geotextiles, stone, chambers or structures, underdrains, outlet controls, filters, water quality devices, backfill, stabilization, and manufacturer-required installation procedures where applicable. Facilities shall be protected from sediment, compaction, contamination, damage, and premature operation until contributing areas are stabilized.

98. The GC Prime Contractor shall install, maintain, inspect, repair, relocate, and remove erosion and sediment control measures required by the approved E&S plans, SWPPP, permits, and field conditions. Additional controls required by the engineer, inspector, conservation district, or jurisdictional agency to prevent sediment discharge shall be provided by the GC.

99. The GC Prime Contractor shall provide temporary and permanent stabilization of disturbed areas in accordance with the E&S plans, civil notes, landscape requirements, and agency approvals. Final stabilization shall include topsoil, seed, sod, mulch, erosion control matting, plantings, watering, lawn restoration, and correction of ruts, ponding, debris, or construction damage.

100. The GC Prime Contractor shall coordinate site utility services with final Architectural, Structural, Mechanical, Electrical, Plumbing, and Fire Protection drawings. Building utility connection points, service sizes, inverts, sleeves, penetrations, vaults, meters, valves, cleanouts, and entry locations shall be verified before installation.

101. The GC Prime Contractor shall maintain accurate record drawings for demolished, abandoned, relocated, and newly installed utilities, stormwater facilities, grading, and site improvements. As-built plans, inspection records, stabilization documentation, and permit closeout materials shall be provided as required by the civil notes, municipality, utility authorities, and permit conditions.

102. The GC Prime Contractor shall field determine actual existing footing and foundation conditions where new foundations occur adjacent to the existing building. New footings adjacent to existing foundations shall match existing bearing elevations or maintain the required maximum 2:1 slope relationship unless otherwise directed by the Structural Engineer. Footing depth, haunching, dowels, and detail selection shall be adjusted as required based on verified existing conditions.

103. The GC Prime Contractor shall coordinate footing excavations with the Owner’s testing agency and shall not place concrete until required foundation bearing inspections are complete. Footings are designed for 3,000 psf net allowable bearing on acceptable undisturbed soils or compacted structural fill. If bearing conditions are not acceptable at the elevations shown, the GC shall coordinate required over-excavation, deeper footings, or redesign direction before proceeding.

104. The GC Prime Contractor shall provide building pad preparation, proofrolling, removal of soft or unsuitable material, corrective measures, and controlled compacted fill within and around the building area as required by the structural notes and geotechnical report. Proofrolling shall be performed in the presence of the testing laboratory representative, and fill shall be placed and compacted to the specified density and moisture requirements. Pipe trench, footing, and foundation wall backfill within structural areas shall receive special compaction attention.

105. The GC Prime Contractor shall submit concrete mix designs, admixtures, curing compounds, reinforcing shop drawings, and related concrete submittals for review before fabrication or placement. Concrete placement shall be coordinated with required inspections, cylinder testing, slump testing, air testing, reinforcing verification, and curing requirements. Concrete placed without required review, inspection, or testing coordination shall be subject to correction at the GC’s expense.

106. The GC Prime Contractor shall provide slab-on-grade thicknesses, reinforcement, granular base, vapor barrier treatment, isolation joints, construction joints, shrinkage joints, sawcut timing, re-entrant corner reinforcement, and slab depressions as shown and detailed. Slab work shall be coordinated with structural requirements for pipe trenches, floor drains, housekeeping pads, equipment pads, depressed areas, and transitions in slab thickness or elevation. Slab curling, shrinkage cracking, curing, and joint layout shall be addressed in accordance with the structural notes and details.

107. The GC Prime Contractor shall coordinate piping below or through structural footings, slabs, and walls with the structural details before installation. Sleeves, trench backfill, lean concrete fill, supplemental reinforcing, slab patching, dowels, vapor barrier restoration, and footing separation requirements shall be provided where pipes conflict with structural elements. Undocumented pipe penetrations or trenches affecting structural work shall be reviewed before installation.

108. The GC Prime Contractor shall provide CMU reinforcing, dowels, bond beams, jamb reinforcing, corner reinforcing, intersection reinforcing, lintel reinforcing, control joint reinforcing, and grouting required by the structural drawings. Masonry walls below slab-on-grade shall be grouted solid unless noted otherwise, and reinforced cells shall be grouted solid. Openings, recesses, and penetrations affecting reinforcing, solid-grouted areas, or dimensions 6 inches or greater shall be reviewed before construction of the affected wall.

109. The GC Prime Contractor shall provide lintels, jamb reinforcing, solid grouting, bearing, bond beam continuity, and reinforcing around masonry openings shown or required by the structural details. Openings greater than the limits of typical lintel details, or openings not specifically detailed, shall be submitted for direction before construction. Steel lintels in exterior masonry shall be hot-dip galvanized where required.

110. The GC Prime Contractor shall coordinate transitions between footing-supported structural CMU walls and slab-supported architectural CMU walls. The structural transition detail, including grouted reinforcing, wire mesh ties, caulked joint, and wall interface requirements, shall be provided at all such transitions shown or reasonably required. These transitions shall be coordinated before masonry layout and slab placement.

111. The GC Prime Contractor shall provide structural steel shop drawings, erection drawings, connection design, welding procedures, welder certifications, and required submittals before fabrication. Beam-to-beam and beam-to-column connections shall be designed for the indicated reactions, or the minimum reaction required where not indicated. Fabrication or erection performed before required review shall be at the GC’s risk.

112. The GC Prime Contractor shall provide open web steel joists, special joists, bridging, uplift bridging, bottom chord extensions, joist bearing plates, and erection stability measures required by the structural drawings and SJI requirements. Signed and sealed calculations shall be submitted for special joists before fabrication, including the required bottom chord loads, concentrated loads, uplift zones, and basketball hoop loads where indicated. Joist installation shall account for required uplift forces, edge/corner zones, bearing conditions, and stability during erection.

113. The GC Prime Contractor shall provide structural framing at roof openings, curbs, rooftop equipment supports, hung loads, and deck openings as required by the structural details. Frames are required at openings exceeding 12 inches in any dimension and at grouped smaller openings spaced less than 36 inches on center, and the bid shall include the noted unit price for a 24 inch by 24 inch opening frame. Hung equipment or piping loads exceeding 100 pounds shall be reinforced and located at joist panel points where possible, with supplemental joist reinforcing provided where required.

114. The GC Prime Contractor shall provide reinforcement of the existing glulam arches and existing roof overbuild framing shown in the structural drawings. Connections, through bolts, plates, rods, turnbuckles, LVLs, and related reinforcing shall be field measured and coordinated with existing

conditions before fabrication or installation. Any discrepancy between existing framing and the reinforcing details shall be submitted for direction before proceeding.

115. The GC Prime Contractor shall provide engineering, shop drawings, field placement drawings, product data, bracing, fastening details, and sealed calculations for exterior and load-bearing structural metal studs and connections. Stud design shall account for gravity, wind, seismic loads, cladding deflection limits, masonry veneer requirements, bracing, top/bottom track bearing, and manufacturer installation requirements. Cutting, welding, splicing, or field modifications shall comply with the structural notes and reviewed shop drawings.

2.01 HEATING, VENTINLATING, AND AIR CONDITIONING (HVAC) CONTRACT

The work of the HVAC Prime Contract Package includes, but is not limited to, the Work detailed by the following specification sections, as shown, implied and/or indicated on the documents provided and as described in the contract description. The work is not restricted by the division of drawings or specification. Unless otherwise specifically noted, all work to be performed shall consist of providing all labor, materials, equipment and other necessary requirements to complete the work in accordance with the specifications and applicable codes.

Specification	Description
a) Division 00	Procurement and Contract Requirements
b) Division 01	General Requirements
c) Division 02	Existing Conditions
d) 078400	Penetration Fire Stopping (as it applies)
e) 079200	Joint Sealants (as it applies)
f) Division 23	Heating, Ventilating, and Air-Conditioning (HVAC)

Related Sections	Description
a) Division 22	Plumbing
b) Division 26	Electrical
c) Division 28	Fire Alarm

1. The MC Prime Contractor shall provide coring, cutting, patching, sleeves, openings, and related coordination required for this Contractor's work. This includes penetrations required for mechanical ductwork, piping, refrigerant piping, condensate piping, controls, equipment supports, and mechanical accessories. Penetrations shall be coordinated with Structural, Architectural, Fire Protection, Electrical, Plumbing, and existing conditions before work proceeds.

2. The MC Prime Contractor shall comply with OSHA requirements related to working with lead and lead-painted materials. This Contractor shall take necessary measures to protect its workers, workers of other Contractors, the Owner, and the public from lead dust exposure when cutting, abrading, burning, drilling, or otherwise disturbing painted surfaces. Assume all painted surfaces contain lead unless otherwise documented.

3. The MC Prime Contractor shall expedite material and equipment submittals, with priority given to long-lead items required to meet the project schedule. This Contractor shall provide a list of all known long-lead material and equipment items and submit those items for review no later than 15 calendar days after NTP. Long-lead items include, but are not limited to, RTUs, DOAS equipment,

VRF equipment, indoor units, branch selector boxes, controls, specialty dampers, air devices, and major mechanical accessories.

4. The MC Prime Contractor shall provide complete operational mechanical systems as shown, scheduled, detailed, and reasonably inferable from the Mechanical drawings. This includes equipment, ductwork, refrigerant piping, condensate piping, controls, insulation, hangers, supports, accessories, startup, testing, and coordination required for complete systems. Mechanical work shall not be limited only to items specifically tagged where additional components are required for proper operation.

5. The MC Prime Contractor shall provide mechanical demolition required to complete the new mechanical work, including disconnection, removal, capping, relocation, and disposal of existing mechanical equipment, ductwork, piping, controls, supports, and accessories. Demolition shall include incidental removals necessary to install the new mechanical systems, even where each item is not individually tagged on the demolition drawings. Existing systems to remain shall be protected and maintained unless shutdowns are approved in advance.

6. The MC Prime Contractor shall field verify existing ductwork, piping, controls, equipment, supports, ceiling conditions, roof conditions, shafts, chases, structural framing, and available routing before fabrication or installation. Mechanical drawings are diagrammatic and shall not relieve this Contractor from coordinating actual field conditions and existing obstructions. Discrepancies affecting routing, equipment placement, service access, or system performance shall be brought to the CM’s attention before proceeding.

7. The MC Prime Contractor shall coordinate all mechanical shutdowns, tie-ins, temporary outages, system interruptions, and phased turnover requirements with the CM, Owner, and affected Prime Contractors. Shutdowns shall be scheduled to minimize disruption to school operations and shall not occur without prior approval. Temporary measures required to maintain mechanical service during approved phasing shall be included by this Contractor.

8. The MC Prime Contractor shall lead overhead MEP rough-in coordination in accordance with Specification Section 013100. This Contractor shall coordinate ductwork, piping, controls, equipment, hangers, structural supports, fire protection, plumbing, electrical conduit, lighting, ceilings, and wall construction to maintain the ceiling heights indicated on the Contract Documents. The MC shall notify the CM of ceiling height or overhead coordination conflicts before installation.

9. The MC Prime Contractor shall reference the reflected ceiling plans for areas exposed to structure and shall avoid routing systems through those locations where possible. Where mechanical systems must pass through open ceiling areas, ductwork, piping, controls, and cabling associated with this Contractor’s work shall be installed neatly, parallel or perpendicular to building lines, and in straight, coordinated runs. Final routing shall be coordinated with architectural finish intent, lighting, fire protection, electrical, and structural conditions.

10. The MC Prime Contractor shall provide all ductwork, fittings, offsets, transitions, elbows, turning vanes, balancing dampers, access doors, flexible connections, hangers, supports, insulation, and accessories required for complete air distribution systems. Duct routing shall be coordinated with structure, ceilings, lighting, sprinklers, fire alarm devices, plumbing, electrical conduit, soffits, access panels, and service clearances. Reasonable offsets and routing adjustments required to avoid field conflicts shall be included where system performance and air quantities are maintained.

11. The MC Prime Contractor shall coordinate all diffusers, grilles, registers, returns, exhaust grilles, transfer openings, and other air devices with final ceiling layouts and reflected ceiling plans. Final locations shall be coordinated with lighting, sprinkler heads, fire alarm devices, speakers, ceiling grid, soffits, access panels, and architectural features before installation. Conflicts shall be identified before ceiling rough-in or device installation proceeds.

12. The MC Prime Contractor shall provide all mechanical piping systems shown or required for complete operation, including refrigerant piping, condensate piping, heating piping where shown, valves, fittings, insulation, supports, hangers, sleeves, identification, and accessories. Piping shall be coordinated with structure, ceilings, walls, equipment service clearances, access requirements, and work of other Prime Contractors. Not all piping sizes, routing, and distribution are shown on the drawings, and this Contractor shall coordinate final routing and pipe sizing with the equipment manufacturer.

13. The MC Prime Contractor shall provide all hot refrigerant lines, cold refrigerant lines, condensate lines, controls, equipment, branch piping, fittings, accessories, insulation, and supports required for complete operational refrigerant-based systems. Not all piping sizes and distribution are shown on the drawings. Final refrigerant piping sizes, routing, branch arrangements, and installation requirements shall be coordinated with the equipment manufacturer.

14. The MC Prime Contractor shall provide the complete VRF system, including outdoor unit, branch selector box, indoor units, refrigerant piping, fittings, branch kits, service valves, insulation, condensate coordination, controls, startup, and manufacturer-required components. Refrigerant pipe sizes, lengths, branch arrangements, routing, and installation requirements shall be coordinated with and verified by the VRF equipment manufacturer. The VRF system shall be complete, tested, started, and operational.

15. The MC Prime Contractor shall provide VRF controls, control wiring, communication wiring, controllers, control interfaces, addressing, setup, programming, and manufacturer startup unless specifically indicated otherwise. Line-voltage power shall be coordinated with the Electrical Prime Contractor, but this Contractor remains responsible for complete VRF controls and communication system functionality. Control wiring and network routing shall be coordinated before wall and ceiling close-in.

16. The MC Prime Contractor shall provide roof-mounted RTU systems shown on the Mechanical drawings, including equipment, accessories, duct connections, controls, safeties, vibration isolation, service clearances, startup, and manufacturer-required components. Equipment locations, weights, duct openings, support requirements, controls, and electrical interface points shall be coordinated before procurement and installation. RTU systems shall be furnished complete and operational.

17. The MC Prime Contractor shall provide the DOAS system shown on the Mechanical drawings, including equipment, duct connections, controls, sensors, safeties, accessories, startup, and manufacturer-required installation requirements. The DOAS system shall be coordinated with roof openings, structure, electrical power, controls, fire alarm interfaces, service access, and related ductwork. The system shall be tested, started, balanced, and operational.

18. The MC Prime Contractor shall provide exhaust fans, exhaust ductwork, backdraft dampers, controls, accessories, supports, terminations, and operational coordination shown or required by

the Mechanical drawings. Exhaust fan operation shall be coordinated with associated spaces, schedules, interlocks, controls, electrical power, and any fire alarm requirements. Exhaust systems shall be complete, tested, balanced, and operational.

19. The MC Prime Contractor shall provide mechanical controls, control devices, control wiring, sensors, thermostats, controllers, actuators, dampers, safeties, network communication wiring, programming, graphics coordination, setup, checkout, and startup required for complete system operation. Controls work shall include the RTU, DOAS, VRF, fin-tube radiation where applicable, exhaust fan controls, and mechanical network tree shown on the Mechanical controls drawings. Interfaces with electrical power, fire alarm, BAS, and Owner systems shall be coordinated before procurement and startup.

20. The MC Prime Contractor shall provide the controls network architecture required for mechanical system operation, including communication wiring, addressing, device integration, programming, testing, and commissioning support. Any required interface with existing controls, Owner remote access, alarm notification, or monitoring systems shall be clarified and coordinated before procurement. The controls system shall be fully operational before final commissioning and Owner training.

21. The MC Prime Contractor shall coordinate equipment startup, both temporary and permanent, with the Electrical Prime Contractor. Electrical power, disconnects, control power, starters, fire alarm shutdowns, duct detector interfaces, and equipment energization requirements shall be coordinated before startup. Equipment shall not be energized or placed into operation until required manufacturer, safety, and project startup procedures are satisfied.

22. The MC Prime Contractor shall provide and maintain temporary heating, cooling, ventilation, and dehumidification using permanent mechanical systems for installation of architectural finishes as required by the project schedule. The Contractor shall reference the bid schedule for dates related to temporary startup of permanent systems for temporary use and shall have the systems in temporary operation by those dates. Use of permanent systems for temporary conditioning shall include required protection, filtration, monitoring, maintenance, and extended warranty provisions.

23. The MC Prime Contractor shall provide temporary heating, cooling, ventilation, and dehumidification using temporary systems from the point the building becomes weather-tight until the permanent HVAC systems are available for temporary operation. Temporary systems shall be sized, distributed, maintained, and operated to support construction, finish installation, humidity control, and protection of the Work. Temporary systems shall not damage permanent construction, finishes, equipment, or materials.

24. The MC Prime Contractor shall provide a means to remotely monitor mechanical equipment operation when equipment is placed into temporary use. Monitoring shall provide notification if equipment is not functioning properly, and this Contractor shall respond 24/7 to troubleshoot equipment operations during temporary use. This requirement applies to equipment operating for temporary heating, cooling, ventilation, or dehumidification.

25. For temporary HVAC use during construction, the MC Prime Contractor shall develop a methodology for moving air throughout the building to distribute heating, cooling, ventilation, and dehumidification. The methodology may use permanent ductwork and, if necessary, temporary ductwork to provide adequate distribution of conditioned air. Temporary air distribution shall be

coordinated with construction phasing, dust control, finish installation, equipment protection, and filter maintenance.

26. The MC Prime Contractor shall protect all return ducts, air handling equipment, outside air plenums, louvers, return registers, and related mechanical components with temporary filter media during construction and during periods of operating equipment for temporary use. Filters shall be inspected, changed, and cleaned as required for the project duration. Protection shall be maintained so construction dust and debris do not contaminate mechanical systems.

27. Upon substantial completion, or as directed by the CM, the MC Prime Contractor shall provide complete cleaning of the mechanical systems. This shall include cleaning required due to construction use, temporary operation, dust exposure, or debris accumulation. The Contractor shall provide new filters for all equipment immediately prior to Owner final acceptance.

28. The MC Prime Contractor shall provide interim maintenance of mechanical equipment during construction, startup, and temporary usage periods until acceptance by the Owner. This Contractor shall include all extended warranties required for equipment used, started, or operated before Owner acceptance, and warranties shall start at Substantial Completion of the Project. Maintenance records shall be kept during this period and turned over to the CM upon request.

29. The MC Prime Contractor shall coordinate mechanical equipment locations to maintain manufacturer-required service clearances, filter access, coil access, valve access, control panel access, and code-required working space. Access above ceilings, on roofs, and within mechanical service zones shall be reviewed before installation. Conflicts affecting serviceability shall be brought to the CM's attention before equipment is installed.

30. The MC Prime Contractor shall coordinate the size, location, weight, vibration isolation, anchorage, and housekeeping pad requirements for mechanical equipment with the GC Prime Contractor and Structural drawings. Concrete housekeeping pads and concrete curbs shown on the drawings will be provided by the GC Prime Contractor, but the MC shall provide layout, final equipment dimensions, anchor requirements, curb requirements, and manufacturer requirements before pad or curb construction. Any bases, pads, supports, or mounting provisions needed for this Contractor's installation and not shown on the drawings shall be provided by this bidder.

31. The MC Prime Contractor shall furnish mechanical equipment curbs, curb adapters, vibration isolation, rails, equipment supports, manufacturer-required mounting accessories, and equipment-specific roof support components unless specifically assigned otherwise. Final curb sizes, duct openings, equipment weights, service clearances, and penetration locations shall be coordinated with the CM, Structural, Roofing, Electrical, and other affected contractors before installation.

32. The MC Prime Contractor shall identify and coordinate roof penetrations required for ductwork, refrigerant piping, condensate piping, controls, outside air, exhaust, relief air, equipment curbs, and mechanical connections. Final opening sizes and locations shall be provided to the CM in time for coordination with structural framing, roof deck openings, blocking, curbs, flashing, and weatherproofing. Changes caused by late or inaccurate penetration information shall be the responsibility of this Contractor.

33. The MC Prime Contractor shall provide condensate drainage associated with mechanical equipment unless specifically assigned otherwise. Condensate routing, traps, cleanouts, insulation,

heat trace if required, termination points, and connection points shall be coordinated with Plumbing, Architectural, Electrical, and roof work. Condensate routing shall be finalized before ceiling close-in and prior to equipment startup.

34. The MC Prime Contractor shall provide floor, wall, and roof penetration sealants and firestopping for this Contractor's work per the Contract Documents. Firestopping materials shall be single-sourced and coordinated among all Prime Contractors, and installation and material selection shall comply with Section 07 84 00 - Firestopping. The MC shall coordinate with the GC Prime Contractor to ensure compatibility and continuity of firestopping systems across all trades.

35. The MC Prime Contractor shall provide floor, wall, and ceiling access panels required to access mechanical work installed under this bid package. Access panels shall be furnished by this Contractor and turned over to the GC Prime Contractor for installation unless specifically indicated otherwise. The MC shall coordinate access panel size, location, fire rating, ceiling type, wall type, and required service clearances before installation.

36. All painting indicated on the Mechanical drawings or required specifically for mechanical work shall be coordinated with the GC Prime Contractor. The MC shall identify mechanical items requiring painting, access requirements, sequencing, surfaces requiring protection, and any equipment or piping that must remain unpainted for manufacturer, code, labeling, or serviceability reasons. Painting performed by others shall not relieve the MC of coordination required for its work.

37. Duct detectors shall be provided by the Electrical Prime Contractor and installed by the MC Prime Contractor. The MC shall coordinate duct detector locations, access, orientation, duct size requirements, installation clearances, and connection points with the Electrical Prime Contractor and Fire Alarm requirements. Duct detector installation shall be completed before system startup where required for equipment operation or fire alarm interface.

38. The MC Prime Contractor shall coordinate smoke detector, fire alarm shutdown, safety interlock, and equipment control interface requirements with the Electrical Prime Contractor. Required contact closures, shutdown wiring, control points, and equipment interface requirements shall be identified before equipment startup. Mechanical equipment shall not be considered complete until required life-safety interfaces have been verified.

39. The MC Prime Contractor shall provide hangers, supports, anchors, inserts, vibration isolation, seismic restraints where required, supplementary steel where required for mechanical work, and miscellaneous support materials for ductwork, piping, equipment, and accessories. Supports shall be coordinated with Structural drawings, roof framing, ceiling systems, architectural finishes, and other trades. Mechanical loads shall not be hung from systems or materials not intended to support them.

40. The MC Prime Contractor shall coordinate hung mechanical loads with joist panel points, structural framing, roof deck opening frames, and supplemental reinforcement requirements. Loads from equipment, piping, ductwork, supports, and accessories shall be submitted for coordination where they affect structural framing. Supplemental support requirements resulting from this Contractor's equipment or routing shall be included by the MC unless specifically assigned otherwise.

41. The MC Prime Contractor shall provide insulation for ductwork, piping, refrigerant piping, condensate piping where required, and other mechanical systems in accordance with the Contract Documents and manufacturer requirements. Insulation shall include fittings, valves, accessories, vapor barriers, jackets, supports, protection, and continuity through concealed and exposed areas. Insulation in exposed areas shall be installed neatly and coordinated with architectural finish requirements.

42. The MC Prime Contractor shall provide mechanical identification, labeling, valve tags, equipment tags, control labels, pipe markers, flow arrows, access labels, and ceiling marker coordination required for operation and maintenance. Identification shall be coordinated with final equipment names, schedules, controls graphics, and Owner requirements. Concealed valves, dampers, and serviceable items shall be identifiable and accessible.

43. The MC Prime Contractor shall provide balancing dampers, volume dampers, control dampers, access doors, test ports, and other devices required to test, adjust, and balance the mechanical systems. Devices shall be located so they are accessible after ceiling and finish installation. Any inaccessible balancing or service device shall be relocated or provided with access by this Contractor.

44. The MC Prime Contractor shall provide system startup, manufacturer startup, pre-functional checks, controls checkout, TAB coordination, balancing support, adjustment, deficiency correction, and commissioning support for all mechanical systems. Systems shall not be considered complete until airflows, controls, safeties, equipment operation, and required sequences have been verified. The MC shall correct deficiencies identified during TAB, startup, or commissioning.

45. The MC Prime Contractor shall coordinate testing and balancing requirements with the project schedule, controls contractor, equipment manufacturers, Electrical Prime Contractor, and CM. Mechanical systems shall be complete, clean, accessible, powered, controlled, and ready before TAB begins. Rebalancing required due to incomplete work, dirty filters, unprogrammed controls, inaccessible dampers, or improper installation shall be provided by this Contractor.

46. The MC Prime Contractor shall provide Owner training for mechanical systems, including RTUs, DOAS, VRF equipment, indoor units, controls, filters, safeties, maintenance requirements, and normal operation. Training shall be coordinated with final startup, TAB completion, commissioning, and turnover of O&M documentation. Training shall include both system operation and routine maintenance requirements.

47. The MC Prime Contractor shall provide complete closeout documentation for mechanical systems, including approved submittals, O&M manuals, warranties, startup reports, controls documentation, as-built drawings, balancing reports, maintenance records, and Owner training sign-in documentation. As-built drawings shall show final routing, equipment locations, valves, controls, access points, and deviations from the Contract Documents. Closeout documents shall be submitted in the format and timeline required by the Contract Documents.

48. The MC Prime Contractor shall provide daily cleanup for its work, workers, and subcontractors. The GC Prime Contractor will provide dumpsters for contractor use, but this Contractor remains responsible for collecting and placing debris in designated containers. Mechanical debris, packaging, scrap duct, insulation, piping, refrigerant materials, filters, and removed equipment shall be removed from work areas daily.

2.02 ELECTRICAL CONSTRUCTION CONTRACT

The work of the Electrical Prime Contract Package includes, but is not limited to, the Work detailed by the following specification sections, as shown, implied and/or indicated on the documents provided and as described in the contract description. The work is not restricted by the division of drawings or specification. Unless otherwise specifically noted, all work to be performed shall consist of providing all labor, materials, equipment and other necessary requirements to complete the work in accordance with the specifications and applicable codes.

Specifications		Description
a)	Division 00	Procurement and Contract Requirements
b)	Division 01	General Requirements
c)	Division 2	Existing Conditions
d)	Division 3	Concrete (as it applies)
e)	078400	Penetration Fire Stopping (as it applies)
f)	079200	Joint Sealants (as it applies)
g)	092900	Gypsum Board Assemblies (as it applies)
h)	Division 26	Electrical
i)	Division 27	Communications
j)	Division 28	Electronic Safety and Security
k)	Division 31	Earthwork (as it applies)

Related Sections		Description
a.	Division 21	Fire Suppression
b.	Division 23	Heating Ventilation and Air-Conditioning

1. The EC Prime Contractor shall provide all electrical work shown, specified, scheduled, detailed, or reasonably inferable from the Contract Documents and as required for a complete electrical system installation, including demolition, normal power, emergency power, lighting, lighting controls, fire alarm, communications infrastructure, low-voltage pathways, security rough-in, A/V rough-in, site electrical, equipment connections, grounding, testing, labeling, and closeout. The Contractor Responsibility Chart included in the Electrical drawings shall supersede other locations describing contractor responsibilities.

2. The EC Prime Contractor shall provide all electrical demolition shown or required to complete the new work, including disconnection, removal, capping, relocation, and disposal of existing lighting, power, fire alarm, communications, site electrical, feeders, branch circuits, devices, conduit, wire, supports, panels, and related equipment. Existing electrical systems serving occupied or active areas shall remain operational unless shutdowns are approved by the Owner and CMa in advance.

3. The EC Prime Contractor shall provide all work assigned to the Electrical Contractor in the LV/AV/IT/Security responsibility matrix, including power, backboxes, conduit, pathways, cable tray, ladder rack, data cabling, data jacks, PA system, wireless clocks, fire alarm, lighting, and related electrical infrastructure. Where Security, A/V, Telecom, or Owner vendors provide devices, programming, head-end equipment, or final terminations, the EC shall still provide the electrical infrastructure assigned to the EC in the matrix.

4. The EC Prime Contractor shall provide communications work shown or specified, including data cabling, data jacks, faceplates, backboxes, conduit, cable tray, ladder rack, supports, power, and other pathway infrastructure assigned to the EC. Final punch-down, activation, network electronics, Owner programming, or equipment installation by others shall be coordinated by the EC where EC-installed infrastructure is required.

5. The EC Prime Contractor shall provide 120V power, backboxes, conduit, pathways, rough-ins, and electrical infrastructure required for card access, intrusion, monitoring, CCTV, cameras, security equipment, and door security interfaces as assigned in the responsibility matrix. Security devices, low-voltage security wiring, programming, and head-end terminations by the Security Vendor shall be fully coordinated by the EC.

6. The EC Prime Contractor shall provide A/V rough-in, power, conduit, backboxes, pathways, junction boxes, and related infrastructure required for projectors, screens, monitors, displays, cabling, and A/V equipment as assigned in the responsibility matrix. Final A/V device installation, punch-down, programming, and equipment setup by the A/V Vendor shall be coordinated by the EC where EC-installed infrastructure is required.

7. The EC Prime Contractor shall provide wiring, rough-in, power, conduit, raceways, disconnects where required, and final electrical connections to Owner-furnished or vendor-furnished equipment where indicated or required for a complete installation. This includes equipment furnished by Security, A/V, Telecom, Owner, GC, Mechanical, Plumbing, Food Service, or other vendors where electrical connection is required.

8. The EC Prime Contractor shall coordinate with the GC, door hardware supplier, Security Vendor, and Fire Alarm Vendor for power, conduit, wiring, boxes, power supplies, relays, interfaces, and testing associated with electric strikes, latch retraction, card readers, door contacts, operators, door releases, and related door security hardware. Door hardware furnished or installed by others shall not exclude EC power, rough-in, conduit, and interface responsibilities shown in the Electrical responsibility chart.

9. The EC Prime Contractor shall provide a complete fire detection and fire alarm system as indicated in the Contract Documents, including devices, wiring, pathways, panels, annunciators, notification appliances, initiating devices, monitoring interfaces, programming coordination, testing, and final acceptance. The system shall be coordinated with the fire alarm event matrix, fire protection system, duct detectors, HVAC shutdown, fire control doors, elevator recall/shunt trip where applicable, waterflow, tamper, supervisory, trouble, alarm, and notification functions.

10. The EC Prime Contractor shall operationally test the Fire Alarm System prior to AHJ inspection, and this pre-test shall be witnessed by the CMa. The EC shall provide labor and support for all AHJ fire alarm inspections and shall coordinate interface testing with Fire Protection, Mechanical, GC, Security, Elevator, and other affected contractors.

11. The EC Prime Contractor shall coordinate the fire alarm system with the Fire Protection Prime Contractor for monitoring, waterflow, tamper, supervisory, alarm, and trouble signals. The fire alarm and fire protection interface shall be completely operational and pre-tested before AHJ inspections are scheduled.

12. The EC Prime Contractor shall provide power wiring, feeders, branch circuits, disconnects, starters where required, conduit, wire, grounding, final terminations, and electrical connections for mechanical equipment shown in the Electrical and Mechanical documents. The EC shall coordinate with the Mechanical Prime using the motor wiring schedule, final approved equipment, voltage, phase, MCA, MOCP, disconnect locations, controls, service clearances, and startup requirements.

13. The EC Prime Contractor shall provide electrical power, control power, starters, relays, disconnects, fire alarm shutdown interfaces, duct smoke detector interfaces, and related electrical infrastructure required for mechanical system operation where assigned to the EC. Low-voltage control devices and control wiring furnished by the Mechanical Prime shall be coordinated with EC-provided power, conduit, boxes, relays, and interface points.

14. The EC Prime Contractor shall provide permanent power to HVAC equipment needed for temporary heating, cooling, and dehumidification by the milestone date identified in the project schedule. Permanent power required for early startup of HVAC systems shall include feeders, breakers, disconnects, terminations, control power coordination, and inspections required to safely energize the equipment.

15. The EC Prime Contractor shall provide electrical panels, switchgear, feeders, breakers, transformers, generator work where shown, metering, grounding, service work, and related long-lead electrical equipment required by the Contract Documents. Within 15 days of notice to proceed, the EC shall submit shop drawings and product information for electric panels, gear, generator, and other long-lead equipment.

16. The EC Prime Contractor shall coordinate final circuiting, panel schedules, feeders, and service capacity with the Electrical load calculation, final mechanical loads, lighting loads, receptacle loads, low-voltage equipment, Owner equipment, and vendor equipment. Any discrepancy between

final equipment requirements and the Electrical drawings shall be identified before equipment procurement or rough-in.

17. The EC Prime Contractor shall provide all lighting fixtures, drivers, LED engines, remote drivers, fixture whips, dimming wiring, mounting hardware, suspension systems, connectors, trims, lenses, adapters, and accessories required by the lighting fixture schedule. Fixture quantities, one-face/two-face exit signs, arrows, mounting conditions, and accessories shall be verified by the EC from the Contract Documents before ordering.

18. The EC Prime Contractor shall provide a complete lighting control system as required by the lighting control schedule, including occupancy sensors, vacancy sensors, daylight sensors, digital switches, dimmers, relays, timeclock controls, UL 924 devices, control wiring, programming, testing, and Owner training. Lighting control sequences shall match the scheduled requirements for each space type.

19. The EC Prime Contractor shall provide emergency lighting, exit signs, life-safety lighting controls, emergency circuits, UL 924 transfer devices, and power outage sequences required by the Electrical drawings and lighting control schedule. Emergency lighting shall be coordinated with egress routes, exit signage, architectural door locations, ceiling layouts, fire alarm/life-safety systems, and AHJ requirements.

20. The EC Prime Contractor shall provide site electrical work shown or required, including site lighting, pole lights, wall-mounted exterior fixtures, underground conduit, wire, grounding, controls, photocells, timeclock interfaces, exterior power, fixture aiming, and coordination with site/civil work. Site lighting shall be coordinated with grading, paving, landscaping, utilities, tree locations, pole foundations, accessible routes, sight lines, and photometric requirements.

21. The EC Prime Contractor shall carry the flagpole lighting scope, including fixture, power, conduit, wiring, controls, aiming, mounting coordination, and connection to the lighting control system where applicable. The fixture schedule identifies flagpole lighting as TBD, so the EC shall include a complete allowance or defined scope sufficient to provide a functional installation unless otherwise clarified by addendum.

22. The EC Prime Contractor shall coordinate with and assist the GC Prime Contractor with electrical requirements for lighted signage. The EC shall provide conduit, wire, boxes, internal wiring where applicable, disconnecting means where required, controls, and final connections for illuminated signage unless specifically assigned otherwise.

23. The GC Prime Contractor is responsible to provide and install a Knox Box if required by the AHJ, and the EC Prime Contractor shall provide any associated wiring, conduit, power, monitoring, or fire alarm/security interface required for the Knox Box. The EC shall coordinate model, location, wiring requirements, and interface requirements with the GC and Fire Marshal.

24. The EC Prime Contractor shall perform coring, cutting, and patching required for its work unless specifically assigned otherwise. The EC shall provide floor, wall, and roof penetration sealants and firestopping for its own penetrations, coordinated with the project's single-source firestopping approach.

25. The EC Prime Contractor shall provide floor, wall, and ceiling access panels required to access electrical junction boxes, pull boxes, control devices, transformers, disconnects, fire alarm modules, low-voltage devices, or other EC-installed concealed equipment. Access panels required for EC work shall be furnished by the EC and turned over to the GC Prime Contractor for installation unless otherwise directed.

26. Concrete housekeeping pads and concrete curbs shown on the drawings shall be provided by the GC Prime Contractor, but the EC shall coordinate size, layout, housekeeping pad location, anchor requirements, equipment dimensions, and clearances with the GC. Any bases, pads, supports, mounting structures, or housekeeping pads needed for EC equipment but not shown on the drawings shall be included in the EC bid package unless specifically assigned otherwise.

27. The EC Prime Contractor shall coordinate overhead electrical rough-in, conduit, cable tray, lighting, fire alarm, speakers, data, security rough-in, and supports with HVAC, Plumbing, Fire Protection, Structural, Architectural ceilings, and wall construction. The EC shall notify the CMa of any issue affecting ceiling heights, access, service clearances, or overhead routing before installation.

28. The EC Prime Contractor shall provide sleeves, conduits, pull strings, junction boxes, backboxes, cable tray, ladder rack, supports, firestopping coordination, and pathways for low-voltage systems where assigned in the responsibility matrix. Pathways shall be coordinated with Security, AV, Telecom, PA, wireless clock, fire alarm, data, WAP, CCTV, and Owner vendor requirements before wall and ceiling close-in.

29. The EC Prime Contractor shall perform Wi-Fi heat mapping throughout the building to determine optimal Wireless Access Point locations. Heat mapping shall be conducted after major wall and ceiling installations are complete but prior to final WAP placement, and a report identifying recommended WAP locations, coverage gaps, interference zones, and signal strength variations shall be submitted to the CMa and Architect for review before installation.

30. The EC Prime Contractor shall provide the public address system, speakers, amplifiers, wiring, rough-ins, wireless clocks, clock power where required, mounting, programming coordination, and final testing where indicated as EC-provided and EC-installed. Device locations shall be coordinated with ceiling layouts, fire alarm devices, lighting fixtures, mechanical diffusers, classroom layouts, and Owner operational requirements.

31. The EC Prime Contractor shall provide and maintain temporary power and lighting services required to satisfy OSHA, NFPA, NEC, AHJ, and project requirements once the building addition shell is complete. Temporary power shall connect to existing electrical infrastructure, with the

Owner paying utility consumption costs directly to the utility company. If power is not available provide portable battery operated lighting until temporary power can provide temporary lighting.

32. The EC Prime Contractor shall provide weatherproof temporary panels, weather protection for subpanels, LED temporary lighting, and three 30A breakers in the temporary electric service for use by other contractors. Temporary power shall be maintained, relocated as required, and removed when no longer needed.

33. The EC Prime Contractor shall coordinate switchover from temporary service to permanent service so ongoing construction activities and Owner operations are not disrupted. If conditions require the switchover to occur outside normal working hours, overtime shall be included with no additional compensation.

34. The EC Prime Contractor shall provide temporary electrical service to the job trailers and coordinate trailer power requirements with the GC Prime Contractor and CMa. The EC shall include all one-time costs associated with installation, maintenance, relocation if required, and removal of the trailer temporary service, with the Owner paying monthly utility usage costs unless otherwise directed.

35. The EC Prime Contractor shall include the cost for an electrical crew to be on standby for observed holidays that fall during the normal work week when other trades are working on site. Standby coverage shall include support for temporary power, lighting, shutdowns, emergency electrical issues, and construction activities requiring electrical support.

36. The EC Prime Contractor shall provide power to pigtail hook-ups and temporary or permanent electrical connections for equipment needed by other trades where such power is required to support construction or final installation. This includes coordination of voltage, amperage, breaker requirements, cord/connection type, GFCI protection, disconnecting means, and safe operation.

37. The EC Prime Contractor shall provide complete cleaning of all electrical panels, meter equipment, gear, transformers, generator, disconnects, devices, and related electrical equipment prior to final acceptance. Cleaning shall remove dust, debris, construction residue, temporary labels, packaging, and contaminants that could affect operation, safety, or appearance.

38. The EC Prime Contractor shall provide daily cleanup of debris, packaging, scrap wire, conduit cuttings, materials, and waste generated by its own forces and subcontractors. The GC Prime Contractor will provide dumpsters for use by all contractors, but the EC remains responsible for collecting and placing its debris into the appropriate disposal locations.

39. The EC Prime Contractor shall expedite all material and equipment submittals, with priority given to long-lead items needed to meet the project schedule. Shop drawings and product data for electrical panels, gear, generator, lighting fixtures, lighting controls, fire alarm, transformers, site lighting, low-voltage infrastructure, and other long-lead equipment shall be submitted early enough to support procurement and installation milestones.

40. The EC Prime Contractor shall provide system testing, verification, labeling, panel directories, circuit identification, fire alarm testing, lighting control programming, site lighting aiming, low-voltage pathway verification, as-built drawings, O&M manuals, warranties, Owner training, and closeout documentation for electrical systems. Vendor programming, security head-end terminations, telecom activation, AV startup, WAP placement, and Owner network coordination shall be supported by the EC where EC-provided infrastructure or power is required.

41. The EC Prime Contractor shall plan for and install the complete Fire Alarm System during the first available summer during the construction period. This contractor shall also provide and install code compliant FA devices in the two modular trailer classrooms at this time. The FA system shall be approved by the appropriate AHJ prior to the following school year starting. FA components installed in the new addition are the be connected to the system in a manner which does not impact the operation of the system. Should a shutdown be required, this must be approved by the CMa/Owner at least 48 hours in advance.

2.03 PLUMBING CONSTRUCTION CONTRACT

The work of the Plumbing Prime Contract Package includes, but is not limited to, the Work detailed by the following specification sections, as shown, implied and/or indicated on the documents provided and as described in the contract description. The work is not restricted by the division of drawings or specification. Unless otherwise specifically noted, all work to be performed shall consist of providing all labor, materials, equipment and other necessary requirements to complete the work in accordance with the specifications and applicable codes.

Specifications		Description
a)	Division 00	Procurement and Contract Requirements
b)	Division 01	General Requirements
c)	Division 02	Existing Conditions
d)	078400	Penetration Fire Stopping (as it applies)
e)	079200	Joint Sealants (as it applies)
f)	092100	Gypsum Board Assemblies (as it applies)
g)	Division 03	Concrete
h)	Division 22	Plumbing
i)	Division 31	Earthwork (as applies)
j)	Division 33	Water Distribution (as it applies)

Related Sections		Description
a)	Division 21	Fire Suppression
b)	Division 23	Heating, Ventilating, and Air-Conditioning (HVAC)

1. The PC Prime Contractor shall provide all plumbing work shown, noted, scheduled, detailed, specified, or reasonably inferable from the Contract Documents and as required for a complete plumbing system installation. This includes plumbing demolition, domestic cold water, domestic hot water, hot water recirculation, sanitary waste, vent piping, storm drainage, overflow drainage, roof drains, rainwater conductors, fixtures, carriers, valves, specialties, insulation, supports, testing, disinfection, startup, and closeout.

2. The PC Prime Contractor shall coordinate all plumbing work with Architectural, Structural, Mechanical, Electrical, Fire Protection, Civil, roofing, casework, ceiling, wall, and finish work prior to installation. Plumbing drawings are diagrammatic, and the PC

shall field verify dimensions, routing, clearances, elevations, existing conditions, and connection points before rough-in. Routing changes required to avoid conflicts shall be included where system performance and design intent are maintained.

3. The PC Prime Contractor shall expedite material and equipment submittals, with priority given to long-lead items needed to meet the installation dates identified in the project schedule. Submittals shall include plumbing fixtures, drains, roof drains, water heater, backflow preventer, pressure reducing valve, recirculation pump, expansion tank, wall hydrants, shock absorbers, valves, cleanouts, carriers, and other equipment or specialties required by the Plumbing drawings. Delays caused by late plumbing submittals or procurement shall be the responsibility of the PC.

4. The PC Prime Contractor shall provide plumbing demolition and relocation of services, equipment, piping, fixtures, valves, drains, vents, and appurtenances relating to the plumbing scope. Removed plumbing materials shall be reviewed with the Owner before disposal, and items not retained by the Owner shall become the PC's responsibility for legal removal from the site. Demolition shall include removal back to the points indicated or, if not indicated, back to the point of source.

5. Where existing plumbing systems must remain in service until new work is installed, the PC Prime Contractor shall maintain those systems and coordinate all interruptions with the Owner, CMa, and affected contractors in advance. The PC shall not interrupt utilities serving occupied or used facilities except when scheduled and approved. Existing plumbing systems damaged by PC demolition, disconnection, temporary work, or new work shall be repaired by the PC.

6. The PC Prime Contractor shall provide draining, refilling, venting, purging, and reactivation of domestic water systems where required for demolition, tie-ins, fixture replacement, water heater removal, water service work, and new plumbing work. When refilling, the PC shall cycle the highest fixtures to confirm the system is not air-bound. Any labor required to purge air, restore pressure, correct air-bound conditions, and return fixtures to service shall be included.

7. The PC Prime Contractor shall coordinate all plumbing shutdowns, including domestic water, hot water, hot water recirculation, sanitary, vent, storm, roof drain, overflow drain, and fixture service interruptions. Shutdowns shall be scheduled with the Owner, CMa, GC, and affected prime contractors and shall be performed at times that minimize disruption to occupied school operations. Temporary measures required to maintain plumbing service during phased work shall be coordinated and included where necessary.

8. The PC Prime Contractor shall field verify all existing sanitary, vent, domestic water, hot water, hot water recirculation, storm, overflow, sump, and roof drainage piping before demolition or new connections. Existing piping sizes, materials, elevations, inverts, routing, pressure, and serviceability shall be confirmed before tying in new plumbing work. Discrepancies between existing conditions and the drawings shall be reported before installation proceeds.

9. The PC Prime Contractor shall provide all plumbing work associated with connecting new fixtures to existing pipe connections where indicated. This includes verifying existing

piping condition, confirming capacity and code compliance, providing adapters, valves, traps, vents, rough-ins, supports, and making final connections. Existing connections that are reused shall be cleaned, tested, and restored to proper operation.

10. The PC Prime Contractor shall provide complete replacement of plumbing fixtures identified for in-kind replacement, including removal, rough-in adjustments, fixture installation, trim, flush valves, faucets, strainers, stops, traps, carriers, supports, escutcheons, mixing valves, protective covers, and final testing. Existing piping connections intended for reuse shall be verified and adapted as required. Fixture replacement shall be coordinated with wall, floor, casework, toilet partition, accessory, and finish work.

11. The PC Prime Contractor shall provide piping behind cabinets and casework where indicated, including new piping serving science classroom sinks and other casework-mounted fixtures. The PC shall coordinate routing, fixture rough-ins, access, cabinet openings, escutcheons, trap locations, supply stops, ADA clearances, and serviceability with the GC casework scope before fabrication and installation. Rework caused by failure to coordinate with casework shall be the PC's responsibility.

12. The PC Prime Contractor shall remove existing service sinks, water piping, valves, vent piping, and sanitary piping where indicated, including capping sanitary piping below floor and disconnecting from existing vent piping. Plumbing-specific cutting, capping, temporary support, drain-down, and make-safe work necessary for this demolition shall be included. Associated slab, wall, or floor patching shall be coordinated with the GC, but plumbing terminations and abandonment shall be by the PC.

13. The PC Prime Contractor shall remove the existing water heater, piping, and appurtenances where indicated and shall coordinate reconnection of existing hot water piping and capping of existing cold water piping at the main. The PC shall provide new domestic electric water heater work shown on the schedules and details, including piping, valves, relief piping, expansion tank, aquastat, recirculation pump coordination, drain valve, insulation, and final testing. Where the Plumbing details identify a concrete pad "by P.C.," that pad shall be provided by the PC unless specifically reassigned.

14. Concrete housekeeping pads and concrete curbs shown on Architectural, Structural, or GC scope drawings shall be provided by the GC Prime Contractor unless specifically identified in the Plumbing drawings as by the PC. The PC shall coordinate pad size, layout, equipment dimensions, anchor requirements, clearances, drain locations, and service access with the GC before pad construction. Any bases, pads, supports, curbs, or housekeeping pads needed for the PC's installation but not shown on the drawings shall be included in the PC bid package unless specifically assigned otherwise.

15. The PC Prime Contractor shall provide domestic water service work shown, including the 2-1/2 inch domestic water service, coordination with Civil continuation, connection to existing water piping, and connection to existing 1-1/2 inch cold water in the basement where indicated. The PC shall coordinate service entry, sleeves, valves, backflow preventer, pressure reducing valve, drains, clearances, and access before installation. Any discrepancy between Civil service routing and interior plumbing connection points shall be resolved before rough-in.

16. The PC Prime Contractor shall provide the backflow preventer assembly, water pressure reducing valve, discharge piping, drain valves, threaded caps, testing, certification, and authority coordination required for a complete domestic water service installation. The riser indicates incoming pressure reduced from 90 psi to 70 psi, and the scheduled WPRV and BFP shall be installed with required access and service clearances. Discharge from the BFP shall be piped to the floor drain as shown.

17. The PC Prime Contractor shall provide new ball isolation valves on all branch piping as noted on the domestic water drawings. Valves shall be accessible and coordinated with ceilings, chases, casework, walls, access panels, and maintenance requirements. Isolation valves omitted due to routing or space constraints shall be corrected by the PC.

18. The PC Prime Contractor shall provide a complete domestic hot water and hot water recirculation system as shown, including hot water piping, recirculation piping, recirculation pump, aquastat, valves, balancing/access provisions, insulation, and connection to fixtures. Recirculation piping shall be routed and adjusted as required to maintain the design intent and hot water availability at served fixtures. Pump power and controls shall be coordinated with the Electrical Prime.

19. The PC Prime Contractor shall provide all sanitary waste and vent piping shown, including below-slab piping, above-slab piping, fixture branches, vents through roof, cleanouts, floor drains, and connections to existing or civil-installed sanitary piping. Sanitary piping shall be installed in accordance with applicable IPC slope requirements and coordinated with structural footings, slab depressions, floor drains, casework, and wall construction. Inverts and connection elevations shall be verified before installation.

20. The PC Prime Contractor shall provide under-slab plumbing work required for the plumbing scope, including layout, sawcutting slab-on-grade, excavation, trenching, pipe installation, bedding, backfill, compaction, vapor barrier restoration where encountered, and slab patching. Under-slab plumbing shall be coordinated with Structural details, footing locations, pipe sleeve requirements, slab reinforcement, floor drain locations, and finished floor elevations. Existing slab patching associated with PC under-slab work shall be included in the PC scope unless specifically assigned otherwise.

21. The PC Prime Contractor shall coordinate piping below or through structural footings, slabs, and walls with the Structural drawings and details before installation. Sleeves, trench backfill, lean concrete fill, supplemental reinforcing coordination, slab patching, dowels coordination, vapor barrier restoration, and footing separation requirements shall be included where piping conflicts with structural elements. Undocumented pipe penetrations, sleeves, or trenches affecting structural work shall be reviewed before installation.

22. The PC Prime Contractor shall provide cleanouts in the locations shown and as otherwise required by code for maintainable sanitary and storm systems. Cleanout access shall be coordinated with walls, floors, casework, corridors, finishes, access panels, and architectural features. Cleanouts concealed or made inaccessible by other work shall be relocated or provided with access at the PC’s expense if not coordinated before close-in.

23. The PC Prime Contractor shall provide complete storm drainage and roof drainage

systems shown, including roof drains, overflow drains, rainwater conductors, downspout nozzles, cleanouts, and piping to daylight or Civil continuation points. Storm piping shall be coordinated with roof drain locations, roof slopes, structural framing, ceilings, walls, Civil storm connections, and exterior discharge locations. Flow rates and pipe sizes indicated on the risers shall be maintained unless otherwise approved.

24. The PC Prime Contractor shall coordinate installation of roof drains, overflow drains, vents through roof, roof drain bodies, clamps, domes, overflow components, strainers, and plumbing accessories with the GC Prime Contractor, roofing contractor, Structural drawings, and Architectural roof details before installation. Roof penetrations shall be located and submitted early enough to avoid framing, roofing, and insulation conflicts. Final roof flashing and roof membrane integration shall be coordinated with the roofing scope, but the plumbing drain bodies and plumbing accessories shall be provided by the PC.

25. The PC Prime Contractor shall provide overflow drain piping to daylight where shown, including coordination of wall penetrations, downspout nozzles, exterior terminations, discharge locations, and Civil grading. Overflow discharge locations shall not conflict with doors, sidewalks, accessible routes, landscaping, building envelope detailing, or other site features. Final exterior discharge conditions shall be coordinated before wall or façade construction is complete.

26. The PC Prime Contractor shall provide all plumbing fixtures and specialties listed in the fixture, drain, wall hydrant, shock absorber, pump, backflow preventer, expansion tank, water heater, and pressure reducing valve schedules. Schedules do not represent quantities, and the PC shall determine actual quantities from the plans, risers, enlarged plans, and details. Fixture packages shall include carriers, supports, flush valves, faucets, ASSE 1017 mixing valves where indicated, stops, supplies, traps, protective covers, strainers, tailpieces, escutcheons, and required accessories.

27. The PC Prime Contractor shall provide wall hydrants, wall faucets, hose bibbs, wall hydrant abandonment, and associated piping shown in the Plumbing drawings. Where existing wall hydrants are disconnected and abandoned, the PC shall remove piping back to the main where indicated and cap the system. New wall hydrants shall be coordinated with exterior wall construction, insulation, freeze protection, access, and finish locations.

28. The PC Prime Contractor shall provide shock absorbers/water hammer arrestors sized in accordance with the Plumbing Drainage Institute fixture unit schedule shown. Shock absorbers shall be located to serve fixture groups and branch piping as required for a complete domestic water system installation. Locations shall remain accessible where required and shall be coordinated with walls, chases, ceilings, and access panels.

29. The PC Prime Contractor shall provide floor, wall, and roof penetration sealants and firestopping for this contractor’s work in accordance with the Contract Documents. Firestopping shall be coordinated with the project’s single-source firestopping approach between all prime contractors. The PC shall provide fireproof pipe sleeves at all new piping penetrations through fire-rated walls and floors as required by the Plumbing drawings.

30. The PC Prime Contractor shall provide cutting, coring, sawcutting, and patching related to the work of this bid package unless specifically assigned otherwise. Penetrations shall be coordinated with Architectural, Structural, Mechanical, Electrical, Fire Protection, GC, roofing, and Civil work before coring or installation. The PC shall not cut or core structural elements without prior coordination and approval where required.

31. The PC Prime Contractor shall provide floor, wall, and ceiling access panels required for access to valves, cleanouts, shock absorbers, traps, piping, controls, or other plumbing components installed above ceilings, behind walls, or within chases. Access panels required for PC work shall be furnished by the PC and turned over to the GC Prime Contractor for installation unless otherwise directed. Locations shall be coordinated with the Architect, GC, wall ratings, ceilings, finishes, casework, and code-required access clearances before close-in.

32. The PC Prime Contractor shall coordinate overhead plumbing rough-in with HVAC, Electrical, Fire Protection, Structural, Architectural ceilings, wall construction, and ceiling framing to maintain ceiling heights indicated on the Contract Documents. This includes storm piping, sanitary piping, vent piping, domestic water piping, hot water recirculation, valves, cleanouts, and hangers/supports. The PC shall notify the CMa of any issue affecting ceiling heights, access, routing, slope, or serviceability before installation.

33. The PC Prime Contractor shall coordinate plumbing rough-ins with toilet partitions, toilet accessories, wall-hung fixture carriers, casework, countertops, ADA clearances, floor drains, wall chases, and finished wall locations. Fixture carrier layout, wall thicknesses, chase dimensions, and rough-in elevations shall be confirmed before wall construction and slab work proceed. Rework resulting from failure to coordinate fixture rough-ins with architectural layouts shall be the PC’s responsibility.

34. The PC Prime Contractor shall install all equipment in accordance with manufacturer’s written instructions. Manufacturers and model numbers indicated are basis of design, and any substitution shall meet the intent of the specifications and drawings. Any design, dimensional, electrical, architectural, structural, maintenance-clearance, or coordination changes required by a substitution shall be the responsibility of the PC unless approved otherwise before procurement.

35. The PC Prime Contractor shall coordinate plumbing work with the Electrical Prime for equipment requiring power, including electric water heater, recirculation pump, bottle fillers/water coolers, trap primers if applicable, and any other plumbing equipment requiring electrical service. The PC shall provide final equipment electrical requirements, voltage, phase, amperage, disconnect requirements, and location information early enough for EC rough-in. Final plumbing startup shall be coordinated with electrical energization.

36. The PC Prime Contractor shall provide testing, inspection, flushing, disinfection, certification, and commissioning support required for domestic water, sanitary, vent, storm, roof drainage, backflow prevention, water heater, and plumbing fixture systems. The PC shall correct leaks, failed tests, improper slopes, air-bound systems, inaccessible valves, blocked drains, and non-functioning fixtures before requesting final inspection.

Required authority inspections and backflow certifications shall be coordinated by the PC.

37. The PC Prime Contractor shall provide labeling, valve tags, equipment tags, pipe identification, system identification, and direction-of-flow markers as required by the Contract Documents and applicable codes. Isolation valves, balancing valves, recirculation components, backflow preventer, pressure reducing valve, water heater, cleanouts, and major plumbing equipment shall be identified for maintenance. Final valve charts and plumbing identification shall be included in closeout documentation where required.

38. The PC Prime Contractor shall provide daily cleanup of debris, packaging, scrap pipe, fittings, insulation, supports, and waste generated by its own forces and subcontractors. The GC Prime Contractor will provide dumpsters for use by all contractors, but the PC remains responsible for collecting and placing its debris into the appropriate disposal locations. Plumbing work areas, chases, mechanical rooms, corridors, and occupied-adjacent areas shall be kept safe and orderly.

39. The PC Prime Contractor shall provide as-built drawings, approved submittals, O&M manuals, warranties, test reports, backflow certifications, disinfection reports, startup documentation, fixture cut sheets, valve information, and Owner training for plumbing systems. Closeout shall include documentation for domestic water, hot water, recirculation, sanitary, vent, storm, roof drains, overflow drains, fixtures, water heater, pressure reducing valve, backflow preventer, and recirculation pump. Final acceptance shall not be requested until plumbing systems are tested, operational, labeled, cleaned, documented, and ready for Owner use.

2.04 FIRE PROTECTION CONSTRUCTION CONTRACT

The work of the Fire Protection Prime Contract Package includes, but is not limited to, the Work detailed by the following specification sections, as shown, implied and/or indicated on the documents provided and as described in the contract description. The work is not restricted by the division of drawings or specification. Unless otherwise specifically noted, all work to be performed shall consist of providing all labor, materials, equipment and other necessary requirements to complete the work in accordance with the specifications and applicable codes.

Specifications		Description
a)	Division 00	Procurement and Contract Requirements
b)	Division 01	General Requirements
a)	Division 02	Existing Conditions
b)	078400	Fire Stopping (as it applies)
c)	079200	Joint Sealants (as it applies)
c)	Division 21	Fire Suppression

Related Sections		Description
a)	Division 28	Electronic Safety and Security

1. The FP Prime Contractor shall design, fabricate, install, test, and secure approvals for a complete automatic fire sprinkler system as required by the Fire Protection drawings, NFPA 13, and authorities having jurisdiction. The scope shall include engineering, shop drawings, hydraulic calculations, permits, inspections, approvals, materials, labor, hangers, supports, valves, trim, drains, tests, and all items required for a complete and code-compliant installation.

2. The FP Prime Contractor shall perform a comprehensive field survey of existing conditions prior to design, fabrication, or installation. The survey shall verify existing sprinkler conditions, existing building conditions, floor layout changes, ceiling conditions, structural conditions, service entry conditions, and coordination requirements with other trades.

3. The FP Prime Contractor shall determine all sprinkler head locations, pipe routing, branch line sizing, main direction changes, offsets, and modifications required to accommodate the final floor plans and ceiling layouts. Sprinkler piping and head layouts shown on the drawings are diagrammatic and shall be finalized by the FP Prime Contractor through delegated design.

4. The FP Prime Contractor shall submit sprinkler working plans, hydraulic calculations, product data, materials lists, details, and sections to the design team and CMa for review

prior to making field modifications or submitting to the AHJ. Working plans and hydraulic calculations shall be prepared in accordance with NFPA 13 and signed and sealed by a Pennsylvania-licensed Professional Engineer who shall be responsible for the final sprinkler system design.

5. The FP Prime Contractor shall submit all required sprinkler documentation to the authorities having jurisdiction and obtain required approvals before installation. This includes working plans, hydraulic calculations, water supply data, product data, specifications, permit applications, inspection requests, and any additional documentation required by the Fire Marshal, Fire Subcode Official, or other reviewing authority.

6. The FP Prime Contractor shall provide a current code-compliant hydrant water flow test prior to performing final hydraulic calculations. The FP shall coordinate with the local utility company to verify available pressure, available flow, seasonal restrictions, and any water supply limitations prior to final design.

7. The FP Prime Contractor shall design the sprinkler system with a 20 percent margin of safety for both available water flow and pressure. Any pipe sizing, layout revisions, design changes, or added components required to achieve this safety margin shall be included in the FP scope.

8. The FP Prime Contractor shall verify hazard classifications and provide sprinkler coverage for all areas based on the classifications shown and required by NFPA 13. Light hazard and ordinary hazard areas shall be confirmed against final room use, storage areas, stages, equipment rooms, service spaces, corridors, classrooms, offices, and other occupancy conditions before final design.

9. The FP Prime Contractor shall make all necessary modifications to the sprinkler system required by updated floor plans, ceiling layouts, architectural changes, mechanical obstructions, lighting locations, ductwork, piping, structural elements, or other field conditions. These modifications shall maintain or improve required coverage, hydraulic performance, and code compliance.

10. The FP Prime Contractor shall include an allowance for a minimum of 10 percent additional sprinkler heads to provide adequate coverage where mechanical, architectural, structural, ceiling, ductwork, piping, lighting, or field obstructions require added heads. The allowance shall include associated piping, fittings, hangers, labor, testing, and coordination required to make the added heads functional.

11. The FP Prime Contractor shall provide sprinkler coverage above and below slat ceilings where required to fully cover the space. This includes upright sprinkler heads above and pendant sprinkler heads below the slat ceiling system, coordinated with Architectural ceiling details, lighting, HVAC diffusers, ductwork, and structure.

12. The FP Prime Contractor shall provide sprinkler coverage for skylight areas, including sprinkler heads with appropriate temperature ratings. Skylight protection shall be coordinated with Architectural skylight details, roof framing, ceiling geometry, glazing conditions, and surrounding obstructions.

13. The FP Prime Contractor shall coordinate sprinkler piping and head locations with all trades before installation, including lighting, HVAC equipment, ductwork, structural framing, ceilings, electrical equipment, plumbing piping, architectural features, and access requirements. Overhead coordination shall begin with the overhead coordination process led by the HVAC Prime, and the FP shall notify the CMa of any issue affecting ceiling heights, access, routing, or serviceability before installation.

14. The FP Prime Contractor shall provide coordination drawings showing all trades as required by the Fire Protection notes. Sprinkler piping shall be held tight to the underside of slab, steel, or wood unless otherwise required, and routing shall not reduce ceiling heights or conflict with required access, lighting, diffusers, structural elements, or architectural ceiling conditions.

15. The FP Prime Contractor shall conceal sprinkler piping in areas with finished ceilings and may expose piping only in storage and service areas where permitted by the Contract Documents. Exposed piping shall be routed as close as practical to the ceiling or structure and coordinated with other overhead systems.

16. The FP Prime Contractor shall provide the complete 6-inch fire protection service scope shown, including coordination with the Civil continuation and termination 5 feet from the building edge. The FP shall coordinate service depth, cover, entry location, sleeves, thrust restraint, backflow preventer, riser, valves, drains, FDC piping, and utility interfaces before installation.

17. The FP Prime Contractor shall provide the complete sprinkler service piping arrangement shown, including RPZ backflow preventer, alarm check valve, main shutoff valve, OS&Y valve, pressure gauges, flow switch, tamper switch, supervisory switches, drains, inspector’s test, FDC piping, and all required trim. Required valve trim shall include the complete manufacturer-required trim package and all appurtenances needed for a complete operating system.

18. The FP Prime Contractor shall provide the Fire Department Connection and coordinate thread size, connection type, location, signage, access, and acceptance requirements with the local Fire Department and AHJ. Any adjustments required by the local fire department for connection type, thread, location, signage, or access shall be included in the FP coordination scope.

19. The FP Prime Contractor shall continue the 4-inch sprinkler main to the edge of the addition and cap it for future consideration of sprinkler coverage in the existing building where shown. The capped future connection shall include required valve, cap, support, identification, access, testing, and coordination so it does not interfere with the current system operation or future extension.

20. The FP Prime Contractor shall provide inspector’s test connections and drains in accordance with NFPA 13, including a minimum of one inspector’s test station per zone at the highest hydraulic demand area. Test and drain discharge locations shall be coordinated with exterior walls, grade, drainage, access, signage, architectural finishes, and adjacent site conditions.

21. The FP Prime Contractor shall provide all flow switches, tamper switches, supervisory switches, pressure gauges, monitored valves, valve seals, signs, tags, charts, and hydraulic placards required by NFPA 13 and the Fire Protection drawings. Fire alarm monitoring points shall be coordinated with the Electrical Prime so alarm, supervisory, and trouble signals are properly wired, programmed, tested, and accepted.

22. The FP Prime Contractor shall coordinate fire alarm system deactivation, activation, testing, and restoration associated with sprinkler tamper switches, flow switches, supervisory devices, and system impairments. Flush and fill, pre-testing, testing, and fire alarm interface requests shall be made at least 72 hours in advance to the Electrical Prime, CMa, and Owner when the fire alarm system is impacted.

23. The FP Prime Contractor shall coordinate all flushing, filling, pre-testing, acceptance testing, fire alarm testing, and final inspections with the Electrical Prime, CMa, Owner, Fire Protection reviewers, and AHJ. The FP shall provide all labor, tools, equipment, water flow coordination, retesting, and documentation required to complete and pass inspections.

24. The FP Prime Contractor shall coordinate project schedule, work times, system downtime, impairments, fire watch requirements, testing dates, and inspections with the local authorities having jurisdiction at least two weeks before fire protection work starts. Maximum sprinkler system downtime shall not exceed the duration stated in the Fire Protection drawings unless specifically approved by the Owner and AHJ.

25. The FP Prime Contractor shall provide fire watch coordination and comply with all AHJ fire watch procedures during sprinkler system downtime, impairments, testing, deactivation, and reactivation. Fire watch requirements shall be followed exactly as directed by the local authority having jurisdiction. Shall maintain fire protection in all existing areas throughout construction.

26. The FP Prime Contractor shall provide cutting, coring, and patching required for work related to this bid package, including wall, ceiling, floor, and roof openings necessary for sprinkler piping, sleeves, risers, drains, and supports. The FP shall reference and comply with OSHA requirements related to working with lead or lead-painted materials where encountered.

27. The FP Prime Contractor shall provide sealants and through-penetration firestopping for all fire protection penetrations through fire-rated walls, floors, roofs, and assemblies. Firestopping shall be coordinated with the project’s single-source firestopping approach among all primes and shall provide a fire rating equal to the construction being penetrated.

28. The FP Prime Contractor shall provide hoods or shields above electrical equipment in electrical rooms where required by the Fire Protection drawings and applicable code. This work shall be coordinated with the Electrical Prime, equipment layouts, service clearances, sprinkler head locations, and NFPA requirements before installation.

29. Concrete housekeeping pads or concrete curbs shown on Architectural, Structural, or GC scope drawings shall be provided by the GC Prime Contractor unless specifically indicated otherwise. The FP Prime Contractor shall coordinate and provide layout for

shown pads and curbs, and any bases, pads, supports, or curbs needed for FP installation but not shown on the drawings shall be provided by this bidder.

30. The FP Prime Contractor shall expedite design, engineering, product data, hydraulic calculations, and shop drawing submittals to meet the installation dates identified in the project schedule. Delays caused by late FP design, late AHJ submission, late shop drawings, or late procurement shall be the responsibility of the FP Prime Contractor.

31. The FP Prime Contractor shall provide all required valve identification, permanent signs, brass tags, chains, padlocks, hydraulic basis of design placards, valve charts, and approved sprinkler system diagrams. Identification shall comply with NFPA 13 and shall be complete before final acceptance.

32. The FP Prime Contractor shall furnish extra sprinkler heads, sprinkler head cabinets, and associated wrenches in the quantities required by the Fire Protection drawings and NFPA 13. Spare heads shall match the types, temperature ratings, finishes, and installation conditions used in the final system.

33. The FP Prime Contractor shall provide all required flushing, hydrostatic testing, retesting, inspections, and MIC water supply testing required by NFPA 13 and the Fire Protection drawings. Failed tests, leaks, inadequate drains, device failures, or deficiencies shall be corrected and retested by the FP Prime Contractor.

34. The FP Prime Contractor shall secure final acceptance from the Fire Subcode Official and provide copies of the final acceptance letter to the Architect, Owner, and CMa. Final acceptance shall not be requested until the system is complete, flushed, tested, inspected, labeled, documented, and accepted by applicable authorities.

35. The FP Prime Contractor shall provide updated as-built drawings showing the final sprinkler system configuration, including head locations, piping routes, main locations, branch lines, valves, drains, inspector’s tests, FDC, service entry, and approved field modifications. As-built drawings shall reflect delegated design decisions, field coordination changes, and approved AHJ revisions.

36. The FP Prime Contractor shall provide a compliance report confirming that the completed sprinkler system meets NFPA standards, AHJ requirements, hydraulic design requirements, and approved working plans. Revised hydraulic calculations, engineering analyses, test reports, inspection reports, and acceptance documentation required by code or project specifications shall be included in closeout documentation.

37. The FP Prime Contractor shall provide O&M manuals, record drawings, approved as-built sprinkler diagrams, valve charts, warranties, test reports, inspection reports, spare head cabinet documentation, and Owner training. Closeout materials shall be complete before final payment and shall be provided in the quantity and format required by the Contract Documents.

38. The FP Prime Contractor shall provide daily cleanup of debris, packaging, scrap pipe, fittings, insulation, hangers, and waste generated by its own forces and subcontractors. The GC Prime Contractor will provide dumpsters for use by all contractors, but the FP

remains responsible for collecting and placing its debris into the appropriate disposal locations.

END OF SECTION

SECTION 012100

ALLOWANCES

PART 1 GENERAL

1.1 SUMMARY

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

B. Section includes administrative and procedural requirements governing allowances.
   1. Certain items are specified in the Contract Documents by allowances. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when direction will be provided to Contractor. If necessary, additional requirements will be issued by Change Order. Allowances are to be used at the sole discretion of the Owner. Any unused allowance will be credited back to the Owner via a deduct change order.
   2. Contractor Markup: Prime Contractors shall not be entitled to additional overhead, profit, or other markup on labor, material, equipment, or subcontractor costs charged to an allowance. Sub-tier contractor markups, if any, shall be limited to amounts permitted by the Contract Documents and shall be included within the applicable allowance unless the Owner expressly authorizes otherwise by Change Order.

C. Types of allowances include the following:
   1. Contingency allowances.

D. Related Requirements:
   1. Section 01 22 00 "Unit Prices" for procedures for using unit prices.

1.2 SELECTION AND PURCHASE

A. At the earliest practical date after award of the Contract, advise Architect of the date when final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.

B. As applicable and at CMa's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.

1.3 ACTION SUBMITTALS

A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.

1.4 INFORMATIONAL SUBMITTALS

A. Submit invoices or delivery slips to show actual quantities of materials delivered to the site for use in fulfillment of each allowance.

B. Submit time sheets and other documentation to show labor time and cost for installation of allowance items that include installation as part of the allowance.

C. Coordinate and process submittals for allowance items in same manner as for other portions of the Work.

1.5 COORDINATION

A. Coordinate allowance items with other portions of the Work. Furnish templates as required to coordinate installation.

1.6 CONTINGENCY ALLOWANCE

A. Use the contingency allowance only upon prior written authorization by the Owner issued through the CMa and only by Change Order that identifies the amount to be charged to the allowance.

B. Use of allowance will be authorized on a unit price, T&M or Lump Sum basis at the Owners sole option.

C. The Prime Contractor's overhead and profit for allowance work are included in the Contract Sum and shall not be charged against or added to the contingency allowance.

D. Each Prime Contractor's proposed Schedule of Values submitted for approval shall list the designated contract allowance as separate line items.

E. Each Prime Contractor shall proceed with all allowance work upon authorization from the Owner through CMa. When authorized on a unit price or T&M basis, the work shall be properly documented on a daily basis by Prime submissions of field tickets to the CMa for signature to verify the hours of work performed or other approved measure. Each ticket shall have a unique number listed that will be referenced during allowance reconciliation. The Owner, at their option, may reach an agreement with the Prime Contractor on a lump sum cost of the work, or a unit rate, at which the Prime Contractor shall perform the entire scope of work. The scope of the work is all inclusive and includes all labor, equipment, supervision, OSHA Safety compliance, materials and any other special conditions notated in the project documents.

F. The Owner retains sole control over the allowance amount in the contract. Upon completion of the authorized work- with a positive balance remaining for the allowance the Owner shall apply a contract credit in the form of a Change Order to each Prime's contract for the full remaining amount. If the allowance is exhausted, the Prime Contractor shall not perform additional allowance work or incur costs in excess of the allowance without the Owner's prior written authorization. Any work properly authorized by the Owner that exceeds

the allowance amount shall be addressed by Change Order and shall be subject to the Contract Documents governing allowable costs and markups.

1.7 ADJUSTMENT OF ALLOWANCES

A. Allowance Adjustment: Reconcile each allowance by Change Order based on actual, properly documented, Owner-authorized costs chargeable to the allowance. Any unused balance shall be credited to the Owner in full. No amount in excess of an allowance shall be added to the Contract Sum unless authorized in writing by the Owner in accordance with the Contract Documents.
   1. Submit substantiation of a change in scope of work, if any, claimed in Change Orders related to allowance adjustments.
   2. Owner reserves the right to establish the quantity of work-in-place by independent quantity survey, measure, or count.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine products covered by an allowance promptly on delivery for damage or defects. Return damaged or defective products to manufacturer for replacement.

3.2 PREPARATION

A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

A. Allowance No. 1: Existing/Unforeseen Conditions Conditions (GC).
   1. General Construction Prime Contractor shall include this allowance in the base bid.
   2. Amount: $100,000.

B. Allowance No. 2: Existing/Unforeseen Conditions (MC).
   1. Mechanical Prime Contractor shall include this allowance in the base bid.
   2. Amount: $25,000.

C. Allowance No. 3: Existing/Unforeseen Conditions (EC).
   1. Electrical Prime Contractor shall include this allowance amount in the base bid.
   2. Amount: $25,000.

D. Allowance No. 4: Existing/Unforeseen Conditions (PC).
   1. Plumbing Prime Contractor shall include this allowance in the base bid.
   2. Amount: $10,000.

E. Allowance No. 5: Existing/Unforeseen Conditions (FPC).
   1. Fire Protection Prime Contractor shall include this allowance in the base bid.
   2. Amount: $10,000.

END OF SECTION

SECTION 012200

UNIT PRICES

PART 1 GENERAL

1.1 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.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes administrative and procedural requirements for unit prices.

D. Related Sections include the following:
   1. Division 01 Section "Contract Modification Procedures" for procedures for submitting and handling Change Orders.

1.3 DEFINITIONS

A. Unit price is an amount proposed by bidders, stated on the Bid Form, as a price per unit of measurement for materials or services added to or deducted from the Contract Sum by appropriate modification, if estimated quantities of Work required by the Contract Documents are increased or decreased. Unit prices shall be utilized for required changes in the work during construction as authorized by the Architect and Owner. Unit prices shall not be utilized for the quantities of work shown in the bid documents.

1.4 PROCEDURES

A. Unit prices shall include all necessary material, plus cost for delivery, installation, insurance, applicable taxes, overhead, and profit.

B. Measurement and Payment: Refer to individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A list of unit prices is included in Part 3. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 LIST OF UNIT PRICES

A. G Unit Prices.
   1. Unit Price No. G1 - Acoustic Ceiling.
      a. Description: Installation of ACT-1 tiles and grid.
      b. Unit of Measurement: 100 SF.
   2. Unit Price No. G2 - Ceiling Paint.
      a. Description: Include GWB preparation, priming and finish coat of P-CLG.
      b. Unit of Measurement: 100 SF.
   3. Unit Price No. G3 - Wall Paint.
      a. Description: Include wall preparation, priming and finish coat of P-1.
      b. Unit of Measurement: 100 SF.
   4. Unit Price No. G4 - VCT.
      a. Description: Include floor preparation and installation of RF-1, RF-2, RF-3, RF-4, RF-5 classroom mix percentages per finish schedule.
      b. Unit of Measurement: 100 SF.
   5. Unit Price No. G5 - Gym Floor.
      a. Description: Include floor preparation and installation of RF-6 per finish schedule.
      b. Unit of Measurement: 100 SF.
   6. Unit Price No. G6 - Tile-1.
      a. Description: Include wall preparation and installation of T-1.
      b. Unit of Measurement: 100 SF.
   7. Unit Price No. G7 - Tile-2.
      a. Description: Include wall preparation and installation of T-2.
      b. Unit of Measurement: 100 SF.
   8. Unit Price No. G8 - Tile-3.
      a. Description: Include wall preparation and installation of T-3.
      b. Unit of Measurement: 10 SF.
   9. Unit Price No. G9 - Wall Base.
      a. Description: Include installation of wall base, B-1.
      b. Unit of Measurement: 10 LF.
   10. Unit Price No. G10 - Epoxy Floor-1.
      a. Description: Include floor preparation and installation of EP-1.
      b. Unit of Measurement: 10 SF.
   11. Unit Price No. G11 - Insulated Glazing Unit.
      a. Description: Include preparation and installation of GLS-1 including new exterior storefront framing.
      b. Unit of Measurement: 10 SF.
   12. Unit Price No. G12 - Insulated Glazing Unit.
      a. Description: Include preparation and installation of GLS-2 including new interior

storefront framing.
b. Unit of Measurement: 10 SF.

13. Unit Price No. G13 - Insulated Glazing Unit.
    a. Description: Include preparation and installation of GLS-3 including new exterior storefront framing.
    b. Unit of Measurement: 10 SF.
14. Unit Price No. G14 - Insulated Glazing Unit.
    a. Description: Include preparation and installation of GLS-4 including new interior storefront framing.
    b. Unit of Measurement: 10 SF.
15. Unit Price No. G15 - GWB Partition.
    a. Description: Include installation of partition type A6DS to 10'-0" A.F.F.
    b. Unit of Measurement: 10 LF.
16. Unit Price No. G16 - GWB Partition.
    a. Description: Include installation of partition type B3D to 10'-0" A.F.F.
    b. Unit of Measurement: 10 LF.
17. Unit Price No. G17 - CMU Partition.
    a. Description: Include installation of partition type M2D to 10'-0" A.F.F.
    b. Unit of Measurement: 10 LF.
18. Unit Price No. G18 - CMU Partition.
    a. Description: Include installation of partition type M8D to 10'-0" A.F.F.
    b. Unit of Measurement: 10 LF.
19. Unit Price No. G19 - CMU Partition.
    a. Description: Include installation of partition type P8D to 10'-0" A.F.F.
    b. Unit of Measurement: 10 LF.
20. Unit Price No. G20 - Existing Slab Trenching/Removal.
    a. Description: Include removal of existing concrete slab and subgrade to a depth of 2’-0” below finish floor.
    b. Unit of Measurement: 10 SF.
21. Unit Price No. G21 - Masonry Veneer Type RS.
    a. Description: Include installation of exterior modular masonry veneer.
    b. Unit of Measurement: 50 SF.
22. Unit Price No. G22 - Masonry Veneer Type UB.
    a. Description: Include installation of exterior modular masonry veneer.
    b. Unit of Measurement: 50 SF.
23. Unit Price No. G23 - Masonry Veneer Type AS.
    a. Description: Include installation of exterior modular masonry veneer.
    b. Unit of Measurement: 50 SF.
24. Unit Price No. G24 - Fiber Cement Siding.
    a. Description: Include installation of exterior Fiber Cement Siding B.O.D. Nichiha, Latura V Groove.
    b. Unit of Measurement: 50 SF.
25. Unit Price No. G25 -Roof Type-1.
    a. Description: Include the preparation and installation of 30 yr. EPDM roof type.
    b. Unit of Measurement: 100 SF.
26. Unit Price No. G26 -Roof Type-2.
    a. Description: Include the preparation and installation of Granule-surfaced SBS self-adhering modified bitumen roofing system on built up insulation.
    b. Unit of Measurement: 100 SF.
27. Unit Price No. G27 -Roof Type-3.

a. Description: Include the preparation and installation of sloping asphalt shingle roof with built up insulation on sloping steel deck and sloping steel.
b. Unit of Measurement: 100 SF.

28. Unit Price No. G28 - Authorized Over-Excavation and Structural Fill.
    a. Description: Authorized over-excavation and structural fill where required for footing over-excavation of soft/unstable soil when authorized by the Owner's testing and inspection agency.
    b. Unit of Measurement: Cubic Yard.

B. E Unit Prices.
1. Unit Price No. E1 - ¾" Conduit and Cabling:
    a. Description: ¾" EMT conduit with supports and couplings and 3#12+1#12GND wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables," "Raceways and Boxes for Electrical Systems" and "Hangers and Supports for Electrical Systems.".
    b. Unit of Measurement: Linear Feet (LF).
2. Unit Price No. E2 - MC #12 Luminary Cabling:
    a. Description: Type MC 2#12+1#12GND with 2#16AWG Luminary Cable according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables.".
    b. Unit of Measurement: Linear Feet (LF).
3. Unit Price No. E3 - MC #10 Cabling:
    a. Description: Type MC Galvanized cabling 3#10+1#10GND according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables.".
    b. Unit of Measurement: Linear Feet (LF).
4. Unit Price No. E4 - 20A Receptacle and Wiring:
    a. Description: 20A industrial/heavy duty grade NEMA 5-20R receptacle, backbox, faceplate and 125 LF of ¾" conduit and 2#12+1#12GND wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables," "Raceways and Boxes for Electrical Systems" and "Hangers and Supports for Electrical Systems," and "Wiring Devices.".
    b. Unit of Measurement: Each (EA).
5. Unit Price No. E5 - 20A Toggle Switch:
    a. Description: 20A industrial/heavy duty grade toggle switch (single pole, 3-way or 4-way as required), backbox, faceplate and 50 LF of ¾" conduit and 3#12+1#12GND wiring according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables," "Raceways and Boxes for Electrical Systems" and "Hangers and Supports for Electrical Systems," and "Wiring Devices.".
    b. Unit of Measurement: Each (EA).
6. Unit Price No. E6 - Lighting Fixture Type "B1":
    a. Description: (1) Fixture type "B1" installed along with 25 LF of MC #12 Luminary Cabling according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables" and "Interior Lighting.".
    b. Unit of Measurement: Each (EA).
7. Unit Price No. E7 - Lighting Fixture Type "B2":
    a. Description: (1) Fixture type "B2" installed along with 25 LF of MC #12 Luminary Cabling according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables" and "Interior Lighting.".
    b. Unit of Measurement: Each (EA).
8. Unit Price No. E8 - Digital Lighting Control C01.
    a. Description: (1) Complete digital lighting control type C01 setup in accordance with

contract drawing E105 and Division 26 Section "Lighting Controls.".
b. Unit of Measurement: Each (EA).

9. Unit Price No. E9 - Lighting Fixture Type "E1":
   a. Description: (1) Fixture type "E1" installed along with 100 LF of MC #12 Cabling according to Division 26 Sections "Low-Voltage Electrical Power Conductors and Cables" and "Interior Lighting.".
   b. Unit of Measurement: Each (EA).
10. Unit Price No. E10 - (1) Smoke Detector.
    a. Description: (1) Smoke detector, mounted in ceiling, with 100 LF of type MC FPLP twisted, shielded pair cabling, including testing & programming, according to Division 28 Section "Digital, Addressable Fire Alarm System.".
    b. Unit of Measurement: Each (EA).
11. Unit Price No. E11 - (1) Speaker/Strobe.
    a. Description: (1) Speaker/strobe device, mounted in ceiling or on wall in backbox, with 100 LF of type MC FPLP cabling, including testing & programming, according to Division 28 Section "Digital, Addressable Fire Alarm System.".
    b. Unit of Measurement: Each (EA).

C. M Unit Prices.
1. Unit Price M1: Galvanized Ductwork:
   a. Description: Furnish and install 22 gauge galvanized duct including internal lining, hangers, in accordance with the applicable Division 23 Sections.
   b. Unit of Measurement: Pounds (lbs).
2. Unit Price M2: Exterior Duct Insulation Wrap:
   a. Description: Furnish and install 1-1/2" Duct Insulation Wrap in accordance with the applicable Division 23 Sections.
   b. Unit of Measurement: Square Foot.
3. Unit Price M3: 1" Schedule 40 PVC Pipe.
   a. Description: Furnish and install 1-inch Schedule 40 PVC plastic pipe and fittings and solvent-welded joints for HVAC condensate piping and hangers including 1" insulation in accordance with the applicable Division 23 Sections.
   b. Unit of Measurement: Per lineal foot.
4. Unit Price M4: Controls.
   a. Description: Furnish and install sensors (temperature, humidity, pressure, etc.) and connect to DDC system with conduit and wiring for monitoring and control in accordance with applicable Division 23 Sections.
   b. Unit of Measurement: Per Unit.

D. P Unit Prices.
1. Unit Price P1: 3/4" Ball Valve:
   a. Description: Furnish and install 3/4-inch ball valve in Plumbing water piping in accordance with the applicable Division 22 Sections.
   b. Unit of Measurement: Per assembly.
2. Unit Price P2: 1" Ball Valve:
   a. Description: Furnish and install 1-inch ball valve in Plumbing water piping in accordance with the applicable Division 22 Sections.
   b. Unit of Measurement: Per assembly.
3. Unit Price P3: 3/4" Copper Pipe Type L.
   a. Description: Furnish and install 3/4-inch L copper domestic water piping and hangers including 1" ASJ insulation in accordance with the applicable Division 22

Sections.
b. Unit of Measurement: Per lineal foot.

4. Unit Price P4: 1" Copper Pipe Type L.
   a. Description: Furnish and install 1-inch L copper domestic water piping and hangers including 1” insulation in accordance with the applicable Division 22 Sections.
   b. Unit of Measurement: Per lineal foot.
5. Unit Price P5: 4" Cast Iron No-Hub Sanitary/Storm Pipe.
   a. Description: Furnish and install 4-inch cast iron no-hub sanitary/storm piping and hangers in accordance with the applicable Division 22 Sections.
   b. Unit of Measurement: Per lineal foot.
6. Unit Price P6: 4" PVC Sanitary/Storm Pipe.
   a. Description: Furnish and install 4-inch PVC underground sanitary/storm piping in accordance with the applicable Division 22 Sections.
   b. Unit of Measurement: Per lineal foot.
7. Unit Price P7: 6" Cast Iron No-Hub Sanitary/Storm Pipe.
   a. Description: Furnish and install 6-inch cast iron no-hub sanitary/storm piping and hangers in accordance with the applicable Division 22 Sections.
   b. Unit of Measurement: Per lineal foot.
8. Unit Price P8: 6" PVC Sanitary / Storm Pipe.
   a. Description: Furnish and install 6-inch PVC underground sanitary/storm piping in accordance with the applicable Division 22 Sections.
   b. Unit of Measurement: Per lineal foot.
9. Unit Price P9: Floor Drain type FD-A.
   a. Description: Furnish and install (1) FD-A floor drain in accordance with the applicable Division 22 Sections.
   b. Unit of Measurement: Each.
10. Unit Price P10: Roof Drain type RD-1.
    a. Description: Furnish and install (1) RD-1 roof drain in accordance with the applicable Division 22 Sections.
    b. Unit of Measurement: Each.
11. Unit Price P11: 6” DIP Sanitary Force-main.
    a. Description: Furnish and install 6” ductile iron underground force-main and required fittings in accordance with the applicable Division 22 Sections.
    b. Unit of Measurement: Per Lineal Foot.
12. Unit Price P12: 8” PVC Storm Pipe.
    a. Description: Furnish and install 8” underground PVC storm piping in accordance with the applicable Division 22 Sections.
    b. Unit of Measurement: Per Lineal Foot.
13. Unit Price P13: 8” HDPE Storm Pipe.
    a. Description: Furnish and install 8” underground HDPE storm piping in accordance with the applicable Division 22 Sections.
    b. Unit of Measurement: Per Lineal Foot.
14. Unit Price P14: 15” HDPE Storm Pipe.
    a. Description: Furnish and install 15” underground HDPE storm piping in accordance with the applicable Division 22 Sections.
    b. Unit of Measurement: Per Lineal Foot.
15. Unit Price P15: 18” HDPE Storm Pipe.
    a. Description: Furnish and install 18” underground HDPE storm piping in accordance with the applicable Division 22 Sections.
    b. Unit of Measurement: Per Lineal Foot.

16. Unit Price P16: 24” HDPE Storm Pipe.
    a. Description: Furnish and install 24” underground HDPE storm piping in accordance with the applicable Division 22 Sections.
    b. Unit of Measurement: Per Lineal Foot.
17. Unit Price P17: 18” RCP Storm Pipe.
    a. Description: Furnish and install 18” underground Reinforced Concrete storm piping in accordance with the applicable Division 22 Sections.
    b. Unit of Measurement: Per Lineal Foot.

E. FP Unit Prices.
1. Unit Price FP1: Sprinkler Head, Concealed.
    a. Description: Furnish and install (1) pendant, concealed sprinkler in accordance with the applicable Division 21 Sections.
    b. Unit of Measurement: Each.
2. Unit Price FP2: 1” Sprinkler Pipe.
    a. Description: Furnish and install 1” threaded black steel pipe in accordance with the applicable Division 21 Sections.
    b. Unit of Measurement: Per lineal foot.
3. Unit Price FP3: 1-1/2” Sprinkler Pipe.
    a. Description: Furnish and install 1-1/2” threaded black steel pipe in accordance with the applicable Division 21 Sections.
    b. Unit of Measurement: Per lineal foot.
4. Unit Price FP4: 2” Sprinkler Pipe.
    a. Description: Furnish and install 2” black steel pipe in accordance with the applicable Division 21 Sections.
    b. Unit of Measurement: Per lineal foot.

END OF SECTION

SECTION 012300

ALTERNATES

PART 1 GENERAL

1.1 SUMMARY

1.2 DESCRIPTION OF WORK

A. This Section identifies each Alternate by number and describes the basic changes to be incorporated into the Work, if that Alternate is made part of the Contract.

1.3 RELATED REQUIREMENTS SPECIFIED ELSEWHERE

A. Applicable provisions of Bidding Requirements, Contract Requirements and other Division 1 sections.

1.4 ADMINISTRATIVE PROCEDURES

A. Referenced Sections of Specifications stipulate pertinent requirements for products and methods to achieve the Work stipulated under each Alternate.

B. Coordinate pertinent related Work and modify surrounding Work as required to properly integrate the Work under each Alternate, and to provide the complete construction required by the Contract Documents.

C. Immediately following the award of the Contract, prepare and distribute to each party involved, notification of the status of each Alternate. Indicate whether Alternates have been accepted, rejected or deferred, to the extent permitted by the Bidding Documents and applicable law, for consideration at a later date.

D. "Schedule of Alternates" is included at the end of this Section. Specification Sections referenced in the Schedule contain requirements for materials and methods necessary to achieve the Work described under each Alternate. Include as part of each Alternate, miscellaneous devices, accessory objects and similar items incidental to or required for a complete installation whether or not mentioned as part of the Alternate.

E. Alternates may be accepted by the Owner in any order or combination, unless otherwise specifically provided in the Bidding Documents. The lowest responsible bidder shall be determined on the basis of the Base Bid plus the Alternates accepted for purposes of award.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 SCHEDULE OF ALTERNATES

A. Add Alternate No. A1 - Exterior Painting.
   1. Base Bid.
      a. Existing exterior masonry surfaces of the building located outside the designated Work Area shall remain unchanged. No painting or coating of existing exterior masonry is included in the Base Bid.
   2. Alternate No. A1.
      a. Summary.
         1) Provide all labor, materials, equipment, surface preparation, and incidentals necessary to paint all existing exposed exterior masonry surfaces of the building.
      b. Surface Preparation.
         1) Clean masonry surfaces to remove dirt, dust, efflorescence, loose material, and other contaminants in accordance with manufacturer's recommendations.
         2) Repair minor surface defects and prepare surfaces as required to receive coating system.
         3) Prime surfaces where required by coating manufacturer.
      c. Coating System.
         1) Apply premium-grade exterior masonry coating system suitable for concrete masonry units (CMU), brick, and other existing masonry substrates.
         2) Provide manufacturer's standard warranty.
         3) Color to be selected by Owner/Architect from manufacturer's full range of standard colors.
      d. Application.
         1) Apply coatings in strict accordance with manufacturer's written instructions.
         2) Provide complete coverage of all exposed exterior masonry surfaces, unless otherwise indicated.
         3) Protect adjacent materials and surfaces from overspray, splatter, and damage during application.
      e. Alternate Price.
         1) Include all costs associated with complete exterior masonry painting as described herein as a lump sum add alternate.

B. Add Alternate No. A2 - Existing Fixture Replacements.
   1. Base Bid.
      a. Existing plumbing fixtures shall remain in place and shall be retained as documented. No replacement of existing plumbing fixtures is included in the Base Bid.
   2. Alternate No. A2.
   3. Summary.
      a. Provide all labor, materials, equipment, demolition, disposal, installation, testing, and incidentals required to remove and replace all existing plumbing fixtures within existing restrooms.
   4. Scope of Work.
      a. Remove and properly dispose of existing plumbing fixtures.
      b. Furnish and install new plumbing fixtures of like type, size, and function to existing

fixtures unless otherwise approved by the Owner/Architect.

c. Reconnect fixtures to existing plumbing systems and provide all fittings, valves, trim, and accessories required for a complete and operational installation.

5. Existing Conditions.
   a. Existing fixture locations shall remain unchanged.
   b. Existing restroom accessories, including but not limited to mirrors, grab bars, toilet partitions, dispensers, hand dryers, and similar items, shall remain and are not included in this Alternate.
   c. Existing piping concealed within walls, floors, and ceilings shall remain unless modifications are required to facilitate fixture replacement.
6. Installation.
   a. Install fixtures level, plumb, and in accordance with manufacturer's written instructions and applicable codes.
   b. Test all fixtures and connections and correct leaks or deficiencies prior to Substantial Completion.
7. Alternate Price.
   a. Include all costs associated with complete replacement of existing restroom plumbing fixtures as described herein as a lump sum add alternate.

END OF SECTION

SECTION 012500

SUBSTITUTION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. The Work of This Section Includes: Administrative and procedural requirements for substitutions.

B. Related Requirements:
   1. Section 012100 "Allowances" for products selected under an allowance.
   2. Section 012300 "Alternates" for products selected under an alternate.

1.2 DEFINITIONS

A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents.
   1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
   2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required to meet other Project requirements but may offer advantage to Contractor or Owner.

1.3 ACTION SUBMITTALS

A. Substitution Requests: Submit documentation identifying product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
   1. Substitution Request Form: Use form acceptable to Architect.
   2. Documentation: Show compliance with requirements for substitutions and the following, as applicable:
      a. Statement indicating why specified product or fabrication or installation method cannot be provided, if applicable.
      b. Coordination of information, including a list of changes or revisions needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
      c. Detailed comparison of significant qualities of proposed substitutions with those of the Work specified. Include annotated copy of applicable Specification Section. Significant qualities may include attributes, such as performance, weight, size, durability, visual effect, sustainable design characteristics, warranties, and specific features and requirements indicated. Indicate deviations, if any, from the Work

specified.

d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
e. Samples, where applicable or requested.
f. Certificates and qualification data, where applicable or requested.
g. List of similar installations for completed projects, with project names and addresses as well as names and addresses of architects and owners.
h. Material test reports from a qualified testing agency, indicating and interpreting test results for compliance with requirements indicated.
i. Research reports evidencing compliance with building code in effect for Project, from ICC-ES.
j. Detailed comparison of Contractor's construction schedule using proposed substitutions with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating date of receipt of purchase order, lack of availability, or delays in delivery.
k. Cost information, including a proposal of change, if any, in the Contract Sum.
l. Contractor's certification that proposed substitution complies with requirements in the Contract Documents, except as indicated in substitution request, is compatible with related materials and is appropriate for applications indicated.
m. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

3. Architect's Action: If necessary, Architect will request additional information or documentation for evaluation within seven days of receipt of a request for substitution. Architect will notify Contractor through Construction Manager of acceptance or rejection of proposed substitution within 15 days of receipt of request, or seven days of receipt of additional information or documentation, whichever is later.
   a. Forms of Acceptance: Change Order, Construction Change Directive, or Architect's Supplemental Instructions for minor changes in the Work.
   b. Use product specified if Architect does not issue a decision on use of a proposed substitution within time allocated.

1.4 QUALITY ASSURANCE

A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage a qualified testing agency to perform compatibility tests recommended by manufacturers.

1.5 PROCEDURES

A. Coordination: Revise or adjust affected work as necessary to integrate work of the approved substitutions.

1.6 SUBSTITUTIONS

A. Substitutions for Cause: Submit requests for substitution immediately on discovery of need for change, but not later than 15 days prior to time required for preparation and review of related submittals.
   1. Conditions: Architect will consider Contractor's request for substitution when the following conditions are satisfied. If the following conditions are not satisfied, Architect will return requests without action, except to record noncompliance with these requirements:
      a. Requested substitution is consistent with the Contract Documents and will produce indicated results.
      b. Substitution request is fully documented and properly submitted.
      c. Requested substitution will not adversely affect Contractor's construction schedule.
      d. Requested substitution has received necessary approvals from authorities having jurisdiction.
      e. Requested substitution is compatible with other portions of the Work.
      f. Requested substitution has been coordinated with other portions of the Work.
      g. Requested substitution provides specified warranty.
      h. If requested substitution involves more than one contractor, requested substitution has been coordinated with other portions of the Work, is uniform and consistent, is compatible with other products, and is acceptable to all contractors involved.

B. Substitutions for Convenience:
   1. Not allowed unless otherwise indicated.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012600

CONTRACT MODIFICATION PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. General: This section specifies administrative and procedural requirements for modifications to the Work of the Contract.

1.2 DEFINITIONS

A. Bulletin.
   1. A Bulletin is a proposed modification to the Contract Documents prepared and issued by the Architect that accomplishes one or all of the following:
      a. Clarifies or changes the Work.
      b. Furnishes information which is supplemental to the Contract which may or may not change the Contract Sum or Contract Time as specified in the Bulletin.
   2. A bulletin is not an order to proceed.
   3. No bulletin shall be issued to the Contractor by the Architect until such bulletin has been reviewed and approved for release by the Owner.

B. Modification: Refer to General Conditions, for definition of a Modification.

C. Change Order: Refer to General Conditions, for definition of a Change Order.

D. Construction Change Directive: Refer to General Conditions, for definition of a Construction Change Directive.

1.3 BULLETINS

A. Issuance of Bulletins: With the approval of the Owner, the Architect may issue Bulletins as defined above.
   1. Bulletins issued by the Architect are for information only. Bulletins are not to be considered as an instruction either to stop work in progress, or to execute the proposed change.
   2. Unless otherwise indicated in the Bulletin, within ten (10) working days after receipt of the Bulletin, the Contractor shall submit to the Construction Manager and Architect a detailed Change Order proposal identifying the cost and time, if any, necessary to execute the proposed change described in the Bulletin.
      a. Include a list of quantities of products to be purchased and unit costs, along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.

b. Indicate applicable taxes, delivery charges, equipment rental, amounts of trade discounts, labor costs, re-stocking charges, legitimate markups and other costs associated with the proposed change.
c. Identify any changes to Work already executed which, if not addressed in the Bulletin, will require revision as part of the proposed change.

3. Include a statement in the Change Order Request indicating the effect the proposed change in the Work will have on the Contract Time.
4. The Owner will use reasonable efforts to review and respond to the Contractor's complete proposal within ten (10) working days after receipt. Failure to respond within that period shall not constitute approval of the proposal, authorization to proceed, or acceptance of any adjustment to the Contract Sum or Contract Time.

1.4 CHANGE ORDER PROCEDURES

A. Owner-Initiated Change Order Requests: A detailed description of proposed changes in the Work will be issued that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
1. Proposal Requests issued are for information only. Do not consider them instructions either to stop work in progress or to execute the proposed change.
2. Within 10 working days after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
3. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
4. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
5. Include an updated Construction Schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.

B. Contractor-Initiated Change Order Request: Should the Contractor discover a discrepancy, latent or other unforeseen condition requiring modification of the Contract Documents that was not previously noted, or determine upon receipt of clarification from the Architect that the Work described may necessitate a Change Order, the Contractor shall promptly notify the Construction Manager, Architect, and Owner in writing of its intention to submit a Change Order request, and shall do so before proceeding with the affected Work except as otherwise expressly authorized by the Contract Documents.

C. Within ten (10) working days of such notice, the Contractor shall submit a Change Order request to the Owner and Architect; Change Order Proposal Requests shall include the following:
1. A statement outlining the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and Contract Time.
2. A list of quantities of products to be purchased and unit costs along with the total amount of purchases to be made. Where requested, furnish survey data to substantiate quantities.
3. An indication of applicable taxes, delivery charges, equipment rental, and amounts of

trade discounts, labor costs, re-stocking charges, legitimate markups and other costs associated with the proposed change.

4. Coordination information, including a list of changes or modifications made necessary to other parts of the Work and to construction performed by separate contractors that will become necessary to accommodate the proposed change or modification.
5. Comply with requirements in Section 01 60 00 "Product Requirements "if the proposed change requires substitution of one product or system for product or system specified.
6. Failure by the Contractor to include the above requirements in the change order request may cause rejection of the request in its entirety.

D. Approval of Change Order: Upon the Owner's approval of a Change Order Request or Bulletin, the CM will prepare and circulate the Change Order for execution by the parties and design professionals required by the Conditions of the Contract. Approval of a request, proposal, estimate, or Bulletin shall not itself modify the Contract Sum or Contract Time or authorize changed Work. A Change Order is effective only when fully executed as required by the Contract Documents.

E. Commencement of Proposed Changes: Work on proposed changes that affect the Contract Sum and/or Contract Time shall not be started until the Contractor has received a fully executed Change Order or a duly authorized Construction Change Directive, except as otherwise expressly permitted by the Contract Documents. Oral directives, field discussions, meeting minutes, e-mails, or other informal communications shall not, by themselves, constitute authorization for additional compensation or an extension of Contract Time.

F. Record of Changes: In all cases, the Contractor shall maintain an accurate account of labor and materials involved in the change.

1.5 CONSTRUCTION CHANGE DIRECTIVE

A. Purpose: When the Owner and Contractor are not in total agreement on the terms of a Change Order Proposal Request, the Owner may authorize a Construction Change Directive directing the Contractor to proceed with a change in the Work for subsequent inclusion in a Change Order. A Construction Change Directive shall be prepared, signed, and authorized in accordance with the Conditions of the Contract and shall be effective only upon the required authorization by the Owner and execution by the Construction Manager and Architect.

B. Description of Changes: The Construction Change Directive will contain a complete description of the change in the Work and designate the method to be followed to determine change in the Contract Sum or Contract Time.

C. Records: Maintain detailed records on a time and material basis of work required by the Construction Change Directive.

D. Submittal of Data: After completion of the change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

1.6 COORDINATION

A. Revision of Schedule of Values and Application for Payment: Promptly revise Schedule of Values and Application for Payment forms to record each authorized Change Order as a separate line item.

B. Revision to Progress Schedule: Promptly revise Progress Schedule to reflect any change in Contract Time; revise schedules to adjust times for other items of work affected by the change and resubmit.

1.7 DISPUTES

A. Notification of Disagreement: Should the Contractor and Owner disagree about the value of a proposed change in the Contract Sum or Contract Time, the Contractor shall notify the Owner and Construction Manager in writing, stating the reason for the disagreement. Disagreement about the value of a change does not relieve the Contractor of responsibility to proceed when directed by a duly authorized Construction Change Directive or other written directive expressly permitted by the Contract Documents, while preserving its right to seek resolution of the dispute in accordance with the Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 012900

PAYMENT PROCEDURES

PART 1 GENERAL

1.1 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.

1.2 SUMMARY

A. Section includes administrative and procedural requirements necessary to prepare and process Applications for Payment.

B. Related Requirements:
   1. Section 01 21 00 "Allowances" for procedural requirements governing the handling and processing of allowances.
   2. Section 01 22 00 "Unit Prices" for administrative requirements governing the use of unit prices.
   3. Section 01 26 00 "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
   4. Section 01 32 00 "Construction Progress Documentation" for administrative requirements governing the preparation and submittal of the Contractor's construction schedule.
   5. Section 01 81 13 "Sustainable Design Requirements."

1.3 DEFINITIONS

A. Schedule of Values: A statement furnished by Contractor allocating portions of the Contract Sum to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

1.4 SCHEDULE OF VALUES

A. Coordination: Coordinate preparation of the schedule of values with preparation of Contractor's construction schedule. Cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the schedule of values.
   1. Coordinate line items in the schedule of values with items required to be indicated as separate activities in Contractor's construction schedule.
   2. Submit the schedule of values to the Construction Manager for review and comment at the earliest possible date, but no later than twenty (20) days after the Notice to Proceed and in all events before submission of the initial Application for Payment. CM will

coordinate review with Architect.

3. Subschedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide subschedules showing values coordinated with each phase of payment.
4. Subschedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide subschedules showing values coordinated with each element.
5. Subschedules for Separate Design Contracts: Where the Owner has retained design professionals under separate contracts who will each provide certification of payment requests, provide subschedules showing values coordinated with the scope of each design services contract, as described in Section 01 10 00 "Summary."

B. Format and Content: Use Project Manual table of contents as a guide to establish line items for the schedule of values. Provide at least one line item for each Specification Section.
   1. Identification: Include the following Project identification on the schedule of values:
      a. Project name and location.
      b. Owner's name.
      c. Owner's Project number.
      d. Name of Architect.
      e. Architect's Project number.
      f. Contractor's name and address.
      g. Date of submittal.
   2. Arrange schedule of values consistent with format of AIA Document G703 Application and Certificate for Payment.
   3. Arrange schedule of values to include the following General Conditions / General Requirements breakdowns:
      a. General Conditions.
         1) Supervision.
            a) Project Manager(s).
            b) Field Supervision.
            c) Project Engineer/Administration.
            d) Safety.
         2) Bonds.
         3) Taxes & Insurance.
         4) Permitting.
         5) Clean Up.
            a) Throughout project - Labor.
            b) Final cleaning.
         6) Schedule Management.
            a) Baseline development.
            b) Monthly Update process.
            c) Submittal Schedule / Log.
         7) Coordination.
            a) Below Grade and Above Ceiling.
            b) BIM Coordination (Refer to 01 requirements).
         8) Temporary Facilities & Controls.
            a) Temporary utilities and usage charges.
            b) Temporary conditioning.
            c) Temporary lighting.
            d) Fencing & Barricades.

e) Street & Sidewalk closures including signage.
f) Temporary bathroom & handwashing facilities.
g) Other items as required or defined in the specifications.

9) QA/QC.
a) Testing/Inspection Requirements.
b) 3rd Party and Manufacturer req'd inspections.

10) Close Out.
a) As-Builts including BIM Model Updates.
b) Punchlist.
c) Closeout Documentation.

4. Arrange the schedule of values in tabular form, with separate columns to indicate the following for each item listed:
   a. Related Specification Section or division.
   b. Description of the Work.
   c. Name of subcontractor.
   d. Name of manufacturer or fabricator.
   e. Name of supplier.
   f. Change Orders (numbers) that affect value.
   g. Dollar value of the following, as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent. Round dollar amounts to whole dollars, with total equal to Contract Sum.
      1) Labor.
      2) Materials.
      3) Equipment.
5. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Provide multiple line items for principal subcontract amounts in excess of five percent of the Contract Sum.
6. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
   a. Differentiate between items stored on-site and items stored off-site.
7. Allowances: Provide a separate line item in the schedule of values for each allowance. Show line-item value of unit-cost allowances, as a product of the unit cost, multiplied by measured quantity. Use information indicated in the Contract Documents to determine quantities.
8. Purchase Contracts: Provide a separate line item in the schedule of values for each Purchase contract. Show line-item value of Purchase contract. Indicate Owner payments or deposits, if any, and balance to be paid by Contractor.
9. Overhead Costs, Proportional Distribution: Include total cost and proportionate share of general overhead and profit for each line item.
10. Overhead Costs, Separate Line Items: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
11. Temporary Facilities: Show cost of temporary facilities and other major cost items that are not direct cost of actual work-in-place as separate line items.
12. Closeout Costs. Include separate line items under Contractor and principal subcontracts for Project closeout requirements in an amount totaling five percent of the Contract Sum and subcontract amount. This is inclusive of but not limited to the items noted above. The closeout cost SOV line item will not be invoiced until all required documentation is submitted and approved. The CMa, A/E and Owner shall have sole discretion.
13. Schedule of Values Revisions: Revise the schedule of values when Change Orders or

Construction Change Directives result in a change in the Contract Sum. Include at least one separate line item for each Change Order and Construction Change Directive.

1.5 APPLICATIONS FOR PAYMENT

A. Each Application for Payment following the initial Application for Payment shall be consistent with previous applications and payments, as certified by the Construction Manager and paid for by Owner.
   1. Process shall follow as noted below:
      a. All pay application processes will be submitted through Procore.
      b. Pencil copy submitted to CM and A/E for review.
      c. Comments returned by CM/A/E within 7 days.
      d. Prime contractors revise application and resubmits final notarized copy with back-up documents (certified payroll, local/dbe participation forms, lien waiver, steel certificates & stored material back-up, statement of accounts, and other required documents).
      e. CM and A/E review & certify invoice.
      f. CM transmits the certified Application for Payment to the Owner for processing.

B. Payment Application Times: The date for each progress payment is indicated in the Owner/Contractor Agreement. The period of construction work covered by each Application for Payment is the period indicated in the Agreement.

C. Payment Application Times: Submit Draft Application for Payment to CM by the 25th of the month. If the 25th falls on a weekend or a holiday, the draft shall be submitted on the last preceding non-holiday weekday. The period covered by each Application for Payment is one month, ending on the last day of the month.

D. Application for Payment Forms: Use AIA Document G732 'Application and Certificate for Payment, Construction Manager as Adviser Edition' and AIA Document G703 'Continuation Sheet' as forms for Applications for Payment.

E. Application Preparation: Complete every entry on form. Notarize and execute by a person authorized to sign legal documents on behalf of Contractor. Construction Manager will return incomplete applications without action.
   1. Entries shall match data on the schedule of values and Contractor's construction schedule. Use updated schedules if revisions were made.
   2. Include amounts for work completed following previous Application for Payment, whether or not payment has been received. Include only amounts for work completed at time of Application for Payment.
   3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.
   4. Indicate separate amounts for work being carried out under Owner-requested project acceleration.

F. Stored Materials: Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed. Differentiate between items stored on-site and items stored off-site. Materials stored off-site must be specifically identified for the Project, segregated from materials for other projects to the extent practicable, suitably protected, and available for inspection by the Owner, Construction Manager, or Architect upon reasonable notice.
   1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment for stored materials.
   2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
   3. Provide summary documentation for stored materials indicating the following:
      a. Value of materials previously stored and remaining stored as of date of previous Applications for Payment.
      b. Value of previously stored materials put in place after date of previous Application for Payment and on or before date of current Application for Payment.
      c. Value of materials stored since date of previous Application for Payment and remaining stored as of date of current Application for Payment.

G. Transmittal: Electronic copies, signed and notarized, of each Application for Payment to Construction Manager. Include waivers of lien and similar attachments if required.

H. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien.
   1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
   2. When an application shows completion of an item, submit conditional final or full waivers.
   3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
   4. Submit final Application for Payment with or preceded by conditional final waivers from every entity involved with performance of the Work covered by the application who is lawfully entitled to a lien, to the extent permitted by applicable law. Within ten (10) days after receipt of final payment, furnish unconditional final waivers and releases from the Contractor and from such subcontractors and suppliers as the Owner may reasonably require, to the extent permitted by applicable law.
   5. Waiver Forms: Submit executed waivers of lien on forms acceptable to Owner.

I. Progress Payment Additional Documentation.
   1. Electronic copies of daily reports for invoice month.
   2. Certified Payroll Reports (Must be submitted twice per month).

J. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
   1. List of subcontractors, suppliers & equipment vendors.
   2. Fully executed subcontracts including suppliers and equipment vendors.
   3. Schedule of values.
   4. Contractor's Start Up construction schedule.
   5. Key personnel list.
   6. Submittal Register & schedule.

7. Combined Contractor's Baseline construction schedule (preliminary if not final), incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
8. Products list (preliminary if not final).
9. Sustainable design action plans, including preliminary project materials cost data.
10. List of Contractor's staff assignments.
11. List of Contractor's principal consultants.
12. Copies of building permits.
13. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
14. Initial progress report.
15. Report of preconstruction conference.
16. Labor Rate Breakdown sheets for all contracts & subcontracts.

K. Certificates of insurance and insurance policies.
1. Performance and payment bonds.
2. Current Certificates of Insurance.

L. Application for Payment at Substantial Completion: After Architect issues the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
a. Complete administrative actions, submittals, and Work preceding this application, as described in Section 01 70 00 "Execution and Closeout Procedures."
2. This application shall reflect Certificate(s) of Substantial Completion issued previously for Owner occupancy of designated portions of the Work.

M. Final Payment Application: After completing Project closeout requirements, submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
2. Certification of completion of final punch list items.
3. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
4. Updated final statement, accounting for final changes to the Contract Sum.
5. AIA Document G706.
6. AIA Document G706A.
7. AIA Document G707.
8. Evidence that claims have been settled.
9. Final liquidated damages settlement statement.
10. Proof that taxes, fees, and similar obligations are paid.
11. Waivers and releases.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 013100

PROJECT MANAGEMENT AND COORDINATION

PART 1 GENERAL

1.1 SUMMARY

A. General: This Section specifies administrative and procedural requirements for Project Management and Coordination by the CM, including but not limited to:
   1. General coordination procedures.
   2. Coordination drawings.
   3. Lean Procedures.
   4. Requests for Information (RFIs).
   5. Project Web site.
   6. Project meetings.

B. Each contractor shall participate in and remain responsible for the coordination requirements applicable to its Work. Certain areas of responsibility are assigned to a specific contractor. The Construction Manager's review, facilitation, coordination, scheduling, or other project administration shall not relieve any Contractor of responsibility for its Work, means and methods, safety obligations, coordination duties, or compliance with the Contract Documents.

1.2 INFORMATIONAL SUBMITTALS

A. Subcontract List: Within twenty (20) days of Notice to Proceed, prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment fabricated to a special design. Subcontract list shall be updated weekly by prime contractor and submitted to CM. Include the following information in tabular form:
   1. Name, address, and telephone number of entity performing subcontract or supplying products.
   2. Number and title of related Specification Section(s) covered by subcontract.
   3. Drawing number and detail references, as appropriate, covered by subcontract.

B. Key Personnel Names: Within fifteen (15) days of Notice to Proceed, submit a list of key personnel assignments, including superintendent and other personnel in attendance at Project site or elsewhere. Identify individuals and their duties and responsibilities; list business contact information, including office and cellular telephone numbers and e-mail addresses. Provide the same business contact information for individuals assigned as alternates in the absence of individuals assigned to Project.
   1. Post copies of the list in the project meeting room, temporary field office, and Project Web site or PMIS, and keep the list current at all times.

1.3 PROJECT MEETINGS

A. General: CM to schedule and administer project meetings throughout the progress of the Work. Prepare agenda, conduct meetings, record meeting results, and distribute recorded proceedings and decisions to participants and other affected parties.
   1. Each Prime Contractor's project manager, superintendent, and other required project team members shall attend required meetings. Attendance is mandatory. If a Contractor fails to attend a required meeting, the Owner may back charge that Contractor for reasonable, documented costs actually incurred by the Owner or Construction Manager as a direct result of the absence, to the extent permitted by the Contract Documents.

B. Regularly Scheduled Project Meetings.
   1. Notification: For meetings not regularly scheduled, give participants not less than three (3) days prior notice.
   2. Attendees: The Owner, CM, Architect and their consultants, all Prime Contractors, their Project Executives, Project Managers and their Superintendents, major subcontractors, manufacturers, suppliers and other concerned parties shall each be represented at the conference by persons familiar with the Work and authorized to make operational commitments on behalf of the entity represented. No meeting attendee shall have authority, solely by virtue of attendance or statements made at a meeting, to modify the Contract Sum or Contract Time or otherwise amend the Contract Documents except in accordance with the Contract modification procedures.
   3. Agenda: Review and correct or approve minutes of the previous progress meeting. Review other items of significance that could affect progress. Include topics for discussion as appropriate to the current status of the Project. Discuss items of significance that could affect progress including review of the present and future needs of each entity present and such topics as:
      a. Lean procedures.
      b. Construction Schedule: Review progress since the last meeting. Determine where each activity is in relation to the Construction Schedule, whether on time or ahead or behind schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.
      c. Critical Work sequencing and interface requirements.
      d. Quality and Work standards.
      e. Designation of responsible personnel.
      f. Procedures for processing field decisions and Change Orders.
      g. Procedures for processing Applications for Payment.
      h. Distribution of Contract Documents.
      i. Submittal of Shop Drawings, Product Data and Samples.
      j. Preparation of record documents.
      k. Site utilization, use of the premises and access.
      l. Office, Work and storage areas.
      m. Equipment deliveries and priorities.
      n. Non-compliance issues.
      o. Bulletins and Change Orders.
      p. Architect's Supplemental Instructions (ASI's) and Requests for information (RFI's).
      q. Documentation of information for payment requests.
      r. Off-site fabrication problems.

s. Security.
t. Housekeeping.
u. Working hours.
v. Prior to the execution of the Work, and in addition to pre-construction or pre-installation meetings specified in technical specification sections, schedule a pre-construction conference with each sub-contractor to review product selection, the procedures for executing the Work and the coordination required with other trades.
w. Insurance COI Updates.
x. Applications for Payment and pencil copies.
y. Certified Payroll.
z. Waivers and Releases.
aa. O&M Manuals, Warranties.
bb. Start-ups and Commissioning.
cc. Safety.
dd. Housekeeping.

4. Reporting: No later than 5 days after each meeting date, distribute copies of minutes of the meeting to each party present and to other parties who should have been present. Include a brief summary, in narrative form, of progress since the previous meeting and report. Meeting minutes are project records only and shall not, by themselves, modify the Contract Documents, authorize changed or additional Work, or adjust the Contract Sum or Contract Time. A Contractor shall notify the CM in writing of any material inaccuracy in meeting minutes within five (5) business days after distribution.

C. Coordination Meetings.
1. Conduct Project coordination meetings at regularly scheduled times convenient for parties involved. Project coordination meetings are in addition to specific meetings held for other purposes, such as regular progress meetings and special pre-installation or pre-construction meetings.
2. Request representation at each meeting by every party currently involved in coordination or planning for the construction activities involved.
3. Record meeting results and distribute copies within 3 days to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

D. Pre-Construction Conference.
1. CM will schedule and conduct a preconstruction conference before starting construction and prior to the installation of building components, at a time convenient to Contractor, Owner and Architect, but no later than ten (10) days after execution of the Agreement or prior to commencement of work.
2. Schedule a pre-construction conference and organizational meeting, prior to commencement of each category of the Work to review the material selections, fabrication and installation procedures, and coordination among the various trades. The categories of Work shall generally correspond with the Sections of the Specifications. CM, Installer, manufacturers' representatives, and any trade that requires coordination with the Work, shall meet at the project site or other location as mutually agreed. Conduct the meeting to review responsibilities and personnel assignments. CM to record meeting results and distribute copies within 3 days to everyone in attendance and to others affected by decisions or actions resulting from each meeting.
3. Agenda: Discuss items of significance that could affect progress, including the following:
a. LEAN Procedures.
b. Tentative construction schedule.

c. Phasing.
d. Critical work sequencing and long-lead items.
e. Designation of key personnel and their duties.
f. Lines of communications.
g. Procedures for processing field decisions and Change Orders.
h. Procedures for RFIs.
i. Procedures for testing and inspecting.
j. Procedures for processing Applications for Payment.
k. Distribution of the Contract Documents.
l. Submittal procedures.
m. Preparation of record documents.
n. Use of the premises and existing building.
o. Work restrictions.
p. Working hours.
q. Owner's occupancy requirements.
r. Responsibility for temporary facilities and controls.
s. Procedures for moisture and mold control.
t. Procedures for disruptions and shutdowns.
u. Construction waste management and recycling.
v. Parking availability.
w. Office, work, and storage areas.
x. Equipment deliveries and priorities.
y. First aid.
z. Security.
aa. Progress cleaning.

E. Lean Training and Pull Planning Meeting: CM will schedule and conduct a Lean Training and Pull Planning Meeting after submission of the Startup Construction Schedule, but no later than Twenty (20) days after execution of the Agreement.
1. CM to conduct the conference to train and familiarize all required project personnel, inclusive of each prime contractor and key subcontractors, with Lean procedures and then, as the foundation of the Lean process, develop a Pull Plan for a phase of the project based on the project knowledge of each participant having developed their individual start-up schedules.
2. Allow a minimum of 12 hours over 2 days for all required personnel.
3. Attendees: Owner, CM, Architect, and their consultants, contractor and its superintendent, major subcontractors, major suppliers, and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

F. Last Planner Meetings: CM will facilitate Last Planner Meetings on a weekly basis. The purpose of the meetings is to plan and coordinate the near-term work to allow coordination between prime contractors and their subcontractors.
1. CM to conduct the conference to develop and improve workflow on the project site based on commitments made and evaluation of results.
2. Allow a minimum of 1.5 hours per week for required attendees.
3. Required Attendees: CM, area foremen for the each of the prime contractors, major subcontractors, major suppliers, and other concerned parties shall attend the conference. Participants at the conference shall be familiar with the Project and authorized to conclude matters relating to the Work.

4. Topics may include the following:
   a. Interface requirements.
   b. Sequence of operations.
   c. Status of submittals.
   d. Deliveries.
   e. Off-site fabrication.
   f. Access.
   g. Site utilization.
   h. Temporary facilities and controls.
   i. Work hours.
   j. Hazards and risks.
   k. Progress cleaning.
   l. Quality and work standards.
   m. Change Orders.
5. Minutes: CM will record and distribute meeting minutes.

G. Lean Daily Huddles: CM will conduct Lean Daily Huddles.
1. CM to facilitate the huddle to review work plans, evaluate performance against commitments and make adjustments to daily planned activities.
2. Allow a minimum of 30 minutes per day for required attendees.
3. Required Attendees: CM, area foremen for each of the prime contractors, major subcontractors, major suppliers, and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.

H. Pre-installation Conferences: Conduct a pre-installation conference at the Project site before each construction activity that requires coordination with other construction. Pre-installation conferences shall be scheduled 4-6 weeks prior to the specific activity commencing. Each prime contractor shall coordinate meeting dates.
1. Attendees: Prime contractors (Involved with direct coordination of work), Installer and representatives of manufacturers and fabricators involved in or affected by the installation and its coordination or integration with other materials and installations that have preceded or will follow, shall attend the meeting. Advise Architect, Construction Manager of scheduled meeting dates.
2. Meeting Minutes: Prime contractor entity responsible for specific activity being reviewed. The prime contractor shall publish meeting minutes to all attendees within 72 hours of the meeting.
3. Agenda: Review progress of other construction activities and preparations for the particular activity under consideration, including requirements for the following:
   a. Contract Documents.
   b. Options.
   c. Related RFIs.
   d. Related Change Orders.
   e. Purchases.
   f. Deliveries.
   g. Submittals.
   h. Review of mockups.
   i. Possible conflicts.
   j. Compatibility requirements.
   k. Time schedules.

l. Weather limitations.
m. Manufacturer's written instructions.
n. Warranty requirements.
o. Compatibility of materials.
p. Acceptability of substrates.
q. Temporary facilities and controls.
r. Space and access limitations.
s. Regulations of authorities having jurisdiction.
t. Testing and inspecting requirements.
u. Installation procedures.
v. Coordination with other work.
w. Required performance results.
x. Protection of adjacent work.
y. Protection of construction and personnel.

4. Record significant conference discussions, agreements, and disagreements, including required corrective measures and actions.
5. Reporting: Distribute minutes of the meeting to each party present and to other parties requiring information.
6. Do not proceed with installation if the conference cannot be successfully concluded. Initiate whatever actions are necessary to resolve impediments to performance of the Work and reconvene the conference at earliest feasible date.
7. At a minimum or unless specified in technical specifications, pre-installation conferences are required for:
   a. Abatement / Demolition.
   b. Foundation modifications.
   c. Exterior skin / Brick Removal, Rebuild and Repointing.
   d. Exterior Skin - Curtainwall / Windows.
   e. Steel Supports.
   f. Roof Modifications.
   g. Finishes (Flooring, Ceilings & Walls).
8. Elevator Renovations.

I. Special Meetings.
   1. Special meetings may be called as required, at a place and time as coordinated by the CM.

J. Project Closeout Conference: CMa will schedule and conduct a project closeout conference, at a time convenient to Contractor, Owner and Architect, but no later than ninety (90) days prior to the scheduled date of Substantial Completion of the final phase.
   1. Attendees: Owner, Construction Manager, Architect, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the meeting. Participants at the meeting shall be familiar with Project and authorized to conclude matters relating to the Work.
   2. Agenda: Discuss items of significance that could affect or delay Phase closeout, including the following:
      a. Preparation of record documents.
      b. Procedures required prior to inspection for Substantial Completion and for final inspection for acceptance.
      c. Submittal of written warranties.
      d. Requirements for preparing operations and maintenance data.

e. Requirements for delivery of material samples, attic stock, and spare parts.
f. Requirements for demonstration and training.
g. Preparation of Contractor's punch list.
h. Procedures for processing Applications for Payment at Substantial Completion and for final payment.
i. Submittal procedures.
j. Coordination of separate contracts.
k. Owner's partial occupancy requirements.
l. Installation of Owner's furniture, fixtures, and equipment.
m. Responsibility for removing temporary facilities and controls.

3. Minutes: Entity conducting meeting will record and distribute meeting minutes.

1.4 GENERAL COORDINATION PROCEDURES

A. General: Coordinate construction activities included under various Sections of these Specifications to assure efficient and orderly installation of each part of the Work. Coordinate construction operations included under different Sections of the Specifications that are dependent upon each other for proper installation, fit, connection, and operation.
   1. Sequence of Construction Activities Schedule: Where installation of one part of the Work is dependent on installation of other components, either before or after its own installation, schedule construction activities in the sequence required to obtain coordinated results.

B. Accessibility in Limited Space: Where availability of space is limited, coordinate installation of different components to assure maximum accessibility for required maintenance, service and repair.

C. Provisions for Later Installation: Make adequate provisions to accommodate items scheduled for later installation.

D. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
   1. Prepare similar memoranda for Construction Manager and separate contractors if coordination of their Work is required.

E. Administrative Procedures: Coordinate scheduling and timing of required administrative procedures with other construction activities and activities of other contractors to avoid conflicts and to ensure orderly progress of the Work. Such administrative activities include, but are not limited to, the following:
   1. Preparation of Contractor's construction schedule.
   2. Preparation of the schedule of values.
   3. Installation and removal of temporary facilities and controls.
   4. Delivery and processing of submittals.
   5. Progress meetings.
   6. Pre-installation conferences.
   7. Project closeout activities.
   8. Startup and adjustment of systems.

F. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials. Coordinate use of temporary utilities to minimize waste.

1.5 COORDINATION DRAWINGS

A. General (All Primes): The Contractors shall produce and submit project specific information for coordination purposes, a set of color-coded "Coordination Drawings" to confirm that the work of subcontractors is coordinated.
   1. Each prime shall provide 3-D REVIT coordination of their work with those of the other M/P/FP/E/L contractors as well as the concrete foundation, structural and architectural packages. As part of this effort each prime contractor and key subcontractors shall attend all coordination meetings & provide work plans on a weekly basis coordinated with the CM.
   2. Mechanical Prime Contractor (MC) will lead the coordination process. The MC will provide a cloud-based model hosting site for use by the project team during the coordination process. The point cloud shall be converted to a REVIT LOD 300 standard model for use by all primes.
   3. Drawings shall be drawn accurately to scale to show the interrelationship of components shown on separate shop drawings and shall indicate mechanical, plumbing, electrical, structural, fire protection, cable trays and contiguous architectural Work in sufficient detail so as to verify that contractors will accomplish their respective Work without conflicting with other contiguous trades. Refer to technical specifications for additional information.
   4. The GC Prime Contractor is responsible for providing a centerline Tekla model detailing structural members, connections, and all other structural components. The GC Prime Contractor will provide this complete model to the Mechanical/HVAC Contractor to use for coordination. The Mechanical/HVAC will lead the coordination process, after receipt of the Tekla model, and develop the base floor plan drawings to be utilized by all prime contractors to prepare and model their respective work. Upon completion and sign-off by all Contractors, the Mechanical/HVAC Contractor shall submit final coordination drawings to Architect/Engineer for review and acceptance.
   5. The Mechanical/HVAC prime shall provide means to host the coordination model for use by all other prime contractors throughout the entire duration of the project.
   6. Indicate space requirements for routine maintenance and for anticipated replacement of components during the life of the installation.
   7. Show location and size of access doors required for access to concealed dampers, valves, and other controls.
   8. Indicate required installation sequences.
   9. Indicate dimensions shown on the Drawings. Specifically note dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect indicating proposed resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.
   10. The following is a list of such Work requiring coordination drawings:
       a. Ceiling assemblies and cavities.
       b. Fire rated and acoustical partitions.
       c. MEPFP, A/V, Low Voltage, Security Systems.
       d. Structural Systems.

B. Coordination Drawing Organization: Organize coordination drawings as follows:
   1. Floor Plans and Reflected Ceiling Plans: Show architectural and structural elements, and mechanical, plumbing, fire-protection, fire-alarm, and electrical Work. Show locations of visible ceiling-mounted devices relative to acoustical ceiling grid. Supplement plan drawings with section drawings where required to adequately represent the Work.
   2. Plenum Space: Indicate sub framing for support of ceiling and wall systems, mechanical and electrical equipment, and related Work. Locate components within plenums to accommodate layout of light fixtures and other components indicated on Drawings. Indicate areas of conflict between light fixtures and other components.
   3. Mechanical Rooms: Provide coordination drawings for mechanical rooms showing plans and elevations of mechanical, plumbing, fire-protection, fire-alarm, and electrical equipment.
   4. Structural Penetrations: Indicate penetrations and openings required for all disciplines.
   5. Slab Edge and Embedded Items: Indicate slab edge locations and sizes and locations of embedded items for metal fabrications, sleeves, anchor bolts, bearing plates, angles, door floor closers, slab depressions for floor finishes, curbs and housekeeping pads, and similar items.
   6. Roof and Wall Penetrations: Indicate all penetrations required for all disciplines.
   7. Mechanical and Plumbing Work: Show the following:
      a. Sizes and bottom elevations of ductwork, piping, and conduit runs, including insulation, bracing, flanges, and support systems.
      b. Dimensions of major components, such as equipment, dampers, valves, diffusers, access doors, cleanouts and electrical distribution equipment.
      c. Fire-rated enclosures around ductwork.
   8. Electrical, A/V & Low Voltage Work: Show the following:
      a. Runs of vertical and horizontal conduit 1-1/4 in. in diameter and larger.
      b. Light fixture, exit light, emergency battery pack, smoke detector, and other fire-alarm locations.
      c. Panel board, switch board, switchgear, transformer, busway, generator, and motor-control center locations.
      d. Location of pull boxes and junction boxes, dimensioned from column center lines.
      e. Main distribution for low-voltage conduit.
      f. A/V and Low voltage equipment and components.
   9. Fire-Protection System: Show the following:
      a. Locations of standpipes, mains piping, branch lines, pipe drops, fire pump and related components and sprinkler heads.
   10. Security Systems.
      a. Runs of vertical and horizontal conduit 1-1/4 in. in diameter and larger.
      b. Panels boards, cabinets and equipment.
   11. Review: Architect will review coordination drawings to confirm that in general the Work is being coordinated, but not for the details of the coordination, which are Contractors' responsibility. If Architect determines that coordination drawings are not being prepared in sufficient scope or detail, or are otherwise deficient, Architect will so inform the CM, who will direct the Contractors make suitable modifications and resubmit.

C. Coordination Digital Data Files: Prepare coordination digital data files according to the following requirements:
   1. File Preparation Format: Same digital data software program, version, and operating system as original Drawings.

2. File Submittal Format: Submit or post coordination drawing files using format same as file preparation format or PDF format as agreed upon.
3. Architect and/or consultants will furnish Contractors one set of digital data files of BIM model for use in preparing coordination digital data files.
    a. Architect and/or consultants make no representations as to the accuracy or completeness of digital data files as they relate to Drawings. Prime contractors are solely responsible to modify, confirm dimensions in the field and incorporate changes as required to develop a fully coordinated model.
    b. Digital Data Software Program: Drawings are available in REVIT.
    c. Contractor shall execute a data licensing agreement in the form of Agreement included in this Project Manual or provided by A/E.
4. Modification of Original Coordination Digital Files: At completion of the Work, original coordination digital files shall be modified by Contractors to indicate as-built conditions and transmitted to the Owner.

D. Conservation: Coordinate construction activities to ensure that operations are carried out with consideration given to conservation of energy, water, and materials.

1.6 ARCHITECT'S SUPPLEMENTAL INSTRUCTIONS

A. Architect's Supplemental Instructions (ASI): An Architect's Supplemental Instruction is an instruction issued by the Architect to make minor changes in the Work that are consistent with the Contract Documents, fall within the Contract Sum, and do not involve an extension of Contract Time. This document describes the change and references any attached documents supporting the description. If a Contractor believes an ASI will affect the Contract Sum or Contract Time, the Contractor shall notify the CM in writing before proceeding with the affected Work and shall comply with Specification 012600, Contract Modification Procedures.

1.7 PROJECT WEB SITE

A. Use the Owners or CM's Project Web site for purposes of hosting and managing project communication and documentation until Final Completion. Project Web site shall include the following functions:
    1. Project directory.
    2. Project correspondence.
    3. Meeting minutes.
    4. Contract modifications forms and logs.
    5. RFI logs.
    6. Schedule.
    7. Submittal schedule.
    8. Submittals logs.
    9. Drawing and specification document hosting and viewing.

B. Managing the Project Management Information System (PMIS).
    1. This project will utilize Procore for all facets of the project including but not limited to communication, document control management and invoicing.
    2. Access to the PMIS system shall be granted the entire length of the project and for 3 months after the final completion date.

3. All prime contractors will submit RFI's and submittals through Procore for processing to CMa and Architect. As part of the training and pre construction conference, PMIS system work flow will be established.
4. Prime Contractors are required to submit updated submittal registers on a weekly basis until all submittals have been issued. This shall be uploaded to Procore and sent to the A/E and CMa for coordination.

C. Project Quality Records and Documentation.
   1. Use of Procore Software.
      a. Contractor acknowledges use of Procore CM software for tracking items related to QA/QC, access to which will be provided by the CMa.
      b. Access to Procore project shall be granted the entire length of the project and for 3 months after the final completion date.
   2. Test and Inspection Log: Contractor to record a log of all tests and inspections utilizing Procore Inspections. Recording of tests and inspections includes the following:
      a. Date test or inspection was conducted.
      b. Description of the Work tested or inspected.
      c. Date test or inspection results were transmitted to Architect.
      d. Identification of testing agency or special inspector conducting test or inspection.
      e. Result of inspection. Includes description of remedial work to complete in case of a failure.
      f. A copy of the testing agency/inspector's report.
   3. Punch List and Observations: Contractor acknowledges that use of Procore software includes not only entry of observations, punch list, tests, and inspections on the part of the Contractor, but also review and generation of responses to entries created by the CMa or AE in a timely manner.
      a. Observations will include items related to:
         1) Commissioning.
         2) Environmental.
         3) Quality.
         4) Safety.
         5) Warranty.
         6) Work to complete.
      b. The AE design team will input non-conformance items, punch list, and other related observations utilizing Procore in conjunction with the CMa. Contractor acknowledges review and response to AE provided items must be done in Procore by the due date specific to each item. Responses to punch list must include comment and/or photos related to the punch list item detailing date of completion, work completed, and any related documentation prior to review by the CMa/AE team.
   4. Commissioning: Cx Agent to utilize Procore to provide an issues log/action items to be provided to the responsible parties. Cx Agent will use the Commissioning Observation type to specify the issue, contributing conditions, contributing behavior, specific location if applicable, trade, assignees, and suggested actions.
   5. The contractor shall use Procore Daily Logs to record all project activities on a daily basis. Entries must be completed by the end of each workday and include:
      a. Weather conditions.
      b. Workforce details by trade with headcount and hours worked.
      c. Equipment on site and its operational status.
      d. Deliveries received and materials installed.

e. Safety observations and any incidents with corrective actions.
f. Significant events or delays impacting progress.
g. Coordination notes and meetings held.
h. Photos documenting site conditions and progress.
i. Daily logs must be accurate, timely, and reviewed by the CMa as part of ongoing project monitoring. Failure to maintain daily logs may result in withholding of payment until compliance is achieved.

D. Project PMIS and Training.
1. The CMa will provide training on the usage and functionality of Procore. CMa will coordinate and schedule (2) training sessions within fifteen (15) business days of the Notice to Proceed. All primes are required to attend one or both sessions.

E. PMIS Closeout.
1. Project PMIS will remain open for a period of three (3) months after Final.
a. Completion to allow all parties access to necessary information. The Owner has discretion to deny access to users at any time.

F. Contractor, subcontractors, and other parties granted access by Contractor to Project Web site shall execute a data licensing agreement.

1.8 REQUESTS FOR INFORMATION

A. Definition: During the bidding process or progress of the Work, the Contractor may uncover situations for which they believe the Contract Documents are not clear in their requirements whereupon they may submit a Request for Information (RFI) to the CM. The CM will then forward to the Architect with recommendations.

B. Correspondence: Contractor correspondence related to the Work shall be addressed to the Architect.

C. General: Immediately on discovery of the need for additional information or interpretation of the Contract Documents, Contractor shall prepare and submit to the Construction Manager an RFI in the form specified.
1. Construction Manager will return RFIs submitted to Architect by other entities controlled by Contractor with no response.
2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.

D. Conditions for Requests for Information: If, after issuance of the "Notice to Proceed" clarification from the Architect concerning questions which may have arisen during the course of the Work, the Contractors may initiate a process of standard form letters identified as "Request(s) for Information" (RFI) subject to the following conditions:
1. RFIs will only be submitted and processed through Procore. No other method of submission will be accepted.
2. RFIs shall contain specific reference to the project name, project number, name of Contractor, Architect, and the CM, drawing number and detail references, specification section and paragraph number, schedule type, or other related document which is pertinent to the Contractor's inquiry. The date of referenced documents or drawings must

be clearly identified.

3. RFIs shall include all field dimensions, sketches, descriptions, measurements, photos, product data or other information necessary to fully describe items needing interpretation. Contractor is to provide a suggested solution. If the suggested solution may impact the Contract Time, Contract Sum, or schedule, the Contractor must state the impact.
4. RFIs shall originate only from the Contractor's on-site staff and shall be signed by the Contractor. RFI's submitted to the Architect by individuals other than the CM will not be accepted.
5. Architect and CM will use reasonable efforts to respond to and return RFIs to Contractor within ten (10) business days after receipt of a complete RFI. Complex RFIs or RFIs requiring consultant review may require additional time. No failure to respond within that period shall constitute approval of the Contractor's proposed solution or, by itself, entitle the Contractor to additional compensation or an extension of Contract Time.
6. RFIs shall not be utilized by the Contractors to request approval of submittals or to solicit consideration by the Architect of a "substitution".
7. RFIs shall not be utilized by the Contractors to request any extension of Contract time or to request any revision of Contract cost. If the Contractors believes that the response received from the Architect to any RFI warrants adjustment of the Contract time or cost, he shall advise the CM in writing immediately upon receipt of the response.
8. RFIs shall not be utilized by the Contractors to request coordination information already indicated in the Contract Documents or to solicit clarification of comments that have been communicated to the Contractor by the Architect in the course of shop drawing review or the review of other required submittals.
9. The Owner reserves the right to assess the Contractors for the cost (based on time and materials) of the review process performed by the Architect and/or any of the Architect's or Owner consultants when RFI's fail to conform to the requirements stated herein, or in the opinion of the Architect, are unnecessary or frivolous (i.e.; the subject of the inquiry noted in the RFI is suitably and/or clearly addressed in the Contract Documents).
10. The Contractors shall submit RFI's sufficiently in advance of the Work to be performed as it relates to the Construction Schedule such that the Architect has ample time to review and respond to RFI's. The Architect will respond to RFI's sequentially in the order they are received.
11. Any written or electronic procedure selected by the Contractors to solicit responses to questions which arise during the course of the Work shall be required to comply with the procedures stated in paragraphs above.
12. RFIs not to be used for:
    a. Resolving Contractor error.
    b. Assisting in the development of a shop drawing.
    c. Confirming a conversation, correspondence, discussion, or decision.
    d. Requesting information not pertaining to the contracted scope of work.
    e. Seeking direction for client directed work or changes unrelated to deficiencies in the contract documents.
    f. Seeking direction for contractor materials and methods procedures.

1.9 LEAN CONSTRUCTION PRINCIPLES

A. Lean Construction Management: The Owner intends to implement the following Lean Construction Principles on this Project. To the extent Lean Principles are implemented, the Owner will require all Prime Contractors to accommodate and participate.

B. "Last Planner System" (LPS) using Pull Scheduling and Percent Planned Complete (PPC) Tracking: The project will utilize the Last Planner System to develop and implement the detailed work plans for each phase of the project based on the master project schedule. That includes Pull Plans and Percent Planned Complete (PPC) tracking that will be utilized throughout the project according to the CMa's methodology.

C. Prime Contractor Last Planner Requirements.
   1. Prime Contractors shall understand that the CMa will be tracking major "promises made".
   2. All "promised" tasks shall be tracked in the matrix with a task description, Prime Contractor responsible, and promised completion date.
   3. CMa will provide Prime Contractor feedback on their reliable promising performance during weekly Foreman's meetings.
   4. CMa will provide an overall PPC rating to each Prime Contractor at the end of the project.
   5. Prime Contractors and other key personnel noted in previous sections will attend pull planning meetings at the request of CMa Superintendent and/or Project Manager.
   6. Actively participate in weekly work planning meetings to review past, current, and future work activities.
   7. MUST prepare and submit Weekly Work Plans as agreed by the contract.
   8. MUST report and track task completions on a weekly basis.

D. To implement the LPS effectively, it is critical for the Prime Contractors Foremen requires certain, specific behavior and actions on the part of the individual's firm, which are described as follows:
   1. Prime Contractors foremen are expected to plan together with other trades in building a "Pull Schedule" for each major phase of work on the project in which they will be participating.
   2. MUST participate in Pull Planning Sessions in which the Prime Contractor is involved and have necessary authority to make decisions on manpower, equipment, materials, and other required resources to ensure commitments are met. Failure to provide an appropriate attendee, timely notice, or attendance may result in a back charge for reasonable, documented costs actually incurred by the Owner or CMa as a direct result, to the extent permitted by the Contract Documents.
   3. Has the ability to plan work for his organization and authority to make commitments to the project in order to execute that plan and/or the person that is able to commit manpower and material needs should be present at the meeting. The end goal of the last planner each week is to make legitimate and obtainable commitments.
   4. MUST know and understand the latest information about the status of contract issues, submittals and shop drawings, material and equipment deliveries, RFI's and changes orders, safety training, labor, and construction equipment availability.
   5. MUST attend and fully participate in Weekly Work Planning meetings (typically about an hour) and Daily Shift Startup Meetings (typically less than 15 minutes, sometime during the day as chosen by the team - not necessarily at startup).
   6. Foreman/PM attend training, provided by CMa, to orient to this system. (Typically 8 hours).

E. Last Planner® System of Production Control.
   1. The Last Planner System of Production Control, or LPS, is an important component of lean construction and the one that has been widely implemented. The LPS was developed to produce predictable workflow and rapid learning. This produces maximum value to the Owner and Contractors by eliminating waste caused by unpredictable workflow. Its use has enabled contractors to reduce the delivery time of the project and at the same time allowed specialty contractors to improve utilization of their resources.
   2. This requires team members (owner, designer, CMa, prime contractors and their sub-contractors), to make and keep commitments based on their confidence that prerequisite work, design information, materials, labor and equipment will be ready so they can start and complete installations to meet Master Schedule milestones.

F. Pull Planning Meeting.
   1. In the Pull Planning Meeting, the CMa will facilitate the meeting and the Prime Contractors foremen structure the flow of work and design the network of commitments by identifying hand-offs between trades.
   2. Each Prime Contractors foremen is considered a "Last Planner" in the LPS, and has the responsibility to plan their activities ten - twelve weeks ahead in a "Make Ready Schedule" and to identify crew assignments for the current and next week in a "Weekly Work Plan".
   3. Last Planners are asked to commit to performing work that they know can be made ready for their crews and to refuse to assign work they are not confident can be started and/or completed because it is not ready. It is this cycle of planning and commitment coupled with learning from seeing the results which creates reliable workflow.
   4. The LPS is based on milestones from the Master Schedule, which are used to identify phases. The effort to determine work flow in the Phase Schedule takes place in a Pull Planning Session involving the Last Planners and in most cases the Project Manager, Owner, CMa and Designers and Prime contractor foreman/PM.
   5. When this workflow plan is converted to a Gantt chart or CPM type schedule and reformatted/filtered to represent the next six-eight week's work, it becomes known as the Make Ready Schedule and is the basis of planning and constraint identification. It also identifies those activities that must be included in the Weekly Work Plan (WWP) - the commitment list for the work force.
   6. Typically, the Make Ready Schedule is developed on the project scheduling system (MS Project, Suretrack, Primavera P6, etc.) and the WWP is based on an Excel spread sheet.
   7. An important part of the LPS is the monitoring and reporting of the team's success in meeting their commitments and the learning developed when the failures are discussed, and improvement strategies put in place.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 013200

CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 GENERAL

1.1 SUMMARY

A. General: The Construction Manager as Advisor (CMa) shall provide administrative, management and related services to coordinate scheduled activities and responsibilities of the Prime Contractor(s) with each other and with those of the Construction Manager as Advisor, the Owner and the Architect. The Construction Manager as Advisor shall assist in coordination of the Contractors' activities in accordance with the current Master Project Schedule issued for the Project and the Contract Documents.

B. The requirements outlined in this specification are the responsibility of each Prime Contractor. The CMa is responsible to facilitate the development of the Master Schedule by which each Prime Contractor provides their activities, durations, logic and other necessary information. The contractors are responsible for providing logic for their activities as well as how the activities tie to other prime contractor's activities. Logic issues and inconsistencies are not grounds for delay claims. The schedule must align to contractual milestones.

C. Contractors shall provide the documentation of the progress of construction during performance of the Work and includes, but is not limited to:
   1. Preliminary Construction Schedule.
   2. Baseline Schedule.
   3. Contractor's Construction Schedule.
   4. Submittals Schedule.
   5. Progress Schedule Updates.
   6. Daily Construction Reports and Progress Reports.
   7. Schedule of Values and Trade Payments Breakdowns.
   8. Construction Survey Data.
   9. Material location reports.
   10. Manpower Reporting.
   11. Field condition reports.
   12. Special reports.
   13. Construction Photographs.

1.2 DEFINITIONS

A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
   1. Critical activities are activities on the critical path. They must start and finish at the

planned early start and finish times.
2. Predecessor activity: is an activity that must be completed before a given activity can be started.
3. Successor Activity: An activity that follows another activity in the network.

B. Construction Manager as Advisor: referenced herein as Construction Manager, CMa or CM. Responsibilities for scheduling are defined as noted.

C. Contractor: referenced herein as Prime, Prime Contractor, contractor or contractors all refers to the responsibilities of each prime contractor unless a singular prime contractor is identified.

D. Cost Loading: The allocation of the schedule of values for completing an activity as scheduled. The breakdown of the Contract Amount and assignment of specific costs to each activity in the Baseline Schedule. The sum of costs for all activities must equal the total Contract Sum unless otherwise approved by the Owner, Architect and Construction Manager as Advisor.

E. CPM: Critical path method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships and schedule logic forming a network of activities in the Master Schedule Network calculations determine when activities can be performed and the critical path of Project.

F. Critical Path: The longest continuous chain of activities through the network schedule that establishes the minimum overall Project duration.

G. Event: The starting or ending point of an activity.

H. Float: The measure of leeway or slack in starting and completing an activity.
1. Free float is the amount of time any single activity can be delayed without adversely affecting the early start of the following activity.
2. Total float is the measure of leeway in starting or completing an activity or any activity on the same activity path without adversely affecting the planned Project Completion date or Contractual Completion date for the schedule network. Total float is a shared Project resource and is not for the exclusive use of any Contractor. Use or allocation of total float for Project coordination or the benefit of the Project shall not, by itself, entitle a Contractor to an adjustment of Contract Time or compensation except as otherwise expressly provided in the Contract Documents.

I. Milestone: A key or critical point in time for reference or measurement. A milestone activity has no duration and identifies a significant date in the schedule network. Milestones can be start or finish type.

J. Network Diagram: A graphic diagram of a network schedule, showing activities and activity relationships which depicts the order and interdependencies of activities and the sequence in which work is to be accomplished.

K. Resource Loading: The allocation of manhours to each associated construction activity in the schedule for the purpose of determining crew size and labor allocation per activity and over the course of the project. Resources shall be loaded into the Baseline schedule and reviewed at

the beginning of the Project for coordination and progress monitoring by the Owner, Architect and Construction Manager as Advisor.

L. Cost Loading: The allocation of cost resources to each activity in the network schedule for the purpose of determining the cost associated with a give activity over the course of the project. Costs shall be loaded into the approved Baseline schedule and reviewed by the CMa and architect with accompanying progress payments to review work in place by the Contractor.

1.3 SUBMITTALS

A. Contractors shall submit the following information to the CMa, which shall be submitted for Architect's review and comment or information.
   1. Submittal Schedule: Submit an electronic copy of submittal schedule, within 15 days of NTP, using software, format and media storage as agreed upon, and labeled to comply with requirements for submittals. Include type of schedule ("Initial" or "Updated") and revision date and revision number.
   2. Submittals Log: An electronic version of an updated submittals log allowing the Architect live access to open and closed submittals and reports at all times, which will also be provided at weekly progress meetings or other agreed upon intervals. These logs are to be updated and coordinated with updated construction schedules throughout the project.
   3. Start Up Construction Schedule: Within 10 calendar days after the NTP is received submit the Start Up Construction Schedule defining the planned operations detailed for the first 120 to 180 calendar days for review and coordination. The Start Up Schedule may be summary in nature for the remaining performance period. It must be early start and late finish constrained and logically tied as specified. The Start Up Schedule forms the basis for the Initial Contractors Schedule specified herein and must include all of the required plan and program preparations, submissions and approvals identified in the contract (for example, Quality Control Plan, Safety Plan, and Environmental Protection Plan) as well as permitting activities. The Start Up Construction Schedule shall be reviewed by the Architect, Owner and/or Construction Manager for conformity with Contract requirements and coordination purposes; such review does not relieve Contractor of responsibility for schedule completeness, accuracy, logic, or performance.
   4. Contractors Project Schedule Submission: Submit the Initial Project Schedule for integration into the Project Master within 20 calendar days after notice to proceed is issued. The schedule must demonstrate a reasonable and realistic sequence of activities which represent all work through the entire contract performance period. No payment will be made for work items not fully detailed in the Project Schedule.
   5. Periodic Schedule Updates: Update the project schedule on a regular basis, monthly at minimum. Provide status updates with a consistent monthly data date (typically the last day of each month) within 5 days of the data date for each update or as defined in the specifications. Update information will include AS (Actual Start) AF (Actual Finish), RD (Remaining Duration) and Percent Complete and be updated on a monthly update form. Periodic Updates shall be reviewed by the Architect, Owner and / or CM.
   6. Contractor's Construction Schedule: Submit an electronic copy of construction schedule, using Oracle Primavera P6 software in. xer format and labeled to comply with requirements for submittals. Include type of schedule ("Initial" or "Updated") and revision date and revision number. P6 will be the sole software platform for the project unless otherwise noted.

B. Other Reports:
   1. Daily Construction Reports: Submit electronic copies at weekly intervals.
   2. Material Location Reports: Submit electronic copies at weekly intervals.
   3. Field Condition Reports: Submit electronic copies at time of discovery of differing conditions.
   4. Special Reports: Submit electronic copies at time of unusual event.
   5. Schedule Narrative Reports: Provide a Narrative Report with each schedule submission (including Updates). The Narrative Report is expected to communicate to the thorough analysis of the schedule output and the plans to adjust for any problems, either current or potential, which are revealed through that analysis. Include in each narrative, work completed during the period, work planned to start in the next month, Critical Path Review and any noted changes, Issues that have arisen, Logic revisions during the period, deleted activities and added activities.

C. Photographic Media: Submit for Owner's Documentation and Architect's information.
   1. Digital Images: Submit a complete set of digital image electronic files using software, format, and media storage as agreed upon as a Project Record Document. Submit images that have same aspect ratio as the sensor, un-cropped.
      a. Identification: Identify electronic media with the following information:
         1) Name of Project.
         2) Name and address of photographer.
         3) Name of Architect.
         4) Name of Contractor.
         5) Date photograph was taken.
         6) Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.

1.4 QUALITY ASSURANCE

A. LEAN Procedures: See Section 01 31 00 - Project Management and Coordination.

B. Pre-Scheduling Conference: Conduct conference at Project site to comply with requirements in Division 1 Section 01 31 00 "Project Management and Coordination." Review methods and procedures related to the Preliminary Construction Schedule and Contractor's Construction Schedule, including, but not limited to, the following:
   1. Review software limitations and content and format for reports.
   2. Verify availability of qualified personnel needed to develop and update schedule.
   3. Discuss constraints, including work stages, interim milestones, and partial Owner occupancy.
   4. Review delivery dates for Owner-furnished products.
   5. Review schedule for work of Owner's separate contracts.
   6. Review submittal requirements and procedures.
   7. Review time required for review of submittals and resubmittals.
   8. Review requirements for tests and inspections by independent testing and inspecting agencies, including mock-up testing.
   9. Review time required for completion and startup procedures.
   10. Review and finalize list of construction activities to be included in schedule including activities for Procurement, Shop Drawing Submittals and Approvals, Material

Fabrication, Mockups, Phases of Construction, Inspections, Startup and Testing, Punchlist, Turnover, and Owner required activities.

11. Review procedures for updating schedule. Items to discuss include frequency of update (minimum monthly), Gathering update information / activity status, review of the draft updates, schedule revisions, recovery schedules (if required), reporting, and final issuance of the update.

1.5 COORDINATION

A. Schedules and Reports of Construction Activities and Separate Contractors: Coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of separate contractors. During Periodic Updates Coordinate with each contractor to record the status of construction and integrate into the Master Project Schedule. Each contractor shall actively participate, attend all schedule update review meetings and have input in the Master Project Schedule.

B. Coordination of Contractors' Construction Schedules: Coordinate Contractors' Construction Schedules with the Schedule of Values, list of subcontracts, Submittals Schedule, progress reports, payment requests, and other required schedules and reports.
   1. Secure time commitments for performing critical elements of the Work from parties involved.
   2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence. Review predecessors - successors for each activity and coordinate with all contractors to ensure dependent activities are documented in the schedule correctly.

C. Auxiliary Services: Cooperate with photographer and provide auxiliary services requested, including access to Project site and use of temporary facilities including temporary lighting.

PART 2 PRODUCTS

2.1 SUBMITTAL SCHEDULE

A. Preparation of Submittal Schedule: Prepare a submittal schedule arranged in chronological order by dates required by construction schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates that contains a complete listing of submittals required by Contract. Submit the schedule to the Architect a minimum of 30 days prior to submitting any submittals grouped and regulated so as not to burden the reviewing facilities, while maintaining job progress. Organize the submittal schedule by specification section number. Each submittal is to be assigned the relevant section number and a sequential number for identification and tracking purposes. Each prime shall provide bi-weekly submittal schedule updates, including all pertinent information, until submittals are complete. Failure to submit timely and accurate submittal schedule will delay invoice processing.
   1. The Submittal Schedule shall be submitted for the Architect's information. Include the following information:
      a. Title of Submittal/Description.
      b. Submittal Number (sequential).
      c. Scheduled date for the first submittal.
      d. Drawing Number (if applicable).
      e. Applicable specification Section title and number.
      f. Name of subcontractor/vendor.
      g. Submittal category (action or informational).
   2. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Construction Schedule.

2.2 SUBMITTALS LOG

A. Submittals Log: Prepare, submit, maintain, and update a single live electronic version of a submittals log (in Microsoft Excel) for the entire project, using approved software, format, and media storage as agreed upon. The submittals log shall be accessible to the Architect at all times and shall contain relevant information related to submittals and the submittal process progress which will be reviewed at the weekly progress meetings or other agreed upon intervals. The logs shall include at a minimum a complete list of required submissions per the project specifications, current status, submission or resubmission date, date required, revision, submittal number and submittal description. The submittals log shall provide the Architect and CMa with the ability to filter for open and reviewed items, have ongoing access to live updates, as well as confirm receipt and response dates for every submittal. The submittal log shall be based on the CSI numbering system and the Project specifications and shall be available to Project team members.
   1. The submittal log shall be updated weekly in a live excel format until all submittals are submitted to the Architect and CMa for review and approved.

2.3 SCHEDULE OF VALUES

A. Contractual Requirements: Refer to General Conditions and Division 01 specifications, for contractual requirements governing schedule of values.

B. Relation to Sections and Divisions of the Work: The schedule of values shall be related to Sections and Divisions of the Work, aggregating the total Contract Sum and shall include overhead and profit as separate line items.

C. Schedule of Anticipated Monthly Requisition Amounts: The Contractor shall also submit a schedule of anticipated monthly requisition amounts which shall be related to the progress schedule.

2.4 CONSTRUCTION SCHEDULE, GENERAL

A. Based on the bid schedule, sequencing, phasing, and durations provided, the Prime Contractors shall prepare construction schedules representing their full scopes of Work in the format and program defined herein for integration into the Master Project Schedule prepared by the Construction Manager as Advisor (CMa). Each Prime Contractor shall participate in development of the Master Project Schedule and promptly identify conflicts affecting its Work. Following coordination, the Master Project Schedule issued by the CMa and accepted by the Owner shall be the schedule of record for measuring sequencing and progress, subject to the Contract Documents. A Contractor's disagreement with, objection to, or failure to accept the Master Project Schedule shall not prevent its issuance or relieve the Contractor of its obligation to proceed with the Work. The schedule-development process is iterative. Costs of preparing, coordinating, revising, and updating schedules are included in the Contract Sum, and no additional compensation or time will be due for such efforts except to the extent expressly authorized by the Contract Documents. Review, acceptance, or use of any schedule by the CMa, Architect, or Owner does not relieve any Contractor of responsibility for its means, methods, sequences, durations, logic, or timely completion and does not modify the Contract Time or any contractual milestone except by Change Order or other written Modification authorized under the Contract Documents.

B. The CMa shall be the Scheduler of Record for the Project Master Schedule. Each Contractor shall have input creating and developing his / her own schedule activities for their work scope. Each Prime Contractor will submit a listing of his/her activities in the appropriate format to the CMa for input in the Master Project Schedule. Activities should have Description, Duration, Manpower to complete that Activity, Predecessors and Successors, and sequence of construction.In addition, each Prime Contractor will list out all required submittals, shop drawings, mockups, inspections, permitting, preinstallation, architect / engineers review and fabrication time for all materials required on the project. The contractors schedule submission shall allow time for things such as, review time, inspections, site visits, fabrication, weather, delivery, cure / drying to not affect the progress of work. Each Prime Contractor shall provide an acceptable construction schedule within 20 days of NTP which is compliant with the bid schedule and includes all tasks required to complete the contractor's work. All costs incurred by the Contractors in preparing and updating the Schedules are included in the Work of the Contract.

C. Computer Scheduling Software: Prepare schedules using current version as defined below.
   1. Use Oracle Primavera P6, version 16 or later. Include electronic schedule in.xer format with all schedule submissions. (use of an earlier version or different scheduling program requires the approval of the CMa).
   2. There shall be no additional costs for updating to the most current version of the required software even if this occurs during the project.

D. Contractor's Construction Schedule Preparation.
   1. Develop the Contractor's Construction Schedule no later than twenty (20) days after Contract Award, NTP which timeframe is established to allow for the Project Master Schedule to be prepared within thirty (30) days.
      a. Failure to include any work item required for performance of this Contract shall not excuse Contractor from completing all work within applicable completion dates, regardless of CMa, Architect's, and / or Owner's review of the schedule.
      b. Contractor(s) to submit cost and resource loaded schedule. Included with the contractor's initial construction schedule submission will be allocation of cost and resources (manhours) loaded in the contractor's activities. Costs shall not be frontloaded and shall equal the total value of the contractor's contract sum. The cost loaded schedule will be the basis for monthly progress payments and tracking of work in place. Resource loading will include total manhours per activity and loaded as a resource into the Master Project Schedule for each work activity. The cost and resource loaded schedule will be reviewed by the Architect, Owner, and/or CMa for payment administration, coordination, and progress monitoring; such review shall not constitute approval of Contractor's means, methods, productivity assumptions, or schedule logic.
   2. CMa will develop the Master Schedule WBS (Work Breakdown Structure), with input from the Contractor(s); the Contractor(s) integrate their activities and send to CMa for incorporation into Master Project Schedule. An initial WBS will be shared with the contractors within 5 days of the NTP. Contractor shall provide comments within 5 days in order for the Master Schedule WBS to be published for use.
   3. The CMa will facilitate schedule workshops to develop the Project Master Schedule. Each Contractor shall attend all workshops required to review the integration of the Contractor's Construction Schedule into the Master Project Construction Schedule. These meetings will be required until the CMa determines that the Master Project Schedule is sufficiently coordinated and issues it following review by the Owner and A/E. Contractor participation in additional schedule workshops is included in the Contract Sum and shall not entitle Contractor to additional compensation or time except as expressly provided by the Contract Documents.
      a. The CMa shall integrate the contractor's Construction Schedule into the Master Project Schedule. The contractors, in conjunction with the CMa, will coordinate all schedule activities, logic and other relevant schedule requirements including those of the various other Contractors into the Master Project Schedule. The Master Schedule development and coordination will be deemed complete when the CMa determines, after considering Contractor input and subject to Owner review, that applicable schedule requirements have been satisfied. The CMa will serve as the record-keeper of the Master Project CPM Schedule with input and accountability by all separate Prime Contractors. The Master Project Schedule will be used to measure progress throughout the duration of the project. All contractors will partake in the Periodic updates, including all necessary workshops, of the Master Project Schedule.

4. Each Prime Contractor shall be responsible for the development of schedules subject to all the same requirements and appropriate for integration by the Construction Manager into the Master Project Schedule. All Prime Contractors are required to submit Schedule Activity Listings in an acceptable format to the CMa. The CMa shall have the right to reject any format that doesn't meet the CMa requirements. All Prime Contractors agree in advance that the integration of schedules is an iterative process and that durations are subject to adjustment, within reason, to align with the properly scheduled work of other prime contractors and subcontractors. Any adjustment made for coordination shall not modify the Contract Time, contractual milestones, scope of Work, or entitlement to compensation unless authorized by a written Modification in accordance with the Contract Documents.
5. Weather: As set forth in the General Conditions, all prime contractors are obligated to account for normal weather conditions, as defined by the NOAA 15-year average for the locality in which the work is performed.
    a. Contractors shall plan for and anticipate loss in its project schedule, all days and productivity for normal temperature, precipitation and wind (Based on the NOAA 15-year average) including related impacted days as a result of a weather event (i.e. cleanup, rework, snow removal, wet/frozen conditions, etc.). The contractor shall include necessary labor, material and equipment necessary to accommodate "weather" in order to achieve contractual schedule milestones dates.
    b. Any Delays requested for weather must be justified and validated using appropriate weather date from NOAA based on a 15-year average for the closest weather station to location of the project.
    c. Weather delays will be reviewed on a monthly basis and notification by the contractor will be per the notice clauses of impacts and delays noted in the contract general conditions.
    d. Precipitation Lost Day Event is defined as:
        1) Rain total greater than or equal to 0.5."
        2) Snow total greater than or equal to 2."
    e. Temperature Lost Day Event is defined as:
        1) Cold Weather: Days lost due to Cold Temps = Less than / Equal to 20 degrees for temperature dependent work, unless the contract stipulates requirements to provide temporary conditions provisions for work due to anticipated work during cold weather months which include November through March.
    f. Only weather impacts which affect critical path dates and the overall Substantial Completion Date required by the Contract will be considered for a time extension.
    g. Weather impacts will not be projected past the data date for any schedule update.
    h. The contractor will clearly document any weather delays and be responsible for demonstrating the impact to the critical path within the Master Project Schedule.
    i. Pursuant to the general conditions, justified weather delays will be Excusable/Non-compensable.
6. Costs associated with preparing, updating, coordinating, and modifying schedules to produce a compliant Overall Project Schedule are included in the Contract Sum and shall not form the basis for additional compensation or time except to the extent expressly authorized by the Contract Documents.

E. Contractor Scheduling Consultant: Engage a consultant to provide planning, evaluation, and reporting using CPM scheduling.
    1. In-House Option: Owner may waive the requirement to retain a consultant if Contractor

employs skilled personnel with experience in CPM scheduling and reporting techniques that meets the qualifications noted below. Submit qualifications for approval to CMa within 5 days of the NTP.

2. Meetings: Scheduling consultant shall attend, in person, all meetings related to Lean Process/Pull Planning, Development of the Project Master Schedule, Project progress meetings, Schedule update workshop meetings, alleged delays, and time impact.
3. Qualifications: Project scheduler or consultant shall have a minimum of 8 years scheduling experience with similar projects using Primavera P6. Scheduler qualifications for each prime contractor shall be submitted within 5 days of the Notice to Proceed. The CMa has the right to approve or disapprove of any proposed scheduling consultant.

F. Schedule Preparation: Prepare a list of all activities required to complete the Work. Using the startup network diagram, prepare a skeleton network to identify Critical Path and subsequent near-Critical Paths.
1. Activities: Indicate the estimated time duration, sequence requirements, and relationship of each activity in relation to other activities. Include estimated time frames for the following activities:
    a. Award and procurement of trades/subcontractors.
    b. Preparation and processing of submittals.
    c. Purchase of materials.
    d. Delivery.
    e. Fabrication. Mobilization and demobilization.
    f. Utility interruptions.
    g. Installation.
    h. Work by Owner that may affect or be affected by Contractor's activities.
    i. Testing and Inspections.
    j. Punch list and final completion.
    k. Final Inspections and Turnover (including required by the AHJ).
    l. Activities occurring following final completion.
2. Processing: Process data to produce output data on a computer-drawn, time-scaled network. Revise data, reorganize activity sequences, and reproduce as often necessary to produce the CPM schedule within the limitations of the Contract Time.
3. Contract Modifications: For each proposed contract modification and its concurrent submission, prepare a Time-Impact Analysis (TIA) using a network fragment to the effect of the proposed change on the overall project schedule.
    a. As determined by CPM analysis, only delays in activities which affect critical path dates and the overall Substantial Completion Date required by the Contract will be considered for a time extension.
    b. All TIAs shall be contemporaneous in nature and submitted within 21 days of the delaying event. It is the contractor's duty to demonstrate the alleged delay is solely impacting the Critical Path and not concurrent with any other delays. Delays due to weather and / or Force Majeure will be deemed non-compensable, and the remedy will be time only (no compensation).
    c. Extensions of time granted to one Prime Contractor shall not affect any other Prime Contractor or any subcontractor except those identified and approved as part of the extension.
    d. If the Contractor requests a time extension of any milestone date or Contract completion date, the Contractor shall provide documentation as required by the CM to enable the CM to determine whether a time extension is appropriate under the

terms the Contract. The Contractor shall submit the Time Impact Analysis which clearly identifies the delay or impact and its effect on the Critical Path. The impact must be solely on the Critical Path in order to recover time and/or compensation for the delay. The contract completion date will be adjusted only for causes specified in the Contract documents.

4. Initial Issue of Schedule: Prepare initial network diagram from an indicating straight "early start-total float." Identify critical activities. Prepare reports showing the following:
   a. Contractor or subcontractor and the Work or activity.
   b. Description of activity.
   c. Main events of activity.
   d. Immediate preceding and succeeding activities.
   e. Early and late start dates.
   f. Early and late finish dates.
   g. Activity duration in workdays.
   h. Total float or slack time.
5. Schedule Updating: Concurrent with making revisions to schedule, prepare tabulated reports showing the following:
   a. Identification of activities that have changed.
   b. Changes in early and late start dates.
   c. Changes in early and late finish dates.
   d. Changes in activity durations in workdays.
   e. Changes in the critical path.
   f. Changes in total float or slack time.
   g. Changes in the Contract Time.
6. Use "one workday" as the unit of time for individual activities. Nonworking days and holidays shall be incorporated into the schedule in order to coordinate with the Contract Time.
7. The Contractor shall not schedule, allow or direct materials or products to be installed prematurely when it is obvious that such materials may be damaged by his own subsequent work or that of another Contractor. When recognized construction procedures or design requirements prescribe that materials be installed before execution of other work which may damage or deface such completed work, the Contractor shall then take such steps as are necessary to protect such completed work.

G. Work Breakdown Structure: Format schedule using Work Breakdown Structure (WBS) to delineate procurement packages, phases, work areas, etc. The base WBS for the project will be developed by the contractor(s) in conjunction with the Construction Manager. Develop the WBS to sufficiently organize and group activities so workflow can be easily understood. The Construction Manager shall have the right to reject or modify the Contractors proposed WBS.
   1. Contractor(s) shall prepare schedule activities for their respective work including logic, relationships, durations, manpower, cost, and sufficient detail as required by the Construction Manager.

H. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
   1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.

I. Activities: Treat each story or separate area as a separate Work Breakdown Structure (WBS) for each main element of the Work. Comply with the following:
   1. Activities shall be sufficiently detailed to indicate each element of work, by specific trade and area the work is taking place.
   2. Activity Duration: Define activities so no activity is longer than 20 days, unless specifically allowed by CMa. Written approval will be required for activities greater than 20 days.
   3. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
   4. Submittal Review Time: Include review and resubmittal times indicated in Division 1 Section 01 33 00 "Submittal Procedures" in schedule. Coordinate submittal review times in Contractor's Construction Schedule with Submittals Schedule.
   5. Startup and Testing Time: Include not less than fifteen (15) days for startup and testing. Start up activities must be sufficiently detailed.
   6. Milestone: the CMa will provide a list of standard milestones to be incorporated into the contractor's schedule. Milestones shall contain logic and be tied with relationships (no constraints). Milestones will identify significant start and finish dates within the schedule for the purpose of measuring progress and completion of major elements or areas of work.
   7. Substantial Completion: Indicate completion in advance of date established for Substantial Completion and allow time for Architect's and Construction Manager's administrative procedures necessary for certification of Substantial Completion. Allow time for local authority (AHJ) inspections to obtain interim approvals, C of O and/or Substantial Completion Certificate.
   8. Punch List and Final Completion: Include not more than thirty (30) days for completion of punch list items on any phase and punch-list items and close-out requirements for final completion at final phase.

J. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule and show how the sequence of the Work is affected.
   1. Phasing: Arrange list of activities on schedule by phase.
   2. Work under More Than One Contract: Include a separate activity for each contract.
   3. Work by Owner: Include a separate activity for each portion of the Work performed by Owner.
   4. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 1 Section 01 11 00 "Summary of Work". Delivery dates indicated stipulate the earliest possible delivery date.
   5. Owner-Furnished Products: Include a separate activity for each product. Delivery dates indicated stipulate the earliest possible delivery date.
   6. Work Restrictions: Show the effect of the following items on the schedule:
      a. Coordination with existing construction.
      b. Limitations of continued occupancies and egress / ingress pathways by existing occupants.
      c. Uninterruptible services.
      d. Partial occupancy before Substantial Completion.
      e. Use of premises restrictions.
      f. Enabling work or temporary construction measures to support future Phases.

g. Provisions for future construction.
h. Seasonal variations.
i. Environmental control.

7. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
   a. Subcontract awards.
   b. Submittals.
   c. Purchases.
   d. Mockups.
   e. Fabrication.
   f. Sample testing.
   g. Deliveries.
   h. Installation.
   i. Tests and inspections.
   j. Adjusting.
   k. Curing.
   l. Startup and placement into final use and operation.
   m. Final Inspection and turnover.
8. Construction Areas or Area Separations: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for the following:
   a. At a minimum the schedule should include the following:
      1) WBS Element.
      2) Floor.
      3) Building / Wing.
      4) Sub Floor / Area.
      5) Construction Category (i.e.: Sitework, Structure, Envelope, Roofing, MEPS Systems / Rooms, Vertical Transportation, Interior Fit out, Risers, Punchlist & Turnover).
      6) Other relevant project specific items.
9. Milestones: Include milestones indicated in the Contract Documents Bid schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, and Final Completion and the following interim milestones:
   a. Project Award.
   b. NTP (Commencement).
   c. Interior Demolition Complete.
   d. Underslab Rough-in Complete.
   e. MEP Rough-in Complete.
   f. Roof Replacement Complete.
   g. Permanent Power Available.
   h. Temporary Conditioning Using Permanent Systems Available.
   i. Façade Complete.
   j. Temp Dry-In (ROOF & CW/WINDOWS COMPLETE).
   k. Start Fitout.
   l. Start Drywall.
   m. Start Ceiling Grid.
   n. Start Flooring.
   o. Start Punchlist (CONSTRUCTION COMPLETE / CLEAN).

p. Substantial Completion / C OF O.
q. Final Completion.

10. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests. Schedule of value / S-Curve of Plan vs Actual costs as is relates to the schedule in order to forecast the construction costs per month or required time interval.
11. Resource Loading Requirements:
    a. Activities shall be loaded with resource assignments (manhours) within the Master Project CPM Schedule. Resource loading should reflect total manhour for each activity within the schedule. Resources shall be in units of hours and designated as a single material resource in the scheduling software (P6). Time Period Admin preferences must remain default "8.0hr / day, 40 hr / week, 172 hr / month, 2000 hr / year". Calendar setting will be 8.0 hr / day.
12. Contract Modifications: For each proposed contract modification and concurrent with its submission, prepare a time-impact analysis to demonstrate the effect of the proposed change on the overall project schedule.
    a. Time Impact Analysis shall be performed in the following manner.
        1) Identify the Impacting event.
        2) Model the event with the appropriate detail of activities (creating a fragnet).
        3) Estimate the duration for the new activities associated with the impact.
        4) Add sequence and relationships to the added activities.
        5) Insert the new fragnet into a copy of the Master Project Schedule.
        6) Calculate the schedule and measure the effect of the Impact on the Project Completion Date and directly affected milestone.
        7) Review the Time Impact Analysis and determine the impacts as a result of the change, and review a potential recovery plan.

K. Schedule Updating Process: Periodic updates will be performed on at least a monthly basis (if not more frequently). Each Contractor shall participate in the monthly update process. The established procedures, as defined in this specification section, will be utilized for progress monitoring and updating the Project Master Schedule, reporting and payment requests.
    1. Schedule Updating Process: At no less than monthly intervals, as deemed necessary by the CMa, contractors will update the schedule to reflect actual construction progress and activities. Schedule updates will be issued on or about the first week of each month (or mutually agreed upon time frame each month) which will provide a progress update for the previous month. The CMa will send out 'Schedule Update Forms' on a monthly basis, approximately 2 weeks prior to the date established for the issuance of the Project Master Schedule Update. All Contractors will provide markups to the update forms with his / her schedule status information noting but not limited to all progress for their activities including Actual Starts, Actual Finishes, Remaining durations, and Projected Starts / Finishes. The contractor shall provide the update forms five (5) days following receipt of the form. The CMa will update the Project Master Schedule and issue a draft schedule update utilizing the information provided by the contractor(s) in the update forms. A schedule progress meeting workshop will be held approximately 5 days after to review the schedule, contractor updates, request sequence and/or logic changes and other comments. Within 2 days of the workshop meeting, each Contractor shall issue additional schedule updates and/or comments to be integrated into the updated Project Master Schedule. The CMa shall integrate changes and reissue the schedule to the Contractor(s)

within 3 days and become part of the project record.

2. Contractor Update Forms.
   a. CMa will distribute Schedule Update Forms each month on or about 25th. Contractors will return completed within the timeframes stipulated above.
   b. Contractors shall provide a detailed report and written narrative with schedule update form that indicates all changes, including, but not limited to, changes in logic, durations, actual starts and finishes, added / deleted activities, and activity durations. Refer to timing as noted in this specification.
      1) As the Work progresses, indicate final completion percentage for each activity.
      2) All proposed logic changes by the contractors shall be proposed in conjunction with the update form submission. The contractor is responsible to identify the reasons for such changes and potential impact to other contractors and/or subcontractors. The proposed change will be reviewed during the monthly schedule workshop.
3. Distribution and Acceptance:
   a. CMa shall issue updated integrated Master Project Schedule to Contractors, Architect and Owner within three (3) business days following receipt of Contractors comments and issue a draft for review.
   b. As workshop will be conducted with all contractors to review the updates, make adjustments to logic and other required changes. Following the workshop, an updated schedule update will be published for final review by all contractors.
   c. Contractors shall review each updated Master Project Schedule within three (3) days of receipt and, within the same period, either confirm that they have no objection for coordination purposes or notify the Construction Manager as Advisor in writing of specific objections and supporting reasons. Failure to respond within the required period will be deemed confirmation that the Contractor has no objection to use of the update for coordination and progress measurement. After considering timely comments, the CMa may issue the updated Master Project Schedule as the schedule of record. A Contractor's objection does not relieve it of the obligation to proceed with the Work in accordance with the Contract Documents.
      1) Any notification shall be fully supported with specific details, references and other relevant data.
   d. Contractors shall distribute issued revised Master Project Schedule and any coordinated sub-schedules to their subcontractors within one (1) day of issuance.
4. The CMa will issue the Master Project Schedule updates on a monthly basis with narrative and reports as follows.
   a. Full Schedule report - sorted by WBS and Start/Finish.
   b. 4 week look-ahead construction schedule.
   c. Milestone Report Listing all Milestones and Level of Effort Activities.
   d. Critical Path Report - sorted by Total float path then Start/Finish.
   e. Predecessor - Successor Report but Activity ID.
   f. Narrative identifying critical issues impacting the schedule.

L. Contractor Schedule Reports:
   1. CPM Reports: In conjunction with the contractor's update forms and the monthly CPM schedule update process, the contractor shall submit reports via the web-based project management software. Format for each activity in reports shall contain activity number, activity description, original duration, remaining duration, early start date, early finish date, late start date, late finish date, and total float in workdays (as based upon the

schedule calendar utilized in the Scheduling Software).

a. Activity Report: List of activities sorted by activity number and then early start date, or actual start date if known.
b. Predecessor-Successor Report: List of all activity predecessors and successors for each activity, sorted in ascending order by activity number and then early start date, or actual start date if known.
c. Total Float Report: List of activities sorted in ascending order of total float, then by Start Date for each activity followed by Finish Date for each activity.
d. A written schedule narrative to include the following at a minimum:
    1) Executive Summary.
    2) Summary of work completed since the previous update.
    3) Summary of Major Milestones completed and progress toward the next milestones.
    4) Status of major deliveries.
    5) Items affecting progress with listed deviations from the previous month.
    6) Upcoming work planned.
    7) Schedule revisions.
    8) Basis and assumptions.
    9) Impacts due to severe or unusually extreme weather conditions.

2. The Contractor's schedule report shall be issued with submission of the Contractor's update form. Submission of the required update forms and reports is a condition to processing Applications for Payment, and failure to timely submit them may result in withholding or deferral of payment processing to the extent permitted by the Contract Documents.
3. Upcoming Work Summary: Contractor to prepare summary report indicating activities scheduled to commence prior to submittal of next schedule update. Summarize the following issues:
    a. Unresolved issues.
    b. Unanswered Requests for Information.
    c. Rejected or unreturned submittals.
    d. Notations on returned submittals.
    e. Pending modifications affecting the Work and Contract Time.

M. Recovery Schedule: When periodic update indicates the Work is ten (10) or more work days behind any milestone as identified in section 2.4.I.9, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished. Recovery plan should be based on actual data from subcontractors, suppliers and vendors with associated manpower listed. The Contractor shall take steps as necessary to improve the progress and shall submit for review, revised schedules to demonstrate that the rate of progress will be regained; without additional cost to the Owner.

2.5 CONTRACTORS LOOKAHEAD SCHEDULE

A. 3 Week Look-Ahead Schedule: Contractors shall submit an electronic 3 Week Look-Head Schedule each Friday for incorporation into a master project 3 Week Look Ahead Schedule. Contractors will utilize the look ahead schedule template provided by the CMa. Weekly submissions will be in a live MS excel file format.
   1. General Contractor Prime shall incorporate all prime contractors Look-Ahead Schedules into a singular file on a weekly interval and distribute the schedule to the entire project team in a live MS excel file format each Monday unless an alternate date is identified by the CMa. 3 Week Look-ahead must include area of work, floor level and estimated manpower for the activity. Format should be at minimum MS Excel schedule template provided by the CMa and identify relationships to other activities. The Look-Ahead schedule should be consistent with the Project Master Schedule. Any deviations including but not limited to logic, overall sequence, and/or duration must be identified. Deviations will be discussed at project meetings.

2.6 STARTUP CONSTRUCTION SCHEDULE

A. Startup Construction Schedule is intended to be preparatory to preliminary Pull Planning activity defined in Lean Procedures. The Startup Construction Schedule should generally reflect milestones contained in Bid Schedule and Master Project Schedule as defined in the Contract Documents. Included with the Startup Construction Schedule framework should be a fully developed Work Breakdown Structure (WBS) for the entire project. The WBS will be further detailed as the Master Construction Schedule is developed. This initial schedule should be considered preliminary and prepared only to allow Contractor to participate knowledgably in a Pull Planning process that will result in further direction in response to constraints determined jointly by the Contractor(s), A/E, Owner and the Construction Manager.
   1. Contractor(s) shall prepare a Startup Construction Schedule including Milestones and detailed WBS and submit to the CMa within ten (10) days of the NTP. The Startup Construction Schedule shall include all activities anticipated in the first four to six months of the project and include but not limited to procurement, submittals, mobilization and enabling, coordination and construction. The schedule shall be developed in Primavera P6.

B. Bar-Chart Schedule: Submit startup, horizontal, bar-chart-type construction schedule. Bar-chart or Gantt Schedule shall consist of Activity ID, Activity Description, Original Duration, Remaining Duration, Early Start, Early Finish and define the entire Contractual Construction Timeline.

C. Preparation: Indicate each significant construction activity separately. Identify first workday of each week with a continuous vertical line. Outline significant construction activities for first one hundred twenty (120) days of construction. Indicate all Milestones into the Startup Schedule for further development in Pull Planning Sessions. Include fully detailed Work Breakdown Structure with skeleton diagram for the remainder of the Work and a cash requirement prediction based on indicated activities.

D. The Startup schedule, compliant with the contract requirements, shall be submitted prior to the first payment application request.

2.7 PROGRSS REPORTS

A. Daily Construction Reports: Prepare a daily construction report recording the following information concerning events at Project site:
   1. List of subcontractors at Project site.
   2. List of separate contractors at Project site.
   3. Approximate count of personnel at Project site.
   4. Equipment at Project site.
   5. Material deliveries.
   6. High and low temperatures and general weather conditions.
   7. Accidents.
   8. Meetings and significant decisions.
   9. Unusual events (refer to special reports).
   10. Stoppages, delays, shortages, and losses.
   11. Meter readings and similar recordings.
   12. Emergency procedures.
   13. Orders and requests of authorities having jurisdiction.
   14. Change Orders received and implemented.
   15. Construction Change Directives received and implemented.
   16. Services connected and disconnected.
   17. Equipment or system tests and startups.
   18. Partial Completions and occupancies.
   19. Substantial Completions authorized.

B. Construction Survey Data: The General Contractor Prime shall take settlement readings of the Work at a predetermined number of points selected by the Architect. Take readings weekly until the Work is substantially completed or until such time as the Architect directs. Record survey data and submit to the Architect on a weekly basis. Furnish certification from a Registered Land Surveyor who shall verify periodically that portions of the Work are located in accordance with the Drawings and at the required elevations. Upon completion of foundation walls, submit to the Architect a certified survey showing that dimensions, elevations, angles and the location of the building is in accordance with the Contract Documents. When enclosing walls are completed, submit a survey certifying their location and plumbness.

C. Material Location Reports: At appropriate intervals, or as requested, prepare a comprehensive list of materials delivered to and stored at the Project site. List shall be cumulative, showing materials previously reported plus items recently delivered. Include with list, a statement of progress on and delivery dates for materials or items of equipment fabricated or stored away from Project site.
   1. Material stored prior to previous report and remaining in storage.
   2. Material stored prior to previous report and since removed from storage and installed.
   3. Material stored following previous report and remaining in storage.

D. Field Condition Reports: Immediately on discovery of a difference between field conditions and the Contract Documents, prepare a detailed report. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.8 SPECIAL REPORTS

A. General: Submit special reports directly to CMa within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.

B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise CM in advance when these events are known or predictable.

2.9 CONSTRUCTION PHOTOGRAPHS

A. Digital Images: Provide images in uncompressed PDF, TIFF or JPEG format, produced by a digital camera with minimum sensor size of 8.0 megapixels.

B. The contractors shall provide a minimum of 25 digital photo images per day when its working on site. Photos shall be submitted as separate files with the daily report. Photos shall be time stamped and labeled to identify location and/or area.

C. 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.

D. Maintain key plan with each set of construction digital images that identifies each photographic location.

E. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software to electronic project management information system.
   1. Date and Time: Include date and time in filename for each image.
   2. Field Office Images: Maintain one set of images in the field office at Project site, available at all times for reference. Identify images same as for those submitted to CMa and Architect.

F. Quantity and Timing of Construction Photographs.
   1. Preconstruction Photographs: Before starting construction, take digital photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points.
   2. Periodic Construction Photographs: Take color, digital photographs, weekly, with timing each month adjusted to coincide with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last photographs were taken.

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

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 013300

SUBMITTAL PROCEDURES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Submittals schedule.
   2. Submittal procedures.
   3. Submittal processing.
   4. Proposed products list.
   5. Action submittals.
   6. Informational submittals.

1.2 SUBMITTALS SCHEDULE

A. Submit submittal list with expected dates and coordinate with start dates of related construction in progress schedule.

B. Transmit submittals schedule electronically to Architect before first application for payment.
   1. No submittals will be reviewed until initial submittals schedule is received.
   2. Revise submittals schedule as directed by Architect.
   3. Revise submittals schedule to be current with construction progress schedule revisions.

C. Submittals Schedule: Provide following information in tabular format with separate line items for each required type of submittal.
   1. Specification section number and title.
   2. Name of Subcontractor.
   3. Description of Work covered by submittals.
   4. Submittal type: action or informational.
   5. Scheduled date for first submittal.
   6. Scheduled date for Architect final release or approval.

1.3 SUBMITTAL PROCEDURES

A. Transmit submittals with AIA Form G810 or Architect accepted form.

B. Sequentially number transmittal forms. Number revised submittals with original number and sequential alphanumeric suffix.

Example	11.A.072100.R02 where:
11 =	Sequential submittal number
A =	Alpha descriptor identifying each major element within single submittal
072100 =	Specification section number
R02 =	Sequential resubmission number

C. Assemble submittals to show:
1. Project, Contractor, Subcontractor, and Supplier identification.
2. Pertinent drawing and detail number, and specification section number.
3. Space for Contractor and Architect review stamps on first page.
4. Variations from Contract Documents highlighted.
5. Product and system limitations potentially detrimental to Work highlighted.
6. Changes since previous submission.

D. Do not submit copies of Contract Documents as submittals. Submittals reproducing Contract Documents, including Drawings bearing the Architect seal or logo, will be rejected and returned without review.
1. When required to reference Contract Documents in a submittal, annotate Project-specific information on a separate sheet and attach to the submittal transmittal.

E. Apply stamp and sign or initial certifying that review, approval, verification of required products, field dimensions, adjacent Work, and information coordination is per Work and Contract Documents.

F. Schedule submittals to expedite Project. Coordinate submission of related items for simultaneous submittal.
1. Submit action submittals and informational submittals for each Specification Section under separate transmittal.
2. Submit sustainable submittals separately from other submittals.

G. Submit one native, editable PDF electronic file for each required submittal to Architect and CMa.
1. Page Size: 8-1/2 by 11 inches minimum; 30 by 42 inches maximum.
2. Submit PDF sample identification with image of each physical sample.
3. Bookmark PDF drawing files showing sheet numbers and titles.
4. Bookmark PDF product files showing product names and data types.
5. Annotated PDF electronic file will be returned to Contractor.

H. Distribute reviewed submittals to affected Parties.
1. Instruct parties to promptly report inability to comply with requirements.

1.4 SUBMITTAL PROCESSING

A. Allow 15 business days for each initial submittal and resubmittal review.
   1. Allow sufficient submittal, resubmittal and review time to avoid delaying Work.
   2. When intermediate submittal is necessary, process as for initial submittal.

B. Architect will promptly notify Contractor when:
   1. Submittal processing must be delayed for coordination with other submittals.
   2. Additional information is required to process submittal.

C. Contract Time extension is not permitted from failing to make submittals sufficiently in advance of Work to permit processing.

1.5 PROPOSED PRODUCTS LIST

A. Submit initial proposed products list within 15 business days after Notice to Proceed.
   1. After review by Owner and Architect, resubmit list within 10 days.

B. Submit revised list with each Application for Payment until all required products are identified.

C. Include major products from each Specification section, with name of manufacturer, trade name, and model number.
   1. Identify proposed products that are specified proprietary products.

D. When proposed products match specified proprietary products by manufacturer and model number, additional submittals are not required except:
   1. Provide shop drawings for products specially fabricated to size or configuration for project conditions.
   2. Provide samples for products requiring selection of color, texture, finish, pattern, or other attributes.

E. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.6 ACTION SUBMITTALS

A. Submit action submittals for Architect review and approval for conformance with Contract Documents.
   1. Provide additional information or clarification upon Architect request.
   2. Action submittals will be returned with Architect stamp indicating submittal status.
   3. Maintain one set of Architect reviewed and approved submittals at Project site for reference.

B. Product Data:
   1. Mark data files indicating applicable products, models, options, and other data.
   2. Supplement manufacturer standard data with Project-specific information.
   3. When requested or specified, submit color charts or sample kits for initial color

selections.
a. Include full range of manufacturer standard colors, textures, and patterns.
b. Include custom colors and other product characteristics where specified.
4. Show product utility and electrical characteristics.
a. Show utility connection types, sizes and locations.
b. Show maintenance and service access locations and required clearances.
5. Do not include Safety Data Sheets in submittals.
a. When requested by Owner, submit SDS directly to Owner.

C. Shop Drawings:
1. Show project-specific construction, including sizes, configurations, and details.
2. Show product connections and anchorages to adjacent systems and building structure.
a. Show location and magnitude of loads transferred to building structural systems.
3. Show terminations and interface with adjacent systems and materials.
4. Show product utility and electrical characteristics.
a. Show utility connection types, sizes and locations.
b. Show maintenance and service access locations and required clearances.
5. Identify required tolerances for successful installation.
6. Identify required and actual field measurements necessary for fabrication.

D. Samples:
1. Submit three Samples, unless individual Specification sections specify a greater number.
a. Attach printed PDF submittal transmittal and sample image to each sample.
2. Show Project specific aesthetic, color, and finish selections.
3. Show product's functional and aesthetic characteristics, including integral parts and attachment devices.
4. Submit Samples for interfacing Work at same time where aesthetic selection coordination is required.
5. Architect retains one Sample and returns remaining Samples.
6. Maintain one approved sample at Project site for Architect reference.

1.7 INFORMATIONAL SUBMITTALS

A. Submit informational submittals for Architect review and limited assessment of conformance with Contract Documents.
1. Provide additional information or clarification upon Architect request.
2. Maintain one set of submittals at Project site for Architect reference.

B. Certificates: Provide manufacturer or independent third-party certification confirming product compliance with Contract Documents.
1. Submit supporting reference data, affidavits, and certifications.
2. Certificates may be recent or previous test results acceptable to Architect.
3. Build America, Buy America Act compliance letters or statements.

C. Delegated Design Submittals:
1. Shop Drawings and calculations, signed and sealed by licensed professional responsible for designing Work shown on approved Shop Drawings.
a. Submit in quantity and form suitable for submission to and approval by authority having jurisdiction.

b. Revise submittal and provide additional information when required by authority having jurisdiction.

2. Submit certificate of professional liability insurance from licensed professional responsible for design.

D. Test and Evaluation Reports: Manufacturer and Independent testing agency reports attesting product compliance with Contract Documents.

E. Manufacturer Instructions: Installation instructions including delivery, storage, examination, preparation, assembly, installation, finishing, cleaning, startup, adjusting, operation, and protection.

F. Source Quality Control Submittals: Shop test and inspection reports attesting product compliance with Contract Documents.

G. Field Quality Control Submittals: Field test and inspection reports attesting product compliance with Contract Documents.

H. Manufacturer Reports: Field test, instruction, and inspection reports recording site observation outcomes.

1. Submit report within five days of site observation.

I. Special Procedure Submittals: Describe perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

J. Qualification Statements: Manufacturer, fabricator, and installer statements, quality manuals, and credentials showing compliance per Contract Documents.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 014000

QUALITY REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Quality Assurance.
2. Quality control and control of installation.
3. Delegated design services.
4. Tolerances.
5. References.
6. Labeling.
7. Mockups.
8. Field samples.
9. Testing and inspecting services.
10. Manufacturer field services.
11. Test reports and certifications.

1.2 REFERENCES

A. Definitions:
1. Experienced: An entity or individual who successfully completed a minimum of five previous projects similar in nature, size, and extent to this Project, with a five year record of successful performance, and familiar with special requirements of product, assembly, project, and authorities having jurisdiction.

1.3 QUALITY ASSURANCE

A. Qualifications:
1. Manufacturers: Experienced firms with sufficient production capacity to produce units required.
2. Fabricators and Finish Applicators: Experienced firms with sufficient production capacity to produce units required.
3. Installers: Experienced firms or individuals with sufficient manpower to produce Work required.
4. Testing Agencies: Experienced firms with sufficient capacity and necessary equipment to perform tests required, following one of the following programs.
a. A nationally recognized testing laboratory per 29 CFR 1910.7.
b. Accredited agency per NIST National Voluntary Laboratory Accreditation Program.
5. Licensed Professionals: Experienced individuals, licensed or otherwise legally qualified to practice in the jurisdiction where the Project is located.

1.4 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Follow specified reference standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements include higher standards or more precise workmanship.

C. Measure in place and existing construction as needed for fabrication and execution. No changes to Contract Sum or Contract Time will be allowed for differences between Drawing dimensions and field measurements where no measurements were performed.

1.5 DELEGATED DESIGN SERVICES

A. Where delegated design is specified, follow specified performance and design criteria.
   1. If criteria are not sufficient, submit RFI for needed criteria.

1.6 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Follow manufacturer tolerances. When manufacturer tolerances conflict with Contract Documents, request clarification from Architect before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.7 REFERENCE STANDARDS

A. Abbreviations and Acronyms: Names of trade associations, standards generating organizations, governing authorities, and other entities are frequently referred to in Contract Documents by acronyms and abbreviations. Request explanation of unknown terms from Architect.

B. For products or workmanship specified by association, trade, or other consensus standards, follow requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

C. Follow reference standards by date of issue current on date of Contract Documents, except where specific edition date is required by code.

D. Where specified reference standards conflict with Contract Documents, request clarification from Architect before proceeding.

E. Provisions within cited reference standards changing Owner, Architect, and Contractor duties and responsibilities from contractual requirements are void.

1.8 LABELING

A. Attach labels from agencies approved by authority having jurisdiction for products, assemblies, and systems required to be labeled by applicable code.

B. Label Information: Include approved agency identification on each label. Install products with labels visible. Include:
   1. Manufacturer name.
   2. Model number.
   3. Serial number.
   4. Performance characteristics.

1.9 MOCKUPS

A. Definition:
   1. Mockups are constructed to demonstrate materials and workmanship for review by Architect and Owner.

B. Construct mockups at Project site in locations acceptable to Architect unless laboratory mockups are specified.

C. Construct mockups in compliance with applicable Specification sections.
   1. Design and construct foundations, supports, framing, and bracing for freestanding mockups.

D. Photograph construction to record concealed conditions. Make photographs available to Architect and Owner when requested.

E. Mockups are subject to testing specified for constituent products.

F. Approved mockups establish work results standard.

G. Protect mockups against damage until removal is authorized.

H. Mockups may remain as part of the Work only when so designated in individual Specification sections.

1.10 FIELD SAMPLES

A. Definition:
   1. Field samples are assemblies constructed to demonstrate materials and workmanship for review by Architect and Owner.
      a. Construct field samples in final locations in sizes described in technical Specifications sections.

B. Construct field samples in compliance with applicable Specification sections.

C. Approved field samples establish Work results standard.

D. Protect field samples against damage until Substantial Completion.

E. Approved, undamaged field samples may remain as part of the Work unless designated in individual Specification sections.

1.11 TESTING AND INSPECTION SERVICES

A. Except where specified as Owner responsibility, employ and pay for specified services of an independent firm to perform testing and inspections.
   1. Owner testing and inspecting agencies will be identified to Contractor.
   2. Copies of reports prepared by Owner testing and inspecting agencies will be sent to Contractor.

B. Include dates for agency testing and inspecting in Progress Schedule and provide minimum 10 days prior notice to agencies.
   1. Provide access to the Work as requested by testing and inspecting agencies.
   2. Provide samples of materials, design mixes, equipment, tools, storage for Samples, and assistance by incidental labor requested by agency.

C. Testing and employment of testing and inspecting agencies shall not relieve Contractor of obligation to perform Work in accordance with requirements of Contract Documents.

D. Retest and reinspect defective work when required by Architect.
   1. Failed Test Retest Cost: Contractor responsibility.

E. Limits on testing and inspecting agencies:
   1. Agency does not have authority to release, revoke, alter, or enlarge on requirements of Contract Documents.
   2. Agency does not have authority to approve or accept any portion of Work.
   3. Agency may not assume duties of Contractor.
   4. Agency does not have authority to stop Work.

1.12 MANUFACTURER FIELD SERVICES

A. When specified in individual specification sections, require material or product suppliers or manufacturers to provide qualified staff personnel to observe and provide instructions when necessary for acceptable:
   1. Installation conditions.
   2. Workmanship quality.
   3. Equipment startup.
   4. Equipment test, adjust, and balance.

B. Submit qualifications of observer to Architect 14 days, minimum, in advance of required observations.

C. Report observations and site decisions or instructions that are supplemental or contrary to Contract Documents or manufacturers written instructions.

D. Submit written inspection reports per Section 013300.

1.13 TEST REPORTS AND CERTIFICATIONS

A. When specified in individual Specification sections, require material or Product suppliers or manufacturers to provide test reports and manufacturer certifications.

B. Show that material or Product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Submittals may be recent or previous test results on material or Product, as acceptable to Architect.

D. Submit reports and certifications per Section 013300.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 015000

TEMPORARY FACILITIES AND CONTROLS

PART 1 GENERAL

1.1 SUMMARY

A. General: This Section specifies administrative and procedural requirements for Temporary Facilities and Controls.

B. Administrative and Procedural Minimum Actions: Specific administrative and procedural minimum actions are specified in this section, as extensions of provisions in other Contract Documents. These requirements have been included for special purposes as indicated. Nothing in this section is intended to limit types and amounts of temporary work required, and no omission from this section will be recognized as an indication that such temporary activity is not required for successful completion of the work and compliance with requirements of the Contract Documents.

C. Arrangement for, Provision and Maintenance of Temporary Facilities and Controls: Arrange for, provide and maintain temporary facilities and controls as required for the proper and expeditious prosecution of the Work. Pay costs including fuel, power and water used until final acceptance of the Work unless the Owner makes arrangements for the use of completed portions of the Work after Substantial Completion in accordance with the provisions of the General Conditions. Responsibility for providing and maintaining particular temporary facilities and controls among the Prime Contractors shall be as assigned in Section 01 12 00 and the other Contract Documents. Nothing in this Section shifts any Contractor's responsibility for its means, methods, safety precautions, or temporary facilities to the Owner, Architect, or CMa.

D. Acceptable Locations for Temporary Connections: Provide and maintain temporary connections to utilities and services in locations acceptable to the Owner, Architect, CMa and local authorities having jurisdiction thereof. Make installations in a manner subject to the acceptance of such authorities and the Architect. Remove temporary installations and connections when no longer required and restore the services and sources of supply to proper operating condition.

1.2 SUBMITTALS

A. Temporary Utilities: Submit reports of tests, inspections, meter readings and similar procedures performed on temporary utilities.

B. Implementation and Termination Schedule: Submit a schedule indicating implementation and termination of each temporary utility within 15 days of the date established for commencement of the Work.

1.3 QUALITY ASSURANCE

A. Regulations: Comply with industry standards and applicable laws and regulations and authorities having jurisdiction, including but not limited to:
   1. Building Code requirements.
   2. Health and safety regulations.
   3. Utility company regulations.
   4. Police, Fire Department and Rescue Squad rules.
   5. Environmental protection regulations.

B. Inspections: Arrange for authorities having jurisdiction to inspect and test each temporary utility before use. Obtain required certifications and permits.

1.4 PROJECT CONDITIONS

A. Temporary Utilities: Prepare a schedule indicating dates for implementation and termination of each temporary utility. At the earliest feasible time, when acceptable to the Owner and CMa, change over from use of temporary service to use of the permanent service.

B. Conditions of Use: Keep temporary services and facilities clean and neat in appearance. Operate in a safe and efficient manner. Take necessary fire prevention measures. Do not overload facilities or permit them to interfere with progress. Do not allow hazardous, dangerous or unsanitary conditions, or public nuisances to develop or persist on the site.

1.5 EQUIPMENT

A. General: Provide new equipment, or undamaged, previously used equipment in serviceable condition. Provide equipment suitable for use intended.

B. Water Hoses: Provide 3/4 in. heavy-duty, abrasion-resistant, flexible rubber hoses 100 ft. long, with pressure rating greater than the maximum pressure of the water distribution system; provide adjustable shut-off nozzles at hose discharge.

C. Electrical Outlets: Provide properly configured NEMA polarized outlets to prevent insertion of 110-120 volt plugs into higher voltage outlets. Provide receptacle outlets equipped with ground-fault circuit interrupters, reset button and pilot light, for connection of power tools and equipment.

D. Electrical Power Cords: Provide grounded extension cords; use "hard-service" cords where exposed to abrasion and traffic. Provide waterproof connectors to connect separate lengths of electric cords if single lengths will not reach areas where construction activities are in progress.

E. Lamps and Light Fixtures: Provide general service incandescent lamps of wattage required for adequate illumination. Provide guard cages or tempered glass enclosures, where exposed to breakage. Provide exterior fixtures where exposed to moisture.

F. Heating Units: Provide temporary heating units that have been tested and labeled by UL, FM

or another recognized trade association related to the type of fuel being consumed.

1.6 TEMPORARY ELECTRICITY AND LIGHTING

A. Temporary Lighting System: Provide and maintain a temporary lighting system to satisfy at least the minimum requirements of safety and security, and to maintain the progress of the Work. The temporary lighting system shall be maintained to afford general illumination in areas of the Project and any additional illumination, where necessary, in the areas of the Project where work is being performed. Temporary wiring shall be maintained in a safe manner and utilized so as not to constitute a hazard to persons or property.

B. Permanent Power and Lighting System: The permanent power and lighting system, or a portion thereof, may be used only with the Owner's prior written approval. Any Contractor using the permanent system shall be responsible for costs attributable to its use and for any damage, maintenance, or restoration caused or required by such use. Use of the permanent system shall not constitute acceptance of the Work, commencement of any warranty period, or a transfer to the Owner of responsibility for incomplete or defective Work.

C. Removal of Temporary Electrical Equipment and Wiring: At the completion of the Work remove temporary electrical equipment and wiring and replace worn or damaged parts of the permanent system. Leave equipment in first-class condition equal to new.

1.7 TEMPORARY HEATING, COOLING AND VENTILATING

A. Temporary Heat and Maintenance of Temperature: Provide temporary heat as required during construction to protect the Work from freezing or frost damage and to ensure suitable conditions for the construction operations of trades. Where work is being conducted, maintain the temperature as specified in the various sections of the Specifications but not less than 45 deg. F. Do not allow the temperature to reach a level which will cause damage to any portion of the Work. N/A for work on roof levels.

B. Removal of Temporary Heating Equipment and Piping: At the completion of the Work remove temporary heating equipment and piping and replace worn or damaged parts of the permanent system. Leave equipment in first-class condition equal to new.

1.8 TEMPORARY WATER

A. Drinking Water: Furnish drinking water with suitable containers and cups for use of employees. Locate drinking water dispensers where work is in progress.

B. Drainage or Collection of Water: Make provisions for drainage or collection of excess or spilled water.

C. Removal of Temporary Water Service Equipment and Piping: At the completion of the Work, remove temporary water service equipment and piping and replace worn or damaged parts of the permanent system. Leave equipment in first-class condition equal to new.

D. Temporary water service in the building will be provided by the Plumbing Prime Contractor.

1.9 TEMPORARY SANITARY FACILITIES

A. The GC Prime Contractor will provide and maintain temporary sanitary facilities for use by all trades. Provide sufficient facilities for the number of workers on site. Clean and sanitize the facility at a minimum of two times a week. Adjacent to the temporary sanitary facilities, provide and maintain temporary hand wash stations with water, hand soap and hand sanitizer.

B. Health and Safety Measures: Each Prime Contractor is responsible for compliance with applicable laws, regulations, and governmental requirements relating to the health and safety of its personnel and operations. Any project-specific communicable-disease or similar health requirements issued by the Owner or authorities having jurisdiction shall be complied with at the Contractor's cost unless otherwise provided in the Contract Documents. Nothing in this paragraph transfers responsibility for Contractor safety means, methods, or precautions to the Owner or CMa.

1.10 TEMPORARY FIRE PROTECTION

A. Fire Extinguishers: Provide hand-carried, portable UL-rated, class "A" fire extinguishers for temporary offices and similar spaces. In other locations provide hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure.

B. Fire Watch: All Prime contractors are responsible for providing fire watch for their scope performed. Fire watch shall be performed per OSHA standards and with a hand-carried, portable, UL-rated, class "ABC" dry chemical extinguishers, or a combination of extinguishers of NFPA recommended classes for the exposures. Comply with NFPA 10 and 241 for classification, extinguishing agent and size required by location and class of fire exposure. Fire watch commences at the completion of hot work. Fire watch shall last minimal 1 hour beyond the completion of hot work, and 2 hours on all roofs, within existing or occupied buildings or over flammable materials which cannot be removed. All hot work and Fire Watch activities on or within existing or occupied buildings shall be coordinated 72 hours in advance with the CMa and Owner.

1.11 TEMPORARY FENCE

A. Maintenance of a Temporary Fence: maintain a temporary galvanized fence to enclose the area at the job site and to effectively guard and close in the designated area. gates of substantial construction, cross-braced, hung on heavy strap hinges, with suitable hasps and padlocks.

B. Removal of Temporary Fence and Barricades: Remove the fence upon completion of the Work or at such time before final completion as directed by the CMa. upon inspection and acceptance.

C. Reference Site Plan & Logistics plans. Temporary fence will be provided and maintained by

the General Construction Prime Contractor to secure construction areas until the temporary fence is no longer required for site security and its removal is authorized by the CMa and Owner.

1.12 SECURITY AND PROTECTION

A. Fire-Safety Program: Show compliance with requirements of NFPA 241 and authorities having jurisdiction. Indicate Contractor personnel responsible for management of fire-prevention program.

B. Precautions Against Fire: Take adequate precautions against fire, keep flammable material at an absolute minimum and ensure that such material is properly handled and stored. Except as otherwise provided herein, do not permit fires or open salamanders in any part of the Work.

C. Storage: Where materials and equipment must be stored, and are of value or attractive for theft, provide a secure lockup. Enforce discipline in connection with the installation and release of material to minimize the opportunity for theft and vandalism.

D. Environmental Protection: Provide protection, operate temporary facilities, and conduct construction in ways and by methods that comply with environmental regulations, and minimize the possibility that air, waterways and subsoil might be contaminated or polluted, or that other undesirable effects might result. Avoid use of tools and equipment which produce harmful noise. Restrict use of noise making tools and equipment to hours that will minimize complaints from persons or firms near the site.

1.13 SURFACE WATER AND SNOW CONTROL

A. Removal of Snow and Ice: Remove snow and ice as necessary for the protection and performance of the Work.

1.14 PROJECT IDENTIFICATION AND SIGNS

A. Display of Signs or Advertisements: No signs or advertisements will be allowed to be displayed on the premises without the acceptance of the Owner and CMa.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: For temporary construction, provide new materials. Undamaged, previously used materials in serviceable condition may be used if approved by CMa. Provide materials suitable for use intended.

B. Chain-Link Fencing: Minimum 2 in. mesh, 0.148 in. thick, galvanized steel, chain-link fabric fencing; minimum 8 ft. high with galvanized steel pipe posts; minimum 2-3/8-in. OD line

posts and 2-7/8-in. OD corner and pull posts, with 1-5/8-in. OD top rails. Provide galvanized barbed-wire top strand if required for security.

C. Gypsum Board: Minimum 1/2 in. thick by 48 in. wide by maximum available lengths; regular-type panels with tapered edges. Comply with ASTM C36 and Section 09 21 16 "Gypsum Board Assemblies".

D. Insulation: Unfaced mineral-fiber blanket, manufactured from glass, slag wool, or rock wool; with maximum flame-spread and smoke-developed indices of 25 and 50, respectively. Comply with and Section 07 21 00 "Thermal Insulation".

E. Tarpaulins: Fire-resistive labeled with flame-spread rating of 15 or less.

F. Water: Potable.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Location of Facilities: Locate facilities where they will serve Project adequately and result in minimum interference with performance of the Work. Relocate and modify facilities as required. Coordinate with all other Primes and CMa.

B. Provision for Ready for Use Facilities: Provide each facility ready for use when needed to avoid delay. Maintain and modify as required. Do not remove until facilities are no longer needed or are replaced by authorized use of completed permanent facilities.

3.2 SUPPORT FACILITIES INSTALLATION

A. Location: Locate storage sheds, sanitary facilities, and other temporary construction and support facilities for easy access and as approved by the Owner and CMa.

B. Incombustible Construction: Provide incombustible construction for offices, shops, and sheds located within construction area Comply with NFPA 241.

C. Maintenance of Support Facilities: Maintain support facilities until near Substantial Completion. Remove before Substantial Completion. Personnel remaining after Substantial Completion will be permitted to use permanent facilities, under conditions acceptable to Owner.

3.3 OPERATION, TERMINATION, AND REMOVAL

A. Supervision: Enforce strict discipline in use of temporary facilities. To minimize waste and abuse, limit availability of temporary facilities to essential and intended uses.

B. Maintenance: Maintain facilities in good operating condition until removal. Protect from

damage caused by freezing temperatures and similar elements.

C. Water-filled Piping: Prevent water-filled piping from freezing. Maintain markers for underground lines. Protect from damage during excavation operations.

D. Termination and Removal: Unless indicated otherwise, Remove each temporary facility when need for its service has ended, when it has been replaced by authorized use of a permanent facility, or no later than Substantial Completion. Complete or, if necessary, restore permanent construction that may have been delayed because of interference with temporary facility. Repair damaged Work, clean exposed surfaces, and replace construction that cannot be satisfactorily repaired.

E. Property of Contractor: Materials and facilities that constitute temporary facilities are the property of Contractor. Owner reserves right to take possession of Project identification signs.

END OF SECTION

SECTION 017000

EXECUTION AND CLOSEOUT REQUIREMENTS

PART 1 GENERAL

1.1 SUMMARY

A. General: This Section specifies administrative requirements for execution and closeout requirements.

1.2 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected by governing authorities and/or agencies, and that Work is complete in compliance with Contract Documents and ready for inspection.

B. Substantial Completion:
   1. Work is not Substantially Complete unless following has been completed:
      a. All Work, other than incidental corrective or punch list work, including appropriate cleaning.
      b. Obtain applicable occupancy permits, pressure vessel permits, elevator permits, and similar approvals or certificates by Authorities Having Jurisdiction, assuring Contractor's and Owner's full access and use of completed Work.
      c. Contractor's punch list of items to be completed or corrected and written request for inspection has been submitted to CM and Architect.
      d. Complete final start-up and testing and commence instruction and training sessions on major systems including HVAC and controls, telephone and intercom, data communications, fire alarm, fire sprinkler, security, and clocks.
      e. Make final changeover of locks and transmit new keys to Owner and advise Owner of changeover in security provisions.
      f. Submit proof of required extended insurance coverages.
      g. Designated systems and components are commissioned and usable.
      h. Utilities are connected and operating normally.
      i. As-Built Drawings, Operation and Maintenance Manuals, and Warranties have been submitted, reviewed and approved.
      j. Work is accessible by normal vehicular and pedestrian traffic routes.
   2. Occupancy of Work by Owner does not indicate that Work is Substantially Complete or is acceptable in whole or in part.
   3. Issuance of Certificate of Substantial Completion does not indicate final acceptance of Project by Owner, and Contractor is not relieved of any responsibility for Project except those outlined by document.
   4. When Contractor considers Work, or designated portion thereof, is substantially complete, he/she shall submit to CM and Architect:
      a. Written notification Work, or designated portion thereof, is substantially complete.

b. A list of items to be completed or corrected.

5. Within a reasonable period of time after receipt of such notice, Architect will make an inspection to determine status of completion.
6. Should Architect determine that Work is not substantially complete:
   a. Architect will promptly notify CM and Contractor in writing, giving reasons thereof.
   b. Contractor shall remedy deficiencies in Work and send a second written notice to CM and Architect.
   c. Architect will re-inspect Work.
7. When Architect, on basis of an inspection, determines that Work or designated portion thereof is Substantially Complete he/she shall prepare for submission to Contractor a list of items to be completed or corrected (aka Punchlist).
   a. Contractor shall fully cooperate with such efforts to establish Punchlist.
   b. Punchlist items shall be completed within thirty (30) days after Date of Substantial Completion, unless Owner approves a different period in writing.
8. When Architect agrees that Work is substantially complete, he/she will:
   a. Provide punch list to Construction Manager, who will attach it to their prepared Certificate of Substantial Completion, which shall be submitted to the Owner and Contractor for their written acceptance of responsibilities assigned to them in Certificate.

C. Requirements Preparatory to Final Inspection:
1. Punchlist items shall be completed.
2. Temporary facilities and construction shall be removed from Site.
3. Building and Site shall be thoroughly cleaned as specified herein.
4. Systems and equipment shall function and operate as designed to meet specified requirements.
5. Contractor's personnel or manufacturer's authorized representatives where applicable, shall have completed instruction for Owner's personnel in proper operation and maintenance of systems, equipment, and other portions of Project.
6. Operational instructions for equipment shall be mounted and posted as needed.
7. Electrical panels shall be properly labeled (typewritten), valves, pipes ducts, etc., properly marked and color-coded.
8. Submittals; refer to Section 01 33 00 "Submittal Procedures".
9. Forward certificates to CM and Architect with a letter requesting inspection.

D. Final Inspection:
1. After preparatory requirements have been completed, Contractor shall notify CM and Architect so that final inspection can be performed.
   a. Contractor shall schedule final inspection in a sequential manner to facilitate inspection.
2. CM and Architect shall perform inspection of Project within 7 days following receipt of certifications and notification.
3. Should CM and Architect determine that Work is not complete for final inspection:
   a. Contractor shall be promptly notified in writing, stating reasons.
   b. Contractor shall immediately remedy deficiencies in Work and send a second written notice to CM and Architect.
   c. CM and Architect will re-inspect Project within 7 days following receipt of notification.
4. When CM and Architect concur that Project is finally complete, CM will request Contractor to make closeout submittals.

E. Re-inspection Fees:
   1. Architect will make only one (1) inspection each to determine Substantial Completion and Final Completion. If these inspections determine that work does not comply with claims of status by Contractor, either because of major items not completed or an excessive number of punch list items, successive inspections requested by Architect shall be charged to Contractor as follows.
      a. Owner will compensate Architect for such additional services.
      b. Owner may deduct the amount of such compensation from payments otherwise due Contractor in accordance with the Contract Documents.from Final Payment to Contractor.

F. Final Payment:
   1. Prior to approval of final request for payment, Contractor shall have completed following items and placed on file with CM:
      a. Final waivers and releases from Contractor, subcontractors, and suppliers as required by Section 01 29 00 and the General Conditions.
      b. Written or printed operating instructions or manuals. This material shall not be submitted with shop drawings. When manuals or printed operating instructions for equipment are specified, they shall be delivered to CM.
      c. Systems completely in operation with balancing completed in compliance with specifications.
      d. Completion of all punch list corrections, except items that Owner agrees in writing may remain incomplete, in which event Owner may withhold an amount sufficient to protect against the cost and risk of completion as permitted by the Contract Documents.
      e. Final requisition to list previous and additional change orders, requests of extras, previous requests for extension of time, etc.
      f. Certification of final inspection from municipal agencies as needed.

G. Submit Final Application for Payment in compliance with procedures and requirements stated in Contract. Final payment shall not constitute acceptance of defective or nonconforming Work or a waiver of warranties, latent defects, claims, or other rights of Owner under the Contract Documents or applicable law.

1.3 FINAL CLEANING

A. Condition of Premises and the Job Site: Maintain the premises and the job site in a reasonably neat and orderly condition and free from accumulations of waste materials and rubbish during the entire construction period. Remove crates, cartons and other flammable waste materials or trash from the Work areas each working day.

B. Cleaning of Generally Unfinished Spaces: Electrical closets, pipe and duct shafts, chases, furred spaces and similar spaces which are generally unfinished shall be cleaned and left free from rubbish, loose plaster, mortar drippings, extraneous construction materials, dirt and dust.

C. Chutes, Hoists and Receptacles: Remove rubbish by means of chutes, hoists or receptacles. Do not drop or throw rubbish or waste from one level to another within or outside the building.

D. Care of Finished Spaces: Care shall be taken by workmen not to mark, soil or otherwise

deface finished surfaces. In the event that finished surfaces become defaced, clean and restore such surfaces to their original condition.

E. Schedule of Clean Up: Clean up immediately upon completion of each trade's work.

F. Cleaning of Areas to Be Painted and Finished: Clean areas in which painting and finishing work is to be performed just prior to the start of this work, and maintain these areas in a clean condition. Cleaning includes the removal of rubbish, broom cleaning of floors, the removal of any plaster, mortar, dust and other extraneous materials from finish surfaces, and surfaces that will remain visible after the Project work is complete. Clean exposed exterior and interior hard-surfaced finishes to a dust-free condition, free of stains, films and similar foreign substances. Restore reflective surfaces to their original reflective condition. Leave concrete floors broom clean. Remove labels that are not permanent labels. Wipe surfaces of mechanical and electrical equipment. Remove excess lubrication and other substances. Clean plumbing fixtures to a sanitary condition. Clean light fixtures and lamps.

G. Preparation of Building for Occupancy: In addition to the cleaning specified above and the more specific cleaning which may be required in various sections of the Specifications, prepare the building for occupancy by a thorough cleaning, including washing (or cleaning by other appropriate methods) surfaces on which dirt or dust has collected and by washing glass on both sides. Wash exterior glass using a window cleaning contractor specializing in such work. Provide and maintain adequate runner strips of non-staining reinforced Kraft building paper on finished floors for protection. Leave equipment in an undamaged, bright, clean, polished condition. Re-cleaning will not be required after the Work has been accepted unless later operations of the Contract make re-cleaning necessary.

H. Cleaning of Site: Clean the site, including landscape development areas, of rubbish, litter and other foreign substances. Sweep paved areas broom clean; remove stains, spills and other foreign deposits. Rake grounds that are neither paved nor planted, to a smooth even-textured surface.

I. Completion of the Work: Upon completion of the work, dismantle the temporary construction facilities and remove construction equipment, fences, scaffolding, surplus materials and rubbish of every kind from the site.

J. Compliance: Comply with regulations of authorities having jurisdiction and safety standards for cleaning. Do not burn waste materials. Do not bury debris or excess materials on the Owner's property. Do not discharge volatile, harmful or dangerous materials into drainage systems. Remove waste materials from the site and dispose of in a legal manner.

1.4 OPERATING AND MAINTENANCE DOCUMENTATION

A. Manuals: Under the direction of the Contractor, each subcontractor shall furnish operation and maintenance instruction manuals. The manuals shall contain the manufacturers' instructions for each item of equipment and apparatus furnished under the Contract, together with any additional data as may be required by the various sections of the Specifications. Furnish manufacturer's original brochures.
   1. Provide Operating and Maintenance Documentation in electronic PDF form to the Architect and CMa. Assemble each manual into a composite electronically indexed file.

2. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory.
3. Printed O&M binders are not required. Owner shall access Operation and Maintenance information via digitally catalogued PDF files, organized in accordance with Section 1.6 Organization herein.

B. Endorsement: By submission of manuals, the Contractor acknowledges, that each of the manuals is complete and accurate.

C. Submittal of Manuals: Prior to the Contractor's applications for final payment, and as a condition to approval of the applications, each subcontractor shall deliver to the Contractor the manuals arranged in proper order, indexed, and endorsed. Assemble the manuals for all divisions of the Work, review them for completeness, and submit them to the CMa. If hardcopy format is required by Owner, deliver the manuals in suitable transfer cases indexed and marked for each division of the Work.

1.5 ORGANIZATION

A. Contents.
1. Prepare a table of contents for each volume, with each product or system description identified.

B. DIRECTORY.
1. List names, addresses, and telephone numbers of Architect, CM and Contractors.
2. List subcontractors, service organizations, and principal vendors, including names, addresses, and telephone numbers where they can be reached for emergency service, including nights, weekends, and holidays.

C. ASSET MANAGEMENT DATA.

D. OPERATION AND MAINTENANCE INSTRUCTIONS.
1. Arrange instructions by system and subdivide by specification section.
2. Identify following for each category:
   a. List of equipment.
   b. Parts list for each asset.
   c. Startup and operating procedures.
   d. Maintenance procedures for equipment and systems.
   e. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions and detrimental agents.
   f. Names, addresses, and telephones of subcontractors and suppliers.

E. Part 4 - Project documents and certificates.
1. Shop drawings and product data.
2. Startup reports.
3. Test and balance reports.
4. Commissioning reports.
5. Spare parts list.
6. Training materials.
7. Certificates.

8. Photocopies of warranties and bonds.

1.6 OPERATING INSTRUCTIONS

A. Operating instructions shall be divided into four subsections as follows:
   1. Start-up - Give complete instructions for energizing equipment and making initial settings and adjustments whenever applicable. If equipment is fully automatic, a statement to that effect shall be all that is needed. If a specific sequence or steps shall be performed, give step-by-step instructions in proper sequence. If timing (such as warm-up between power-on and adjustment) is important, clearly state specific minimum time needed at proper point in procedure. Refer to controls and indicators by panel; make references consistent with nomenclature used in illustrations and tables of controls and indicators. If preliminary settings differ from different modes of operations, give procedures for each mode.
   2. Operation - Give detailed instruction in proper sequence for each mode of operation. When, for a given action on part of operator, alternate equipment responses are possible, give appropriate operation reaction to each.
   3. Emergency Operation - If some functions of equipment can be operated while other functions are disabled, give instructions for operations under these conditions. Include here only those alternate methods from operation (from normal) that operator can follow when there is a partial failure or malfunctioning of components, or other unusual condition.
   4. Shutdown - Include instructions for stopping and securing equipment after operation. If a particular sequence is needed, give step-by-step instructions in that order.

1.7 MAINTENANCE INSTRUCTIONS

A. Maintenance instructions shall be divided into two subsections as follows:
   1. Preventive Maintenance - Provide a schedule for preventive maintenance. State, preferably in tabular form, recommended frequency of performance for each preventive task (cleaning, inspection, and scheduled overhaul).
      a. Provide instruction and schedules for routine cleaning and inspection, with recommended lubricants where applicable.
      b. If periodic inspection of equipment is needed for operation, cleaning, or other reasons, indicate items to be inspected and give inspection criteria for, but not limited to motors, controls filters, heat exchangers, etc.
      c. Provide instruction for minor repairs or adjustments needed for preventive maintenance routines. Minor repairs and adjustments shall be limited to repairs and adjustments that may be performed without special tools or test equipment, and that require no special training or skills. Identify test points and give values for each.
   2. Corrective Maintenance - Provide instructions predicated upon a logical effect-to cause trouble-shooting philosophy to minimize equipment down time. Instructions and data shall appear in normal sequence of corrective maintenance, for example, troubleshooting first, repair and replacement of parts second, and then parts list.
      a. Trouble-shooting - shall describe general procedure for locating malfunctions and shall give, in detail, any specific remedial procedures or techniques. Data shown is intended to isolate only most common equipment deficiencies. Trouble-shooting tables, charts, or diagrams may be used to present specific procedures. A guide to

this type shall be a three column chart. Columns shall be entitled Malfunction, Probable Cause, and Recommended Action. Information shall be alphabetically arranged by component, and each component shall, in turn, list deficiencies that may be expected. Each deficiency shall contain one or more problems with a recommended correction.

b. Repair and Replacement - Indicate procedures most likely to be needed in maintenance of systems and equipment. Information included here shall consist of step-by-step instructions for repair and replacement of defective items. Include all information needed to accomplish repair and replacement, including information such as torque values. Identify tools, special equipment, and materials that may be needed. Identify uses for maintenance equipment. Paragraphs shall contain headings to identify topics covered.

c. Safety Precautions - shall comprise a listing of safety precautions and instructions to be followed before, during, and after repairs or adjustments are made or routine maintenance is performed.

B. Spare Parts Lists:

1. Include recommended spare parts for equipment furnished for Project. List shall include a tabulation of descriptive data for all electrical electronic spare parts and all mechanical spare parts for each type of equipment or system. Each part shall be properly identified by part number and manufacturer.

1.8 SUBMISSION REQUIREMENTS

A. For Final Inspection: Submit one digital copy of completed volumes in final form 15 days prior to final inspection. This copy will be returned with Architect's comments. Revise content of documents as needed prior to final submittal.

B. Submit final volumes revised, in PDF and if requested, as hardcopies, within 10 days following final inspection.

C. PDF Format: PDF format for Operation and Maintenance Manuals shall be organized using the same method as the hard copy manuals. Parts and specifications sections shall be bookmarked and have searchable functionality.

D. Verify with Owner for additional PDF File organization.

1.9 OPERATING AND MAINTENANCE TRAINING AND INSTRUCTIONS

A. Items in Detailed Review: Arrange for each installer of equipment that requires regular maintenance to meet with the Owner's personnel to provide instruction in proper operation and maintenance. If installers are not experienced in procedures, provide instruction by manufacturer's representatives. Include a detailed review of the following items:

1. Maintenance manuals.
2. Record documents.
3. Spare parts and materials.
4. Tools.
5. Lubricants.

6. Fuels.
7. Identification systems.
8. Control sequences.
9. Hazards.
10. Cleaning.
11. Warranties and bonds.
12. Maintenance agreements and similar continuing commitments.

B. Demonstration of Procedures: As part of instruction for operating equipment, demonstrate the following procedures:
1. Start-up.
2. Shutdown.
3. Emergency operations.
4. Noise and vibration adjustments.
5. Safety procedures.
6. Economy and efficiency adjustments.
7. Effective energy utilization.

C. Video Recordings: Videography documenting equipment startup, inspections and/or training shall adhere to the following requirements:
1. Engage a qualified commercial videographer to record demonstration and training video recordings. Record each training module separately. Include classroom instructions and demonstrations, board diagrams, and other visual aids, but not student practice.
2. At beginning of each training module, record each chart containing learning objective and lesson outline.
3. Provide high quality color video recordings with menu navigation in format acceptable to Professional.
4. Mount camera on tripod before starting recording, unless otherwise necessary to show area of demonstration and training. Display continuous running time.
5. Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed.
6. Provide a transcript of the narration. Display images and running time captured from videotape opposite the corresponding narration segment.
7. Provide video recordings used as a component of training modules in same format as recordings of live training.

1.10 PROJECT RECORD DOCUMENTS

A. Contractual Requirements: Refer to General Conditions, for contractual requirements governing record documents.

B. Record Set: Make a complete and accurate record of the changes or deviations from the Contract Documents and shop drawings, indicating the Work as actually installed. The Contractor, and the subcontractor for each part of the Work, shall record the changes under the direction of the Contractor as the Work progresses. Neatly and correctly mark such changes on blackline prints of the Drawings affected, or on a copy of the Specifications, together with appropriate supplementary notes. Arrange the record Drawings in proper order and index the shop drawing information in accordance with the various sections of the Specifications. Keep the record set of Drawings, shop drawings and Specifications at the job site for review by the Architect or Owner.
   1. Provide version of record set drawings in PDF format, indexed by discipline, and drawings series within each discipline.

C. Endorsement: At the completion of the Work the Contractor acknowledges, that each of the revised prints of the Drawings and Specifications constitutes a complete and accurate record of the Work as installed or constructed.

D. Record of Changes or Deviations from the Contract Documents and the shop drawings: As the work progresses keep a complete and accurate record of changes or deviations from the Contract Documents and the shop drawings, indicating the Work as installed. Show changes neatly and correctly on the affected document using black line prints of the Drawings or the Specifications, with appropriate supplementary notes. Keep this record set of Drawings, shop drawings and Specifications at the job site available to the Architect and Owner.

E. Delivery of the Record Documents: Prior to application for final payment, and as a condition to its acceptance by the Architect and Owner, deliver the record documents in proper order. Deliver the records digitally or in suitable transfer cases, indexed and marked, for each Division of the Work.

F. Responsibility of the Contractor: Acceptance of such records by the Architect or Owner shall not be a waiver of any deviation from the Contract Documents or the shop drawings or in any way relieve the Contractor from his responsibility to perform the Work in accordance with the Contract Documents and the shop drawings to the extent they are in accordance with the Contract Documents.

G. Sustainable Building Manual: The Contractor shall compile a Sustainable Building Manual of items required in Section 01 81 13 "Sustainable Design Requirements", in a loose-leaf binder with tabs for each section of the specifications which has such a requirement. Provide subdivided tabs by the specific requirement (Low Emitting Materials, Recycled Content, Certified Wood). The Contractor shall include each product data, manufacturer's specifications and installation requirements, certifications and other data which specifically address each product's compliance with specified requirements. The Contractor shall maintain 3 copies of this binder. One on site for the Contractor's use, one with the Owner's Environmental Consultant, and the final one to be submitted to the Owner at Project Completion.

1.11 WARRANTIES AND GUARANTEES

A. Terms of the Contractor's Special Warranties and Guarantees: Refer to the General Conditions for terms of the Contractor's special warranties and guarantees of workmanship and materials.
   1. Warranties and guarantees required by the Technical Sections of the Specifications shall

not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and are in addition to and run concurrent with other warranties and guarantees made by the Contractor under requirements of the Contract Documents.

B. Definitions.
   1. Standard Product Warranties and/or Guarantees are preprinted written documents published by individual manufacturers for particular products and are specifically endorsed by the manufacturer to the Owner.
   2. Special Warranties and/or Guarantees are written documents required by or incorporated in the Contract Documents, either to extend time limits provided by standard warranties and/or guarantees or to provide greater rights for the Owner. When a special warranty and/or guarantee is required to be executed by the Contractor, or the Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by the required parties. Submit a draft to the Owner for Owner's approval prior to final execution.

C. Submission Requirements.
   1. Submit documents to Owner and Architect within 10 days following Date of Substantial Completion. For item accepted after Date of Substantial Completion, submit documents within 10 days following each individual acceptance.
      a. When a designated portion of Work is completed and occupied or used by Owner, by separate agreement with Contractor during construction period, submit properly executed warranties to Owner within 15 days of completion of that designated portion of Work.
   2. When special warranty is required to be executed by Contractor, or Contractor and a subcontractor, supplier or manufacturer, prepare a written document that contains appropriate terms and identification, ready for execution by required parties. Submit a draft to Owner.

D. Organization.
   1. Compile specified warranties and service and maintenance agreements. Execute and assemble documents from subcontractors, suppliers, and manufacturers.
   2. Prepare a table of contents, in an orderly sequence, with information as follows:
      a. Product or assembly.
      b. Firm, with name of principal, address, and telephone number.
      c. Scope.
      d. Date of beginning and duration of warranty, bond, or service agreement.
      e. Provide information for proper procedure to be followed in case of failure, and in instances that may affect validity of warranty.

1.12 WARRANTY REQUIREMENTS

A. Written warranties made to Owner are in addition to implied warranties and shall not limit duties, obligations, right and remedies otherwise available under law, nor shall warranty periods be interpreted as limitations on time in which Owner can enforce such other duties, obligations, rights, or remedies.

B. Manufacturer's disclaimers and limitations on product warranties shall not relieve Contractor of warranty on Work that incorporates products, nor shall it relieve suppliers, manufacturers,

and subcontractors required to countersign special warranties with Contractor.

C. Warranties shall become valid and operative upon issuance of Certificate of Substantial Completion.

D. For items of Work delayed beyond Date of Substantial Completion, provide an updated schedule within 10 days after acceptance, listing date of acceptance as start of warranty.

E. Related Damages and Losses:
   1. When correcting warranted and/or guaranteed Work that has failed, remove and replace other Work that has been damaged as a result of such failure or that must be removed and replaced to provide access for correction of warranted and/or guaranteed Work.

F. Reinstatement of Warranty and/or Guarantee.
   1. When Work covered by a warranty and/or guarantee has failed and been corrected by replacement or rebuilding, reinstate the warranty and/or guarantee by written endorsement. The reinstated warranty and/or guarantee shall be for the full duration of the original warranty or guarantee commencing on the date the corrected Work is completed, unless a longer period is required by the Contract Documents.

G. Replacement Cost.
   1. Upon determination that Work covered by a warranty and/or guarantee has failed, replace or rebuild the Work to an acceptable condition complying with requirements of the Contract Documents.
   2. The Contractor is responsible for the cost of replacing or rebuilding defective Work regardless of whether the Owner has benefited from use of the Work through a portion of its anticipated useful service life.

H. Owner's Recourse: Written warranties and/or guarantees made to the Owner are in addition to implied warranties and/or guarantees, and shall not limit the duties, obligations, rights and remedies otherwise available under the law, nor shall warranty and/or guarantee periods be interpreted as limitations on time in which the Owner can enforce such other duties, obligations, rights, or remedies.
   1. Rejection of Warranties and/or Guarantees: The Owner reserves the right to reject warranties and/or guarantees and to limit selections to products with warranties and/or guarantees not in conflict with requirements of the Contract Documents.

I. The Owner reserves the right to refuse to accept Work for the Project where a special warranty, guarantee, certification, or similar commitment is required on such Work or part of the Work, until evidence is presented that entities required to countersign such commitments are willing to do so.

J. Disclaimers and Limitations: Manufacturer's disclaimers and limitations on product warranties and/or guarantees do not relieve the Contractor of the warranty and/or guarantee on the Work that incorporates the products, nor does it relieve suppliers, manufacturers, and subcontractors required to countersign special warranties and/or guarantees with the Contractor.

K. Documents to be Provided to the Owner Prior to Final Payment: Prior to final payment and before the issuance of a final Certificate for Payment, in accordance with the provisions of the General Conditions, provide the following documents directly to the Owner:
   1. Warranties and/or Guarantees: The warranties and/or guarantees required by the General Conditions and any other extended warranties and/or guarantees stated in the technical Sections of the Specifications.
   2. Release or Waiver of Liens: As required by the General Conditions.
   3. Service and Maintenance Contracts: Furnish properly executed contracts for any extended service or maintenance as required by the technical sections of the Specifications.

1.13 CERTIFICATE OF OCCUPANCY

A. Filing of Documents with the Architect for Transmittal to the Owner: Prior to final payment and before the issuance of a final Certificate for Payment, in accordance with the provisions of the General Conditions, file the following documents with the Architect for transmittal to the Owner:

B. Certificate of Occupancy: Where the local law at the site of the building requires either a temporary and/or permanent Certificate of Occupancy, obtain and pay for these certificates and deliver to the Architect.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 024119

SELECTIVE DEMOLITION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Demolition and removal of selected portions of building or structure.
2. Demolition and removal of selected site elements.
3. Salvage of existing items to be reused or recycled.

1.2 MATERIALS OWNERSHIP

A. Unless otherwise indicated, demolition waste becomes property of Contractor.

1.3 PREINSTALLATION MEETINGS

A. Predemolition Conference: Conduct conference at Project site.
1. Inspect and discuss condition of construction to be selectively demolished.
2. Review structural load limitations of existing structure.
3. Review and finalize selective demolition schedule and verify availability of materials, demolition personnel, equipment, and facilities needed to make progress and avoid delays.
4. Review requirements of work performed by other trades that rely on substrates exposed by selective demolition operations.
5. Review areas where existing construction is to remain and requires protection.

1.4 INFORMATIONAL SUBMITTALS

A. Proposed Protection Measures: Submit report, including drawings, that indicates the measures proposed for protecting individuals and property, for environmental protection, for dust control and, for noise control. Indicate proposed locations and construction of barriers.

B. Schedule of Selective Demolition Activities: Indicate the following:
1. Detailed sequence of selective demolition and removal work, with starting and ending dates for each activity. Ensure Owner's on-site operations are uninterrupted.
2. Interruption of utility services. Indicate how long utility services will be interrupted.
3. Coordination for shutoff, capping, and continuation of utility services.
4. Coordination of Owner's continuing occupancy of portions of existing building and of Owner's partial occupancy of completed Work.

C. Inventory: Submit a list of items to be removed and salvaged and deliver to Owner prior to start of demolition.

D. Predemolition Photographs or Video: Submit before Work begins.

E. Statement of Refrigerant Recovery: Signed by refrigerant recovery technician responsible for recovering refrigerant, stating that all refrigerant that was present was recovered and that recovery was performed according to EPA regulations. Include name and address of technician and date refrigerant was recovered.

F. Warranties: Documentation indicated that existing warranties are still in effect after completion of selective demolition.

1.5 CLOSEOUT SUBMITTALS

A. Inventory: Submit a list of items that have been removed and salvaged.

B. Landfill Records: Indicate receipt and acceptance of hazardous wastes by a landfill facility licensed to accept hazardous wastes.

1.6 QUALITY ASSURANCE

A. Refrigerant Recovery Technician Qualifications: Certified by an EPA-approved certification program.

1.7 FIELD CONDITIONS

A. Owner will occupy portions of building immediately adjacent to selective demolition area. Conduct selective demolition so Owner's operations will not be disrupted.

B. Conditions existing at time of inspection for bidding purpose will be maintained by Owner as far as practical.
   1. Before selective demolition, coordinate with Owner for Owner removal of items prior to commencement of demolition Work.

C. Notify Architect of discrepancies between existing conditions and Drawings before proceeding with selective demolition.

D. Hazardous Materials: It is not expected that hazardous materials will be encountered in the Work.
   1. Hazardous materials will be removed by Owner before start of the Work.
   2. If suspected hazardous materials are encountered, do not disturb; immediately notify Architect and Owner. Hazardous materials will be removed by Owner under a separate contract.

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

F. Utility Service: Maintain existing utilities indicated to remain in service and protect them

against damage during selective demolition operations.

1.8 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. Notify warrantor before proceeding.

B. Notify warrantor on completion of selective demolition, and obtain documentation verifying that existing system has been inspected and warranty remains in effect. Submit documentation at Project closeout.

PART 2 PRODUCTS

2.1 PEFORMANCE REQUIREMENTS

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

B. Standards: Comply with ANSI/ASSP A10.6 and NFPA 241.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that utilities have been disconnected and capped before starting selective demolition operations.

B. Review record documents of existing construction provided by Owner. Owner does not guarantee that existing conditions are same as those indicated in record documents.

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

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

E. Perform an engineering survey of condition of building to determine whether removing any element might result in structural deficiency or unplanned collapse of any portion of structure or adjacent structures during selective building demolition operations.
   1. Perform surveys as the Work progresses to detect hazards resulting from selective demolition activities.

F. Survey of Existing Conditions: Record existing conditions by use of preconstruction photographs.
   1. Inventory and record the condition of items to be removed and salvaged. Provide photographs of conditions that might be misconstrued as damage caused by salvage operations.

3.2 UTILITY SERVICES AND MECHANICAL/ELECTRICAL SYSTEMS

A. Existing Services/Systems to Remain: Maintain services/systems indicated to remain and protect them against damage.

B. Existing Services/Systems to Be Removed, Relocated, or Abandoned: Locate, identify, disconnect, and seal or cap off indicated utility services and mechanical/electrical systems serving areas to be selectively demolished.
   1. If services/systems are required to be removed, relocated, or abandoned, provide temporary services/systems that bypass area of selective demolition and that maintain continuity of services/systems to other parts of building.
   2. Disconnect, demolish, and remove fire-suppression systems, plumbing, and HVAC systems, equipment, and components indicated to be removed.
      a. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
      b. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
      c. Equipment to Be Removed: Disconnect and cap services and remove equipment.
      d. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
      e. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
      f. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
      g. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.

C. Refrigerant: Remove refrigerant from mechanical equipment to be selectively demolished according to 40 CFR 82 and regulations of authorities having jurisdiction.

3.3 PREPARATION

A. Temporary Shoring: Provide and maintain shoring, bracing, and structural supports as required to preserve stability and prevent movement, settlement, or collapse of construction and finishes to remain, and to prevent unexpected or uncontrolled movement or collapse of construction being demolished.
   1. Strengthen or add new supports when required during progress of selective demolition.

3.4 SELECTIVE DEMOLITION, GENERAL

A. General: Demolish and remove existing construction only to the extent required by new construction and as indicated. Use methods required to complete the Work within limitations of governing regulations and as follows:
   1. Proceed with selective demolition systematically, from higher to lower level. Complete selective demolition operations above each floor or tier before disturbing supporting members on the next lower level.
   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. Use hand tools or small power tools designed for sawing or grinding, not hammering and chopping, to minimize disturbance of adjacent surfaces. 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 fire watch and 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 and remove debris and materials so as not to impose excessive loads on supporting walls, floors, or framing.

B. Removed and Salvaged Items:
   1. Clean salvaged items.
   2. Pack or crate items after cleaning. Identify contents of containers.
   3. Store items in a secure area until delivery to Owner.
   4. Transport items to Owner's storage area as designated by Owner or as indicated on Drawings.
   5. Protect items from damage during transport and storage.

C. Removed and Reinstalled Items:
   1. Clean and repair items to functional condition adequate for intended reuse.
   2. Pack or crate items after cleaning and repairing. Identify contents of containers.
   3. Protect items from damage during transport and storage.
   4. Reinstall items in locations indicated. Comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make item functional for use indicated.

3.5 SELECTIVE DEMOLITION PROCEDURES FOR SPECIFIC MATERIALS

A. Concrete: Demolish in sections. Cut concrete full depth at junctures with construction to remain and at regular intervals using power-driven saw, then remove concrete between saw cuts.

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's "Recommended Work Practices for the Removal of Resilient Floor Coverings."

E. Roofing: Remove no more existing roofing than what can be covered in one day by new roofing and so that building interior remains watertight and weathertight.
   1. Remove existing roof surface material, flashings, copings, and roof accessories.
   2. Remove existing roofing system down to substrate.

3.6 DISPOSAL OF DEMOLISHED MATERIALS

A. General: Except for items or materials indicated to be reused, salvaged, reinstalled, or otherwise indicated to remain Owner's property, remove demolished materials from Project site and legally dispose of them in an EPA-approved landfill.
   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. Remove debris from elevated portions of building by chute, hoist, or other device that will convey debris to grade level in a controlled descent.

B. Burning: Do not burn demolished materials.

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

3.7 CLEANING

A. Clean adjacent structures and improvements of dust, dirt, and debris caused by selective demolition operations. Return adjacent areas to condition existing before selective demolition operations began.

END OF SECTION

SECTION 033000

CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Cast-in-place concrete, including concrete materials, mixture design, placement procedures, and finishes.
   2. Form-facing materials.
   3. Formwork shoring, bracing, and anchoring.
   4. Reinforcing.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of the following: blended hydraulic cement, fly ash, slag cement, other pozzolans, and silica fume; materials subject to compliance with requirements.

B. Water/Cement Ratio (w/cm): The ratio by weight of water to cementitious materials.

1.3 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. Contractor's superintendent.
      b. Independent testing agency responsible for concrete design mixtures.
      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. Methods for achieving specified floor and slab flatness and levelness.
k. Floor and slab flatness and levelness measurements.
l. Concrete repair procedures.
m. Concrete protection.
n. Initial curing and field curing of field test cylinders (ASTM C31/C31M.).
o. Protection of field cured field test cylinders.

1.4 ACTION SUBMITTALS

A. Product Data: For each of the following.
1. Waterstops.
2. Portland cement.
3. Fly ash.
4. Slag cement.
5. Blended hydraulic cement.
6. Silica fume.
7. Aggregates.
8. Admixtures:
a. Include limitations of use, including restrictions on cementitious materials, supplementary cementitious materials, air entrainment, aggregates, temperature at time of concrete placement, relative humidity at time of concrete placement, curing conditions, and use of other admixtures.
9. Vapor retarders.
10. Floor and slab treatments.
11. Liquid floor treatments.
12. Curing materials.
a. Include documentation from color pigment manufacturer, indicating that proposed methods of curing are recommended by color pigment manufacturer.
13. Joint fillers.
14. Repair materials.

B. Design Mixtures: For each concrete mixture, include the following:
1. Mixture identification.
2. Minimum 28-day compressive strength.
3. Maximum w/cm.
4. Slump limit.
5. Air content.
6. Nominal maximum aggregate size.
7. Indicate amounts of mixing water to be withheld for later addition at Project site if permitted.
8. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

C. Shop Drawings:
1. Reinforcing Shop Drawings: Comply with ACI SP-066:
a. Include placing drawings that detail fabrication, bending, and placement.
b. 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.

2. Construction and Shrinkage Joint Layout: Indicate proposed construction joints and shrinkage joints in slab-on-grade construction (where not shown on the drawings) required to construct the structure.
   a. Location of construction and shrinkage joints is subject to approval of the Architect.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For the following:
   1. Installer: Include copies of applicable ACI certificates.
   2. Ready-mixed concrete manufacturer.

B. Material Test Reports: For the following, from a qualified testing agency:
   1. Portland cement.
   2. Fly ash.
   3. Slag cement.
   4. Blended hydraulic cement.
   5. Silica fume.
   6. Aggregates.

C. Floor surface flatness and levelness measurements report, indicating compliance with specified tolerances.

D. Preconstruction Test Reports: For each mix design.

E. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs Project personnel qualified as an ACI-certified Flatwork Technician and Finisher and a supervisor who is a certified ACI Flatwork Concrete Finisher/Technician or an ACI Concrete Flatwork Technician.

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.
   1. Manufacturer certified in accordance with NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Comply with ASTM C94/C94M and ACI 301 (ACI 301M).

B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

C. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and

damage.

1.8 FIELD CONDITIONS

A. Cold-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 306.1 and 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 average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
   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 (1.7 deg C), other than reinforcing steel.
   5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.

B. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and ACI 305.1 (ACI 305.1M), and as follows:
   1. Maintain concrete temperature at time of discharge to not exceed 95 deg F (35 deg C).
   2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

PART 2 PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 and ACI 117 (ACI 301M) unless modified by requirements in the Contract Documents.

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 03 30 00 "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. 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.

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.

2.3 WATERSTOPS

A. Self-Expanding Rubber Strip Waterstops: Manufactured rectangular or trapezoidal strip, bentonite-free hydrophilic polymer-modified chloroprene rubber, for adhesive bonding to concrete, in manufacturer's standard size.

B. Subject to compliance with requirements, provide one of the following:
   1. CCW (Carlisle); Mirastop NBW, 3/8 by 3/4 inch.
   2. GCP Applied Technologies: ADCOR ES (no substitutions), 1/2 by 1 inch.

2.4 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A615/A615M, deformed.

B. Low-Alloy Steel Reinforcing Bars: ASTM A706/A706M, deformed.

C. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, plain, fabricated from as-drawn steel wire into flat sheets.

2.5 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A615/A615M, Grade 60 (Grade 420), plain-steel bars, cut true to length with ends square and free of burrs.

B. 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 slabs-on-grade, use precast concrete blocks spaced a maximum of three feet on center each way, unless indicated otherwise.

C. Steel Tie Wire: ASTM A1064/A1064M, annealed steel, not less than 0.0508 inch (1.2908 mm) in diameter.
   1. Finish: Plain.

2.6 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.7 CONCRETE MATERIALS

A. Source Limitations:
   1. Obtain all concrete mixtures from a single ready-mixed concrete manufacturer for entire Project.
   2. Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant.
   3. Obtain aggregate from single source.
   4. Obtain each type of admixture from single source from single manufacturer.

B. Cementitious Materials:
   1. Portland Cement: ASTM C150/C150M, Type I or Type II.
   2. Fly Ash: ASTM C618, Class C or F.
   3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
   4. Blended Hydraulic Cement: ASTM C595/C595M, Type IS, portland blast-furnace slag, Type IP, portland-pozzolan cement.
   5. Silica Fume: ASTM C1240 amorphous silica.

C. Normal-Weight Aggregates: ASTM C33/C33M, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source.
   1. Alkali-Silica Reaction: Comply with one of the following:
      a. Expansion Result of Aggregate: Not more than 0.04 percent at one-year when tested in accordance with ASTM C1293.
      b. Expansion Results of Aggregate and Cementitious Materials in Combination: Not more than 0.10 percent at an age of 16 days when tested in accordance with ASTM C1567.
      c. Alkali Content in Concrete: Not more than 4 lb./cu. yd. (2.37 kg/cu. m) for moderately reactive aggregate or 3 lb./cu. yd. (1.78 kg/cu. m) for highly reactive aggregate, when tested in accordance with ASTM C1293 and categorized in accordance with ASTM C1778, based on alkali content being calculated in accordance with ACI 301 (ACI 301M).
   2. Maximum Coarse-Aggregate Size: 1-1/2 inches for footings, 1 inch for walls and slabs-on-grade, and 3/4 inch for slabs less than 4’ thick. Use #57 aggregate minimum for footings, walls, and slabs-on-grade.
   3. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

D. Air-Entraining Admixture: ASTM C260/C260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
   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.
   6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

F. Water: Potable.

2.8 VAPOR RETARDERS

A. Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mil thick. Include manufacturer's recommended adhesive,pressure-sensitive tape, and accessories.
   1. Provide Stego Wrap 15 mil Vapor Barrier (no substitutions).

2.9 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Clear, chemically reactive, waterborne solution of inorganic silicate or siliconate materials and proprietary components; odorless; that penetrates, hardens, and densifies concrete surfaces.
   1. Product: Subject to compliance with requirements, provide one of the following:
      a. Conspec by Dayton Superior; Intraseal.
      b. Dayton Superior Corporation; Day-Chem Sure Hard (J-17).
      c. Edoco by Dayton Superior; Titan Hard.
      d. Euclid Chemical Company (The), an RPM Company; Euco Diamond Hard.
      e. Kaufman Products, Inc.; SureHard.
      f. L&M Construction Chemicals, Inc.; Seal Hard.
      g. Meadows, W. R., Inc.; LIQUI-HARD.

2.10 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
   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. BASF Construction Chemicals - Building Systems; Confilm.
      b. Conspec by Dayton Superior; Aquafilm.
      c. Dayton Superior Corporation; Sure Film (J-74).
      d. Euclic Chemical Company (The), an RPM Company; Eucobar.
      e. Kaufman Products, Inc.; Vapor-Aid.
      f. L&M Construction Chemicals, Inc.; E-CON.
      g. Meadows, W. R., Inc.; EVAPRE.
      h. Sika Corporation; SikaFilm.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jude or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Euclid Chemical Company (The), an RPM company; Diamond Clear VOX; Clearseal WB STD.
      b. L&M Construction Chemicals, Inc.; Dress & Seal WB.
      c. Meadows, W. R., Inc.; Vocomp-20.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Euclid Chemical Company (The), an RPM company; Super Diamond Clear VOX; LusterSeal WB 300.
      b. L&M Construction Chemicals, Inc.; Lumiseal WB Plus.
      c. Meadows, W. R., Inc. ; Vocomp-30.

2.11 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D1751, asphalt-saturated cellulosic fiber.

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, 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 I and II, nonload bearing and Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.12 REPAIR MATERIALS

A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch (3 mm) 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 (3 to 6 mm) or coarse sand, as recommended by underlayment manufacturer.
4. Compressive Strength: Not less than 4100 psi (29 MPa) at 28 days when tested in accordance with ASTM C109/C109M.

2.13 CONCRETE MIXTURES, GENERAL

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 (ACI 301M).
   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 cement in concrete 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, Slag Cement, and Silica Fume: 50 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.
   1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete, and concrete with a w/cm below 0.50.

D. Limit water-soluble, chloride-ion content in hardended concrete to 0.15 percent by weight of concrete.

2.14 CONCRETE MIXTURES

A. Footings, grade beams, and tie beams: Normal-weight concrete.
   1. Minimum Compressive Strength: 3000 psi at 28 days.
   2. Slump Limit: 4 inches, plus or minus 1 inch, 8 inches, plus or minus 1 inch, for concrete with verified slump of 3 inches, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
   3. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery.

B. Walls and Piers: Normal-weight concrete.
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Slump Limit: 3 inches, plus or minus 1 inch, 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
   3. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery.

C. Slabs-on-Grade: Normal-weight concrete.
   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Minimum Cementitious Materials Content: 470 lb/cu. yd.
   3. Slump Limit: 3 inches, plus or minus 1 inch, 8 inches, plus or minus 1 inch for concrete with verified slump of 3 inches, before adding high-range water-reducing admixture or plasticizing admixture at Project site.
   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.

D. Work exposed to Weather: Proportion normal-weight concrete mixture as follows:
   1. Minimum Compressive Strength: 4500 psi at 28 days.
   2. Maximum Water-Cementitious Materials Ratio: 0.45.
   3. Slump Limit: 4 inches.
   4. Air Content: 5 to 7 percent.

2.15 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete in accordance with ASTM C94/C94M and ASTM C1116/C1116M, and furnish batch ticket information.
   1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Before placing concrete, verify that installation of concrete forms, accessories, and 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. Protection of In-Place Conditions:
   1. Do not cut or puncture vapor retarder.
   2. Repair damage and reseal vapor retarder before placing concrete.

B. 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 INSTALLATION OF FORMWORK

A. Concrete Formwork: Design, engineer, erect, shore, brace, and maintain formwork in accordance with ACI 301 (ACI 301M), 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.

B. Construct formwork, so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117 (ACI 117M).

C. Limit concrete surface irregularities as follows:
   1. Surface Finish-2.0: ACI 117 Class B, 1/4 inch (6 mm).
   2. Surface Finish-3.0: ACI 117 Class A, 1/8 inch (3.0 mm).

D. Construct forms tight enough to prevent loss of concrete mortar.

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.
   3. Depress slabs for gym floor finish system, refrigerator/freezer units and as indicated on the Drawings.

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. 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.

K. 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 Architect.
3. Place joints perpendicular to main reinforcement.
4. Locate joints for beams, slabs, joists, and girders in the middle third of spans.
    a. 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.
    a. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.

L. 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.

M. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

N. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

O. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.4 INSTALLATION OF WATERSTOPS

A. Self-Expanding Strip Waterstops: Install in construction joints and at other locations indicated on Drawings, according to 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.

3.5 REMOVING AND REUSING FORMS

A. Formwork for sides of beams, 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 (10 deg C) 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.

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 Architect.

3.6 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 ANSI/AISC 303.

3.7 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 (25 mm), 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 (ACI 318M).

E. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

F. Splices: Lap splices as indicated on Drawings.
   1. Stagger splices in accordance with ACI 318 (ACI 318M).
   2. Mechanical Splice Couplers: Install in accordance with manufacturer's instructions.

G. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging.
   1. Lap edges and ends of adjoining sheets at least one wire spacing plus 2 inches.
   2. Offset laps of adjoining sheet widths to prevent continuous laps in either direction.
   3. Lace overlaps with wire.

3.8 INSTALLATION OF VAPOR RETARDER

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 (150 mm), sealing vapor retarder to concrete.
   4. Lap joints 6 inches (150 mm) 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. Extend vapor barrier up face of foundation wall to top of concrete slab on grade.
   7. Extend vapor barrier down face of footing wall to top of concrete footing. Seal vapor barrier to footing with manufacturer’s mastic.
   8. Seal penetrations in accordance with vapor retarder manufacturer's instructions.
   9. Protect vapor retarder during placement of reinforcement and concrete.
   10. Repair damaged areas by patching with vapor retarder material, overlapping damages area by 6 inches (150 mm) on all sides, and sealing to vapor retarder.
   11. Overlap new vapor retarder over existing vapor retarder where existing concrete slabs are cut. Seal vapor retarders together by overlapping 6 inches and taping the intersection of the two vapor retarders.

3.9 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 Architect.
   2. Place joints perpendicular to main reinforcement.
      a. Continue reinforcement across construction joints unless otherwise indicated.
      b. Do not continue reinforcement through sides of strip placements of slabs-on-grade.
   3. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) 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. Where indicated, use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   8. Where indicated, use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

C. Control Joints (shrinkage joints) in Slabs-on-Grade: 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 (3.2 mm). 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- (3.2-mm-) 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-grade: 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 (13 mm) or more than 1 inch (25 mm) below finished concrete surface, where joint sealants, specified in Section 07 92 00 "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.

F. Dowel Plates: Install dowel plates at joints where indicated on Drawings.

3.10 CONCRETE PLACEMENT

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 Architect and testing and inspection agencies 24 hours prior to commencement of concrete placement.

C. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect in writing, but not to exceed the amount indicated on the concrete delivery ticket.
   1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

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 (ACI 301M).
      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 (150 mm) 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, including welded wire fabric, 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.

3.11 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 (19 mm) wide or 1/2 inch (13 mm) deep.
      b. Remove projections larger than 1/4 inch (6 mm).
      c. Patch tie holes.
      d. Surface Tolerance: ACI 117 (ACI 117M) Class B.
      e. Locations: Apply to concrete surfaces not exposed to public view, or to be covered with a coating or covering material applied directly to concrete.
   2. ACI 301 (ACI 301M) Surface Finish SF-3.0:
      a. Patch voids larger than 3/4 inch (19 mm) wide or 1/2 inch (13 mm) deep.
      b. Remove projections larger than 1/8 inch (3 mm).
      c. Patch tie holes.
      d. Surface Tolerance: ACI 117 (ACI 117M) Class A.

e. Locations: Apply to concrete surfaces exposed to public view.

B. Rubbed Finish: Apply the following to as cast surface finishes where indicated on Drawings:
1. Smooth-Rubbed Finish:
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 mockups.

C. Related Unformed Surfaces:
1. At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a color and texture matching adjacent formed surfaces.
2. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.12 FINISHING FLOORS AND SLABS

A. Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

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 (ACI A117M) tolerances for conventional concrete.
3. Apply float finish to surfaces to receive trowel finish.

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.
5. Do not apply hard-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 (ASTM E1155M), 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: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom perpendicular to main traffic route.
   1. Coordinate required final finish with Architect before application.
   2. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

E. Broom Finish: Apply a broom finish to exterior concrete walks, patios, platforms, steps, ramps, and locations indicated on Drawings.
   1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route.
   2. Coordinate required final finish with Architect before application.

3.13 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 blend with in-place construction.
   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 steel-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 6 inches (150 mm) high unless otherwise indicated on Drawings, and extend base not less than 6 inches (150 mm) 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 (27.6 MPa) at 28 days.
   4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) 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.

3.14 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot

temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed 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.

C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.

D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.

E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
      d. Do not moist cure slabs to receive finishes.
   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. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
      a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive roofing or waterproofing.
      b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
      c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
      a. Removal: After curing period has lapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certified curing compound will not interfere with bonding of floor covering used on Project.
   4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.15 LIQUID FLOOR TREATMENTS

A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer’s written instructions.
   1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
   2. Do not apply to concrete that is less than 28 days’ old.
   3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

B. Sealing Coat: Uniformly apply a continuous sealing coat of curing and sealing compound to hardened concrete by power spray or roller according to manufacturer’s written instructions.

3.16 TOLERANCES

A. Conform to ACI 117 (ACI 117M).

3.17 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 six month(s).
   2. Do not fill joints until construction traffic has permanently ceased.

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 (50 mm) deep in formed joints.

D. Overfill joint, and trim joint filler flush with top of joint after hardening.

3.18 CONCRETE SURFACE REPAIRS

A. Defective Concrete:
   1. Repair and patch defective areas when approved by Architect.
   2. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

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 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, 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 (13 mm) in any dimension to solid concrete.

a. Limit cut depth to 3/4 inch (19 mm).
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 strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that will affect concrete's durability and structural performance as determined by Architect.

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 (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
   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 cutting out low areas and replacing with 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 (6 mm) 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 (25 mm) 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 (19-mm) 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 (25 mm) 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 Architect's approval, using epoxy adhesive and patching mortar.

F. Repair materials and installation not specified above may be used, subject to Architect's approval.

3.19 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a special inspector to perform field tests and inspections and prepare testing and inspection reports.

B. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
1. Testing agency to be responsible for providing curing container for composite samples on Site and verifying that field-cured composite samples are cured in accordance with ASTM C31/C31M.
2. Testing agency to immediately report to Architect, 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 Owner, Architect, 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.
        13) Information on storage and curing of samples before testing, 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.

C. Batch Tickets: For each load delivered, submit three copies of batch delivery ticket to testing agency, indicating quantity, mix identification, admixtures, design strength, aggregate size,

design air content, design slump at time of batching, and amount of water that can be added at Project site.

D. Inspections:
   1. Steel-reinforcement placement.
   2. Headed bolts and studs.
   3. Verification of use of required design mixture.
   4. Concrete placement, including conveying and depositing.
   5. Curing procedures and maintenance of curing temperature.

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. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
   2. Slump: ASTM C143/C143M:
      a. One test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture.
      b. Perform additional tests when concrete consistency appears to change.
   3. Air Content: ASTM C231/C231M pressure method, for normal-weight concrete.
      a. One test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
   4. Concrete Temperature: ASTM C1064/C1064M:
      a. One test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
   5. Compression Test Specimens: ASTM C31/C31M:
      a. Cast and laboratory cure two sets of two 6-inch (150 mm) by 12-inch (300 mm) or 4-inch (100 mm) by 8-inch (200 mm) cylinder specimens for each composite sample.
   6. Compressive-Strength Tests: ASTM C39/C39M.
      a. Test one set of two laboratory-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.
   7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength, and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa) if specified compressive strength is 5000 psi (34.5 MPa), or no compressive strength test value is less than 10 percent of specified compressive strength if specified compressive strength is greater than 5000 psi (34.5 MPa).
   8. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
   9. 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 Architect.
      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 Architect.

1) Acceptance criteria for concrete strength to be in accordance with ACI 301 (ACI 301M), Section 1.6.6.3.

10. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
11. 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 (ASTM E1155M) within 48 hours of completion of floor finishing and promptly report test results to Architect.

3.20 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 on concrete surfaces.
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.

END OF SECTION

SECTION 042000

UNIT MASONRY

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete masonry units.
2. Decorative concrete masonry units.
3. Concrete bricks.
4. Concrete and masonry lintels.
5. Mortar and grout.
6. Reinforcing steel.
7. Joint reinforcement.
8. Wall and veneer anchors.
9. Flashing.
10. Cavity wall accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting:
1. Conduct meeting one month, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Submittals, General: Follow TMS 602.

B. Product Data:
1. Initial selection color samples.

C. Shop Drawings:
1. Masonry Units: Shapes, sizes, profiles, and coursing.
2. Reinforcing Steel: ACI 315R, show placement of bars in masonry, including wall elevations.

D. Samples:
1. Mortar color.
2. Accessories: Vents, flashing, control joints, and each type of product indicated.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates: Data substantiating compliance with requirements for the following:
   1. Brick: Size tolerance, Efflorescence, and Freeze thaw durability.
   2. Structural Masonry: Net-area compressive strength.
   3. Mortar and Grout: Mix designs for compressive strength, water retention, and air content.

B. Qualification Statements: Manufacturer and Installer.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Flashing Installers: Workers who have completed International Masonry Institute flashing upgrade course.
   2. Grout and Reinforcing Installers: Workers who have completed International Masonry Institute grouting and reinforced masonry upgrade course.

B. Preconstruction Testing: Test each product. Complete testing 30 days, minimum, before scheduled field installation.
   1. Brick: Compressive strength, ASTM C67.
   2. CMU: Compressive strength, ASTM C140.
   3. Mortar: Compressive strength, ASTM C109, Property Specification.
   4. Grout: Compressive strength, ASTM C1019.
   5. Wall Assembly: Compressive strength, prism test ASTM C1314.

C. Mockup: Construct full thickness masonry wall containing all components required for finished construction.
   1. Mockup Size: See drawings.
   2. Demonstrate:
      a. Supporting structure, including backup wythe and air barrier.
      b. Face wythe, including color, texture, coursing, and blending of masonry unis.
      c. Tooled mortar joints.
      d. Sealant-filled joints.
      e. Flashing, weep vents, mortar trap, and drainage material.
      f. Sills and Wall Caps.
   3. Utilize stepped back technique, exposing each layer of construction.
   4. Approved mockup establishes work results standard.
   5. Remove mockup when Architect directs.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Masonry Units: Store elevated above grade, protected from precipitation and stormwater runoff. Do not use wet units.
   2. Mortar and Grout: Store elevated above grade, protected from moisture. Do not use materials that have become damp.

1.7 FIELD CONDITIONS

A. Cold Weather: ACI 530.1/ASCE 6/TMS 602.
   1. Do not use frozen or frost damaged materials.
   2. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.

B. Hot Weather: ACI 530.1/ASCE 6/TMS 602.

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

A. CMUs:See structural drawings: ASTM C90.
   1. Net Area CMU Compressive Strength: 2150 psi, minimum.
   2. Density Classification: Normal weight.
   3. Nominal Size: 8 inches high by 16 inches long.
      a. Width: 3/8 inch less than nominal dimensions.

B. Shapes:
   1. Special Shapes: For lintels, corners, jambs, sashes, movement joints, headers, bonding conditions, and other special conditions.
   2. Outside Corners: Square edged, Bullnose, and See Drawings.

C. Integral Water Repellent: Exposed units.
   1. Manufacturers and Products:
      a. ACM Chemistries RainBloc.
      b. BASF Aktiengesellschaft; Rheopel Mortar Admixture.
      c. GCP Applied Technologies Dry-Block.
   2. Substitutions: Not Permitted.
   3. Walls Requiring Water Resistance: Units and mortar containing water repellent admixtures.

2.2 CONCRETE BRICKS

A. Concrete Building Brick Units, RS: ASTM C55.
   1. Density Classification: Normal weight.
   2. Actual Size: 3-1/2 inches wide by 11-3/8 inches high by 23-1/4 inches long.

B. Concrete Facing Brick Units UB: ASTM C1634.
   1. Manufacturers and Products: See Elevations on Drawings.
   2. Manufacturers and Products:
      a. Shouldice Stone; as basis of design.
      b. Or approved equal.
   3. Substitutions: As approved during bidding question period via Addenda.
   4. Density Classification: Normal weight.

5. Net Area Compressive Strength: 3750 psi, minimum.
6. Actual Size: 3-1/2 inches wide by 2-1/4 inches high by 15-5/8 inches long.
7. Texture: Smooth.
8. Color: Architect selected.

C. Concrete Facing Brick Units AS: ASTM C1634.
1. Manufacturers and Products: See Elevations on Drawings.
2. Manufacturers and Products:
   a. Shouldice Stone; as basis of design.
   b. Or approved equal.
3. Substitutions: As approved during bidding question period via Addenda.
4. Density Classification: Normal weight.
5. Net Area Compressive Strength: 3750 psi, minimum.
6. Actual Size: 3-1/2 inches wide by 2-1/4 inches high by 7-5/8 inches, 15-5/8 inches, and 23-5/8 inches long.
7. Texture: Split face.
8. Color: Architect selected.

2.3 MASONRY LINTELS

A. Masonry Lintels: Refer to Structural Drawings for lintel types. Provide Steel lintels where shown. Where masonry lintels are indicated, provide solid concrete masonry lintels:
1. Concrete Lintels: ASTM C1623; precast or formed-in-place reinforced concrete.
2. Compressive Strength: 3000 psi, minimum.

2.4 MORTAR AND GROUT

A. Portland Cement: ASTM C150, Type I or Type II.
1. Cold Weather Applications: Type III.
2. Color: White or natural color as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C207, Type S.

C. Packaged Mortar Mix: Factory blend of portland cement and hydrated lime.

D. Masonry Cement: ASTM C91.
1. Manufacturers:
   a. Holcim.
   b. Lafarge North America.
   c. Lehigh Cement Company.
   d. National Cement Company.

E. Mortar Cement: ASTM C1329.
1. Manufacturers:
   a. Lafarge North America.

F. Mortar Aggregate: ASTM C144.
1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or

crushed stone.
2. For joints less than 1/4 inch thick, use aggregate graded with 100 percent passing the No. 16 sieve.
3. White-Mortar Aggregates: Natural white sand or crushed white stone.
4. Colored-Mortar Aggregates: Natural sand or crushed stone of color necessary to produce required mortar color.

G. Colored Mortar: Provide mortar pigments, portland cement, and aggregates to create specified color.
1. Mortar Pigments: ASTM C979, products formulated for masonry mortar.
a. Manufacturers and Products:
1) Davis Colors True Tone Mortar Colors.
2) Lanxess Corp Bayferrox Iron Oxide Pigments.
3) Solomon Colors SGS Mortar Colors.
2. Color: Architect selected.

H. Grout Aggregate: ASTM C404 fine and coarse.

I. Water Repellent Admixture: Same product used for CMU.

J. Water: Potable, free of substances that cause discoloration or adversely affect mortar setting or strength.

K. Mortar Mixes:
1. Mortar: Portland cement-lime mortar, ASTM C270, Proportion Specification.
2. Mortar Compressive Strength:
a. Structural Masonry: Type S.
b. Below Grade Masonry: Type S.
c. Reinforced Masonry: Type S.
d. Non-Load-Bearing Walls: Type N.
e. Non-Load-Bearing Partitions: Type N.
3. Admixtures: Containing no calcium chloride.

L. Grout Mixes:
1. Masonry Grout: ASTM C476 and TMS 602, Table 1.15.1 for grout space and pour height dimensions.
2. Grout Compressive Strength: 3000 psi..
3. Slump: 8 to 11 inches per ASTM C143.

2.5 STEEL MATERIALS

A. Steel Wire: ASTM A1064, hot-dip galvanized per ASTM A153.

B. Steel Sheet: ASTM A1008, Commercial Steel, hot-dip galvanized per ASTM A153.

C. Steel Plates, Shapes, and Bars: ASTM A36, hot-dip galvanized per ASTM A153.

D. Steel Anchors: ASTM B633 Class Fe/Zn 5 minimum, zinc-plated steel.

E. Stainless Steel Wire: ASTM A580, Type 304 and Type 316.

F. Stainless Steel Sheet: ASTM A666, Type 304 and Type 316.

G. Stainless Steel Anchors: ASTM F593 and ASTM F594, Alloy Group 1 and Alloy Group 2.

2.6 REINFORCING STEEL

A. Reinforcing Steel: ASTM A615, 60 ksi, deformed billet bars, galvanized finish.

B. Rebar Positioners: Preformed galvanized steel wire positioned in mortar beds to support reinforcing steel.

2.7 JOINT REINFORCEMENT

A. Joint Reinforcement: ASTM A951.
   1. Interior Walls: Hot-dip galvanized, carbon steel.
   2. Exterior Walls: Hot-dip galvanized steel.
   3. Side Rod Wires: 0.148 inch diameter.
   4. Cross Rod Wires: 0.148 inch diameter.
   5. Length: 10 feet, minimum.
   6. Corners and Tees: Prefabricated.

B. Single Wythe Masonry and Cavity Wall Joint Reinforcement: Ladder type.
   1. Manufacturers and Products:
      a. 3GEN Masonry Products Ladder Reinforcing.
      b. Heckmann Building Products #1100.
      c. Hohmann & Barnard 220 Ladder Mesh.
      d. Wire-Bond Ladder 2 Wire.

C. Composite Masonry Joint Reinforcement:
   1. Ladder type, with one side rod at each CMU face shell and at each additional wythe.
   2. Manufacturers and Products:
      a. Hohmann & Barnard 230 Ladder Tri-Mesh and 240 Ladder-Twin-Mesh.
      b. Wire-Bond Ladder 3 Wire and Ladder 4 Wire.

2.8 VENEER ANCHORS

A. Veneer Anchors - General: Resist tension and compression forces perpendicular to wall plane.
   1. Performance: Withstand 100-lbf tension and compression loads without deforming or developing play in excess of 1/16 inch (1.6 mm).
   2. Veneer Tie Size: Extend to outer half of veneer, over 5/8 inch from outside face.

B. Steel and Wood Studs and Sheathing Attachment: Mounted after insulation and One of the following types.
   1. Single Barrel Thermal Screw Anchors: Stainless steel barrel fasteners with washer resting against insulation, and wire ties.

a. Manufacturers and Products:
1) Hohmann & Barnard 2-Seal Thermal Wing Nut Anchor.
b. Coating: Plastic sheath over fastener barrel.
c. Washers: EPDM.
d. Wire Ties: Hot-dip galvanized steel, double pintle type.

C. Masonry Attachment: Mounted after insulation.
1. Single Barrel Thermal Screw Anchors: Stainless steel barrel fasteners with washer resting against insulation, and wire ties.
a. Manufacturers and Products:
1) Hohmann & Barnard 2-Seal Thermal Concrete Wing Nut Anchor.
b. Coating: Plastic sheath over fastener barrel.
c. Washers: EPDM.
d. Wire Ties: Hot-dip galvanized steel, double pintle type.

2.9 WALL ANCHORS

A. Structural Steel Attachment: Hot-dip galvanized steel Wire weld on anchors and wire ties.
1. Crimped Wire Anchors: 1/4 inch diameter continuous wires.
2. Ties: Wires fabricated to size of masonry being anchored.

B. Concrete Attachment: Cast in slot and dovetail anchor ties.
1. Slot: Hot-dip galvanized steel sheet, 0.034 inch thickness; with flexible foam filler.
2. Ties: Hot-dip galvanized steel trapezoidal wires with dovetail triangle tabs.
a. Manufacturers and Products:
1) 3GEN Masonry Products Dovetail Triangle.
2) Heckmann Building Products #103 Dovetail Triangular Anchor.
3) Hohmann & Barnard 315 - Flexible Dovetail Brick Tie.
4) Wire-Bond Dovetail Triangular Tie 2102.

C. Wall Top Anchors: Steel bracing, see Structural Drawings and One of the following.
1. Bent metal plate fit to width of wall, anchored to structure.
a. Manufacturers and Products:
1) Hohmann & Barnard PTA-422.
2) Wire-Bond 4310.
2. Metal tube with plastic tube cover, anchored to and attached by dovetail embedded in structure above.
a. Manufacturers and Products:
1) 3GEN Masonry Products Partition Top Anchor.
2) Hohmann & Barnard PTA 300 Series.
3) Wire-Bond 4300 Series.

D. Anchor Bolts: ASTM A307 Grade A, headed and L-shaped hot-dip galvanized steel bolts with hex nuts and flat washers.

E. Anchorage Devices: Expansion anchors.
1. Interior Locations: Zinc plated steel.
2. Exterior Locations: Stainless Steel.

2.10 SHEET METAL FLASHING

A. Stainless Steel Flashing:
   1. Stainless Steel Sheet: ASTM A240, Type 304, 0.016 inch thick.
   2. Solder: ASTM B32, Grade Sn60, flashing manufacturer recommended type.

B. Flashing Fabrication: Cut and form flashing as shown on Drawings. and as follows:
   1. End Dams: Extend flashing 6 inches minimum beyond lintels and turn edges up 2 inches minimum.
   2. Drip Edges: Extend flashing through veneer, turn down 45 degrees and hem edges.
   3. Cavity Wall Flashing: Extend flashing through outer wythe, across cavity, and turn up 8 inches minimum onto inner wythe.

2.11 FLEXIBLE FLASHING

A. Stainless Steel Laminated Flashing: ASTM A240, Type 304 stainless steel sheet laminated to polymer fabric backing.
   1. Manufacturers and Products:
      a. 3GEN Masonry Products GENFLASH SS.
      b. Hohmann & Barnard Mighty-Flash.
      c. PROSOCO SS ThruWall.
      d. STS Coatings Wall Guarding Stainless Steel TWF.
      e. TK Products, Inc. TFW-18.
      f. York Multi-Flash SS.

B. Flexible Sheet Membrane Flashing: Self-adhering, composite polyethylene membrane laminated to butyl and proprietary adhesive sheet and abrasion-resistant coating.
   1. Manufacturers and Products:
      a. 3GEN Masonry Products GENFLASH.
      b. Carlisle CCW BRT-801.
      c. GCP Applied Technologies Grace Ultra.
      d. Protecto Wrap Company Protecto Seal 45 Butyl.
      e. York Wicked Good Flashing.

C. Flashing Accessories: Flashing manufacturer products required for complete installation:
   1. Termination Bars: Aluminum, Stainless Steel, and PVC.
   2. Preformed corners, end dams, special shapes, and seaming materials.
   3. Adhesives and primers.

2.12 CAVITY WALL ACCESSORIES

A. Cellular Plastic Weep Vents: Flexible plastic extrusions.
   1. Manufacturers and Products:
      a. 3GEN Masonry Products Cell Vent.
      b. Advanced Building Products Mortar Maze Weep Vent.
      c. Heckmann Building Products No 85 Cell Vent.
      d. Hohmann & Barnard Quadro-Vent.
      e. Wire-Bond Cell Vent.

2. Size: Full head joint height and depth.
3. Color: Architect selected and Match mortar color.

B. Cavity Drainage Material: Mesh panels, base of wall system to catch mortar droppings.
1. Manufacturers and Products:
a. 3GEN Masonry Products Mortar Clear.
b. Advanced Building Products Mortar Break.
c. Hohmann & Barnard Mortar Trap.
d. Mortar Net USA MortarNet.
e. York Weep Net.
2. Depth: Full cavity depth.

2.13 PERFORMANCE

A. Fire Resistance:
1. Fire-Rated Assemblies: ASTM E119.

2.14 ACCESSORIES

A. Control Joint Gaskets: Neoprene material. Furnish with corner and tee accessories, heat and cement fused joints.

B. Compressible Filler: Closed cell rubber; oversized 50 percent to joint width; self expanding.

C. Non-Acid Masonry Cleaners: Masonry unit manufacturer recommended product; not harmful to masonry or adjacent materials.

D. Acid Masonry Cleaners: Masonry unit manufacturer recommended product for removing mortar, efflorescence and other stains from masonry.
1. Manufacturers and Products:
a. Diedrich Technologies 202 New Masonry Detergent.
b. EaCo Chem NMD 80.
c. PROSOCO Sure Klean 600.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify field conditions are acceptable and are ready to receive Work.
1. Verify foundations are within specified tolerances.
2. Verify reinforcing is properly placed.
3. Verify rough-in for piping and electrical systems are properly placed.

3.2 PREPARATION

A. Coordinate placement of anchors provided under other Sections.

3.3 INSTALLATION - GENERAL

A. Maintain masonry courses to uniform dimensions. Form uniform thickness vertical and horizontal joints.

B. Use full size units unless cutting is unavoidable. Cut units to provide clean, sharp, unchipped edges. Conceal cut edges wherever possible.

C. Blending Exposed Masonry: Mix units to produce uniform blend of colors and textures.

D. Protection During Installation: Cover open masonry walls, projections, and sills when work is not in progress; utilize waterproof membrane.
   1. Extend protection 24 inches, minimum, on both sides of wall.

E. Stain Prevention: Immediately remove mortar and soil.
   1. Protect in place construction from mortar droppings.
   2. Protect walls from rain water splashing up from ground or scaffold.

3.4 INSTALLATION OF CONCRETE MASONRY UNITS

A. Coursing:
   1. Bond: Running.
   2. Interior Mortar Joints: Concave except cut joints flush where shown on Drawings and resilient base is scheduled.
   3. Exterior Mortar Joints: Concave except where shown on Drawings and air barrier manufacturer recommends a specific mortar shape.

B. Joint Reinforcement Placement:
   1. 16 inch intervals.
   2. First course below top of walls.
   3. Above and Below Openings: Installed in first course, 16 inches minimum each side of opening.
   4. Interrupt joint reinforcement at control and expansion joints.
   5. Corners and Intersections: Reinforced with prefabricated units.

C. Reinforcement and Grouting: Follow TMS 602.
   1. Grouted Components: See Drawings.
      a. Support and secure reinforcing bars from displacement.
      b. Place and consolidate grout fill without displacing reinforcing.
      c. At bearing locations, fill masonry cores with grout for minimum 12 inches both sides of opening.
   2. Grout Pour Height: 60 inches, maximum.

D. Isolation from Structure:
   1. Isolate masonry partitions from vertical structural framing members with movement joint shown on Drawings.
   2. Isolate top of masonry from horizontal structural framing members and slabs or decks with compressible joint filler.

3.5 INSTALLATION OF COMPOSITE MASONRY

A. Concrete Masonry Facing Units:
   1. Bond: Running.
   2. Mortar Joints: Concave except cut joints flush where shown on Drawings and resilient base is scheduled.

B. Brick Units:
   1. Bond: Lay exposed units in running bond unless noted otherwise.
   2. Mortar Joints: Concave.

C. Composite Masonry Bonding System: See Drawings. and One of the following:
   1. Masonry Joint Reinforcement:
      a. Ladder type ties installed in horizontal joints, spaced 16 inches vertically.
      b. Seismic Reinforcement: Continuous horizontal wire attached to ties, installed in facing wythe.

3.6 INSTALLATION OF CAVITY WALLS

A. Concrete Masonry Facing Units:
   1. Bond: Running and unless noted otherwise.
   2. Mortar Joints: Tool concave except cut joints flush where unless noted otherwise.

B. Brick Units:
   1. Bond: Lay exposed units in running bond unless noted otherwise.
   2. Mortar Joints: Tool to concave profile unless noted otherwise.

C. Cavity Wall Bonding System: See Drawings.
   1. Provide adjustable two-piece reinforcement spaced 16 inches horizontally and 16 inches vertically.
   2. Provide adjustable two-piece reinforcement, one tie for each 1.77 sq ft of wall.

D. Air Barrier: Apply to backup wythe per Section 072700.

E. Cavity Wall Insulation: See Section 072100; fit insulation between wall ties and other obstructions.

3.7 INSTALLATION OF MASONRY VENEER

A. Facing Units:
   1. Bond: Lay exposed units in running bond unless noted otherwise.
   2. Mortar Joints: Tool to concave and unless noted otherwise profile.

B. Anchoring: Anchor masonry veneers to wall framing and backup construction.
   1. Anchor Spacing:
      a. One anchor for each 1.77 sq ft of wall.
      b. Space anchors 16 inches horizontally and 16 inches vertically.

3.8 INSTALLATION OF CONTROL AND EXPANSION JOINTS

A. Control Joints in CMU: One of the following methods.
   1. Preformed control joint gaskets designed to fit standard block.
   2. Interlocking units designed for control joints with bond-breaker strips at joint. Rake out head joints for application of sealant.
      a. Apply sealant to open joints.

B. Expansion Joints in Brick: One of the following methods.
   1. Preformed factory fabricated fillers built into masonry.
   2. Compressible joint fillers built into masonry.
      a. Apply sealant to open joints.

3.9 INSTALLATION OF FLASHING, WEEPS, AND DRAINAGE

A. Install flashing in the following locations to effectively drain water from wall cavities.
   1. Where shown on Drawings.
   2. At obstructions to downward flow of water in wall.

B. Rigid Sheet Metal Flashing:
   1. Extend flashing horizontally through outer wythe, extend out beyond face and turn down and hem to form continuous drip edge.
   2. Turn flashing up inner wythe and backup construction, 8 inches minimum and secure in termination bar, in reglet, and by extending 1-1/2 inches into inner wythe.

C. Flexible Flashing:
   1. Install metal drip edges at exterior face of wall.
   2. Install flexible flashing flush with outside face of exterior wall.
   3. Turn flashing up inner wythe and backup construction, 8 inches minimum and fully adhere to substrate and secure in termination bar.

D. Weep Vents: Full depth of head joints. Install where shown on Drawings and above flashing and below obstructions to upward flow of air in wall.
   1. Weep Vent Spacing: 24 inch centers.

E. Cavity Drainage Material: Place in cavities to maximize drainage.

3.10 INSTALLATION OF LINTELS

A. Install lintel type indicated on drawings over openings.

B. Bearing: 8 inches each side, minimum.

3.11 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to Work areas.
   1. Failed Test Retest Cost: Contractor responsibility.
   2. Do not begin construction until inspectors have verified compliance of materials.
   3. Do not use materials that fail tests and inspections.

B. Testing Frequency: One test for each 5000 sq ft of wall area.

C. Special Inspections: TMS 402, Level B.

D. Mortar Tests: Test each mix provided per ASTM C780 to determine the following:
   1. Mortar Aggregate Ratio.
   2. Air Content.
   3. Consistency.
   4. Board life.

E. Grout Compressive Strength Test: ASTM C1019.

F. Non-Conforming Work: Make corrections or replace, and re-test.

3.12 REPAIRING AND POINTING

A. Repairing and Replacing:
   1. Remove and replace chipped, broken, or stained units.
   2. Remove and replace units that do not match adjacent units.
   3. Set replacement units in fresh mortar; point to eliminate evidence of replacement.

B. Pointing: Enlarge voids and holes and fill with mortar. Point joints to provide neat, uniform appearance.

3.13 CLEANING

A. In Progress Cleaning: Dry brush to remove excess mortar before tooling joints.

B. Final Cleaning: Clean exposed masonry as follows:
   1. Allow mortar to set and cure.
   2. Scrape to remove excess mortar.
   3. Clean brick by bucket-and-brush hand-cleaning method per BIA Technical Note 20.
   4. Clean brick by pressurized water cleaning method per BIA Technical Note 20.

C. Final Cleaning: Clean exposed masonry as follows:
   1. Allow mortar to set and cure.
   2. Scrape to remove excess mortar.
   3. Wet wall before applying cleaners.

4. Clean masonry.
5. Rinse cleaner from brick thoroughly.

END OF SECTION

SECTION 051200

STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Structural steel.
2. Shrinkage-resistant grout.

D. Related Requirements:
1. Section 05 50 00 "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.

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. Anchor rods.
   4. Threaded rods.
   5. Shop primer.
   6. Galvanized-steel primer.
   7. Etching cleaner.
   8. Galvanized repair paint.
   9. 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 qualified by testing.

1.7 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Welding certificates.

C. Survey of existing conditions.

D. Source quality-control reports.

E. 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.

B. 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 Owner's 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 360.
   3. RCSC's "Specification for Structural Joints Using High-Strength Bolts."

B. Connection Design Information:
   1. Fabricator's experienced steel detailer shall select or complete connections in accordance with ANSI/AISC 303.
      a. Select and complete connections using schematic details indicated, and ANSI/AISC 360.
      b. Use Allowable Stress Design; data are given at service-load level.

C. Moment Connections: Type FR, fully restrained.

2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A992/A992M, Grade 50.

B. Channels and Angles, ASTM A36/A36M.

C. Plate and Bar: ASTM A36/A36M.

D. Cold-Formed Hollow Structural Sections: ASTM A500/A500M, Grade B structural tubing.

E. Steel Pipe: ASTM A53/A53M, Type E or Type S, Grade B.
   1. Weight Class: As indicated.

F. 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.
   1. Direct-Tension Indicators: ASTM F959/F959M, Type 325-1, compressible-washer type with plain finish.

B. 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.

C. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F3125/F3125M, Grade F1852, Type 1, heavy-hex 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.

2.4 RODS

A. Unheaded Anchor Rods: ASTM F1554, Grade 36.
   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, unless noted otherwise.

B. Headed Anchor Rods: ASTM F1554, Grade 36, 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, unless noted otherwise.

C. Threaded Rods: ASTM A36/A36M.
   1. Nuts: ASTM A563 heavy-hex carbon steel.
   2. Washers: ASTM F436, Type 1, hardened.
   3. Finish: Plain, unless noted otherwise.

2.5 PRIMER

A. Steel Primer:
   1. Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.

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. Mark and match-mark materials for field assembly.
   4. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.

B. Bolt Holes: Cut, drill, or punch standard bolt holes perpendicular to metal surfaces.

C. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

D. 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.
   2. Baseplate Holes: Cut, drill, or punch holes perpendicular to steel surfaces.
   3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

E. See structural drawings for steel designated as AESS Category 3 steel. Fabricate in accordance with Section 10 of AISC Code of Standard Practice ANSI/AISC 303.

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, Pretensioned, or Slip critical, as indicated on the drawings.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
   1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in ANSI/AISC 303 for mill material.

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 located in exterior walls, and as noted on drawings.

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.

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, “Hand Tool Cleaning.”.
   2. SSPC-SP 3. “Power Tool Cleaning”.

C. Surface Preparation of Galvanized Steel: Where indicated, 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.

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. Fabricator to be AISC Certified and provide Quality Control in accordance with AISC 360 Chapter N.

B. Testing Agency: If Quality control issues arise with steel delivered to the site, the Owner may engage an independent testing and inspecting agency to perform shop tests and inspections and prepare test reports.
   1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.

C. Correct deficiencies in Work that test reports and inspections indicate does not comply with

the Contract Documents.

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 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. 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.
   3. 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.

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.
   2. Make allowances for difference between temperature at time of erection and mean

temperature when structure is completed and in service.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection.

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, Pretensioned, or Slip critical as indicated.

B. Weld Connections: Comply with AWS D1.1/D1.1M 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.

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: Owner 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: Owner will engage a qualified testing agency to perform tests and inspections.
   1. Bolted Connections: Inspect and test 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.
      b. Testing Agency shall ultrasonically inspect all complete-penetration welds in accordance with ASTM E164.

C. Correct deficiencies in Work that test reports and inspections indicate does not comply with requirements.

END OF SECTION

SECTION 052100

STEEL JOIST FRAMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. K-series steel joists.
2. KCS-type K-series steel joists.
3. K-series steel joist substitutes.
4. LH-series long-span steel joists.
5. Special Joists.
6. Steel joist accessories.

D. Related Requirements:
1. Section 04 20 00 "Unit Masonry" for installing bearing plates in unit masonry.

1.3 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI;s “Specifications.”.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of joist, accessory, and product.

B. Shop Drawings:
1. Include layout, designation, number, type, location, and spacing of joists.
2. Include joining and anchorage details; bracing, bridging, and joist accessories; splice and

connection locations and details; and attachments to other construction.

3. Indicate locations and details of bearing plates to be embedded in other construction.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Manufacturer certificates.

C. Mill Certificates: For each type of bolt.

D. Field quality-control reports.

E. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables in SJI's "Specifications."

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

1.8 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

PART 2 PRODUCTS

2.1 MANUFACTURERS

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. Canam Steel corporation; Canam Group, Inc.
2. CMC Joist & Deck.

3. New Millennium Building Systems, LLC.
4. Vulcraft; Nucor Vulcraft Group.

2.2 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
   1. Use ASD; data are given at service-load level.
   2. Design special joists to withstand design loads with live-load deflections no greater than the following:
      a. Roof Joists: Total load vertical deflection of 1/360 and live load deflection of 1/240 of the span.

2.3 STEEL JOISTS

A. K-Series Steel Joist: Manufactured steel joists of type indicated according to "Standard Specification for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members, underslung ends, and parallel top chord.
   1. Joist Type: K-series steel joists and KCS-type K-series steel joists.
   2. K-Series Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.
   3. Provide holes in chord members for connecting and securing other construction to joists.
   4. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated on Drawings, complying with SJI's "Specifications."
   5. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated on Drawings, complying with SJI's "Specifications."
   6. Camber joists according to SJI's "Specifications."
   7. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

B. Long-Span Steel Joist: Manufactured steel joists according to "Standard Specification for Longspan Steel Joists, LH-Series and Deep Longspan Steel Joists, DLH-Series" in SJI's "Specifications," with steel-angle top- and bottom-chord members; of joist type and end and top-chord arrangements as indicated on Drawings.
   1. Joist Type: LH-series long-span steel joists.
   2. End Arrangement: Underslung.
   3. Top-Chord Arrangement: Parallel.
   4. Camber long-span steel joists according to SJI's "Specifications.".
   5. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

C. SPECIAL JOISTS.

2.4 PRIMERS

A. Primer:
   1. SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.5 STEEL JOIST ACCESSORIES

A. Bridging:
   1. Provide bridging anchors and number of rows of horizontal or diagonal bridging of material, size, and type required by SJI's "Specifications" for type of joist, chord size, spacing, and span. Furnish additional erection bridging if required for stability.
   2. Fabricate as indicated on Drawings and according to SJI's "Specifications." Furnish additional erection bridging if required for stability.

B. Steel bearing plates with integral anchorages are specified in Section 05 50 00 "Metal Fabrications."

C. High-Strength 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: Plain.

D. Welding Electrodes: Comply with AWS standards.

E. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.6 CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing 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

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications," joist manufacturer's written instructions, and requirements in this Section.
   1. Before installation, splice joists delivered to Project site in more than one piece.
   2. Space, adjust, and align joists accurately in location before permanently fastening.
   3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
   4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.

E. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 REPAIRS

A. Repair damaged galvanized coatings on galvanized items with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Touchup Painting:
   1. Immediately after installation, clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, and accessories.
      a. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.
      b. Apply a compatible primer of same type as primer used on adjacent surfaces.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Visually inspect field welds according to AWS D1.1/D1.1M.
   1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, at testing agency's option:
      a. Liquid Penetrant Inspection: ASTM E165/E165M.
      b. Magnetic Particle Inspection: ASTM E709.
      c. Ultrasonic Testing: ASTM E164.

d. Radiographic Testing: ASTM E94.

C. Visually inspect bolted connections.

D. Prepare test and inspection reports.

E. Contractor to correct deficiencies in Work that testing and inspection reports have indicated are not in compliance with specified requirements.

END OF SECTION

SECTION 053100

STEEL DECKING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Roof deck.
2. Acoustical roof deck.

D. Related Requirements:
1. Section 05 50 00 "Metal Fabrications" for framing deck openings with miscellaneous steel shapes.
2. Section 09 91 10 " Painting" for repair painting of primed deck and finish painting of deck.

1.3 ACTION SUBMITTALS

A. Product Data: For the following:
1. Roof deck.
2. Acoustical roof 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. Product Test Reports: For tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
   1. Power-actuated mechanical fasteners.
   2. Acoustical roof deck.

D. Research Reports: For steel deck, from ICC-ES.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E329 for testing indicated.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

C. 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. 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 according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."

B. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

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. Canam Steel Corporation; Canam Group, Inc.
   2. CMC Joist & Deck.
   3. New Millennium building Systems, LLC.
   4. Nucor Corp.

B. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized-Steel Sheet: ASTM A653/A653M, Structural Steel (SS), G60 zinc coating.
   2. Deck Profile: As indicated on the Drawings.
   3. Profile Depth: 1-1/2 inches.
   4. Design Uncoated-Steel Thickness: As indicated on the Drawings.
   5. Span Condition: Triple span or more.
   6. Side Laps: Overlapped.

2.3 ACOUSTICAL ROOF DECK

A. Manufacturers: Subject to compliance with requirements provide the following:
   1. Epic Metals Corp.
      a. Gym: Epicore ER3.5A.
   2. New Millennium Building Systems, LLC.
      a. Gym: Versa-Dek 3.5 LS Acoustical.

B. Acoustical Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
   1. Galvanized and Shop-Primed Steel Sheet: ASTM A653/A653M, Structural Steel (SS), G60 zinc coating; cleaned, pretreated, and primed with manufacturer's standard baked-on, rust-inhibitive primer.
   2. Finish: Paint all exposed decking.
      a. Comply with requirements of Division 09 Section “Painting”.
      b. Refer to Division 09 Section “Color Schedule” for paint colors.
   3. Deck Profile: As indicated by manufacturer’s designation.
   4. Profile Depth: As indicated.
   5. Design Uncoated-Steel Thickness: As indicated.
   6. Span Condition: As indicated.
   7. Side Laps: Overlapped.
   8. Acoustical Perforations: Deck units with manufacturer's standard perforations.
   9. Sound-Absorbing Insulation: Manufacturer's standard premolded roll or strip of glass or mineral fiber.
   10. Acoustical Performance: NRC 0.90, tested according to ASTM C423.

a. Meet BOTH the minimum NRC and the minimum absorption coefficients. The recommended minimum absorption coefficients are as follows:

Octave Band Center Frequency	125	250	500	1000	2000	4000
Minimum Absorption Coefficient	0.30	0.75	0.90	0.90	0.85	0.70

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. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.

E. 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.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.

G. Galvanizing Repair Paint: ASTM A780/A780M, SSPC-Paint 20, or MIL-P-21035B, with dry film containing a minimum of 94 percent zinc dust by weight.

H. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

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 according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.

B. Locate deck bundles to prevent overloading of supporting members.

C. 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.

D. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

E. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

F. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

G. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

H. Mechanical fasteners may be used in lieu of welding to fasten deck if calculations are provided that demonstrate equivalent strength and stiffness to attachment shown on the Structural Drawings. Locate mechanical fasteners and install according to deck 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: As indicated on the Drawings.
   2. Welds Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds as indicated on the Drawings.

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, unless closer spacing is indicated, and as follows:
   1. Mechanically fasten side laps with self-drilling, No. 10 diameter or larger, carbon-steel screws.
   2. Welds at perimeter with 5/8 inch diameter welds.

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.

D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld flanges to top of deck. Space welds not more than 12 inches apart with at least one weld at each corner.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. 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.

F. Sound-Absorbing Insulation: Installation into topside ribs of deck as specified in Section 72100 "Thermal Insulation."

3.4 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

B. Repair Painting:
   1. Wire brushing, cleaning, and repair painting of rust spots, welds, and abraded areas of both deck surfaces are included in Section 09 91 10 "Painting".

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Field welds and mechanical fasteners will be subject to inspection.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 054000

COLD-FORMED METAL FRAMING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Exterior non-load-bearing wall framing.
2. Exterior cladding attachment wall furring.
3. Soffit framing.

D. Related Requirements:
1. Section 05 50 00 "Metal Fabrications" for miscellaneous steel shapes, masonry shelf angles, and connections used with cold-formed metal framing.
2. Section 09 22 16 "Non-Structural Metal Framing" for standard, interior non-load-bearing, metal-stud framing, with height limitations and ceiling-suspension assemblies.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For the following:
1. Cold-formed steel framing materials.
2. Exterior non-load-bearing wall framing.
3. Vertical deflection clips.
4. Single deflection track.
5. Soffit framing.
6. Post-installed anchors.
7. Power-actuated anchors.

B. Shop Drawings:
   1. Include layout, spacings, sizes, thicknesses, and types of cold-formed steel framing; fabrication; and fastening and anchorage details, including mechanical fasteners.
   2. Indicate reinforcing channels, opening framing, supplemental framing, strapping, bracing, bridging, splices, accessories, connection details, and attachment to adjoining work.

C. Delegated-Design Submittal: For cold-formed steel framing, including attachment to Main Structure.

1.5 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of code-compliance certification for studs and tracks.

C. Product Test Reports: For each listed product, for tests performed by manufacturer and witnessed by a qualified testing agency.
   1. Steel sheet.
   2. Expansion anchors.
   3. Power-actuated anchors.
   4. Mechanical fasteners.
   5. Vertical deflection clips.
   6. Miscellaneous structural clips and accessories.

D. Research Reports:
   1. For nonstandard cold-formed steel framing post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.6 QUALITY ASSURANCE

A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud Association, the Steel Framing Industry Association, or the Steel Stud Manufacturers Association.

B. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3/D1.3M, "Structural Welding Code - Sheet Steel."

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. ClarkDietrich Building Systems.
   2. MarinoWARE.
   3. Nuconsteel; a Nucor Company.
   4. Steel Network, Inc. (the).
   5. Super Stud Building Products, Inc.
   6. Telling Industries, LLC.
   7. United Metal Products.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 40 00 "Quality Requirements," to design cold-formed steel framing.

B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Loads: As indicated on Drawings.
   2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
      a. Exterior Load-Bearing Wall Framing: Horizontal deflection of 1/360 of the wall height for non masonry finish: 1/600 of the wall height for masonry veneer.
      b. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/360 of the wall height for non masonry finish: 1/600 of the wall height for masonry veneer.
      c. Soffit Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.
   3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120 deg F.
   4. Design exterior non-load-bearing wall framing to meet horizontal deflection limits without regard for contribution of sheathing materials.

C. Cold-Formed Steel Framing Standards: Unless more stringent requirements are indicated, framing shall comply with AISI S100, AISI S200, and the following:
   1. Floor and Roof Systems: AISI S210.
   2. Wall Studs: AISI S211.
   3. Headers: AISI S212.
   4. Lateral Design: AISI S213.

D. Fire-Resistance Ratings: Comply with ASTM E119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency acceptable to authorities having jurisdiction.

2.3 COLD-FORMED STEEL FRAMING MATERIALS

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60.

B. Steel Sheet for Vertical Deflection Clips: ASTM A653/A653M, structural steel, zinc coated, of grade and coating as follows:
   1. Grade: As required by structural performance.
   2. Coating: G60.

2.4 EXTERIOR NON-LOAD-BEARING WALL FRAMING

A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch at non masonry finish; 0.0428 inch at masonry veneer.
   2. Flange Width: 1-5/8 inches.

B. Steel 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.

C. 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. Manufacturer’s: Subject to compliance with requirements, provide product by one of the following:
      a. Dietrich Metal Framing: a Worthington Industries Company.
      b. MarinoWare, a division of Ware Industries.
      c. The Steel Network, Inc.

D. 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 loads and transfer them to the primary structure, and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch.
   2. Flange Width: 1 inch plus the design gap for one-story structures.

2.5 EXTERIOR WALL CLADDING ATTACHMENT FURRING

A. Steel Sheet: ASTM A1003/A1003M, Structural Grade, Type H, metallic coated, of grade and coating designation as follows:
   1. Grade: As indicated.
   2. Coating: G90.

B. Steel Furring: Manufacturer's standard hat-shaped channels of web depths indicated and as follows:
   1. Minimum Base-Metal Thickness: 0.0428 inch.
   2. Section Properties: As required by design criteria.

C. Delegated Design: Coordinate furring design with proposed cladding materials, substrates, foam insulation thickness, and wind loads as indicated.

2.6 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
   1. Minimum Base-Metal Thickness: 0.0329 inch.
   2. Flange Width: 1-5/8 inches, minimum.

2.7 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from ASTM A1003/A1003M, Structural Grade, Type H, metallic coated steel sheet, of same grade and coating designation 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 and knee braces.
   9. Joist hangers and end closures.
   10. Hole-reinforcing plates.
   11. Backer plates.

2.8 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A36/A36M, zinc coated by hot-dip process according to ASTM A123/A123M.

B. Anchor Bolts: ASTM F1554, Grade 36, threaded carbon-steel hex-headed bolts, carbon-steel nuts, and flat, hardened-steel washers; zinc coated by hot-dip process according to ASTM A153/A153M, Class C.

C. Post-Installed Anchors: Fastener systems with bolts of same basic metal as fastened metal, if visible, unless otherwise indicated; with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC193, ICC-ES AC58, or ICC-ES AC308 as appropriate for the substrate.
   1. Uses: Securing cold-formed steel framing to structure.
   2. Type: Torque-controlled expansion anchor, Torque-controlled adhesive anchor, or adhesive anchor.
   3. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B633 or ASTM F1941, Class Fe/Zn 5, unless otherwise indicated.
   4. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F593, and nuts, ASTM F594.

D. Power-Actuated Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

E. Mechanical Fasteners: ASTM C1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
   1. Head Type: Low-profile head beneath sheathing; manufacturer's standard elsewhere.

F. Welding Electrodes: Comply with AWS standards.

2.9 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: ASTM A780/A780M, or SSPC-Paint 20.

B. Cement Grout: Portland cement, ASTM C150/C150M, Type I; and clean, natural sand, ASTM C404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.

C. Nonmetallic, Nonshrink Grout: Factory-packaged, nonmetallic, noncorrosive, nonstaining grout, complying with ASTM C1107/C1107M, and with a fluid consistency and 30-minute working time.

D. Shims: Load-bearing, high-density, multimonomer, nonleaching plastic; or cold-formed steel of same grade and metallic coating as framing members supported by shims.

2.10 FABRICATION

A. Fabricate cold-formed steel 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 steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.

a. Comply with AWS D1.3/D1.3M 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 screws penetrating joined members by no fewer than three exposed screw threads.

4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.

B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies by means that prevent damage or permanent distortion.

C. Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable 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 steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, conditions, and abutting structural framing 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. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.

B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that required to obtain fire-resistance ratings indicated. Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, AISI S202, and manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
   1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.

D. Install cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened.
   1. Cut framing members by sawing or shearing; do not torch cut.
   2. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, or riveting. Wire tying of framing members is not permitted.
      a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners, install according to Shop Drawings, and comply with requirements for spacing, edge distances, and screw penetration.

E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.

F. Install temporary bracing and supports to secure framing and support loads equal to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.

G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.

H. Install insulation, specified in Section 07 21 00 "Thermal Insulation," in framing-assembly members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

I. Fasten hole-reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

3.4 INSTALLATION OF EXTERIOR NONLOADBEARING WALL FRAMING

A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure.

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
   1. Stud Spacing: 16 inches maximum.

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 deep-leg deflection tracks and anchor to building structure, or.
   2. Connect vertical deflection clips to bypassing studs and anchor to building structure.

E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
   1. Channel Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
   2. Strap Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
   3. Bar Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.

F. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
   1. Install solid blocking at centers indicated on Shop Drawings.

G. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 INSTALLATION TOLERANCES

A. Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
   1. 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.

3.6 REPAIR

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on fabricated and installed cold-formed steel framing with galvanized repair paint according to ASTM A780/A780M and manufacturer's written instructions.

3.7 FIELD QUALITY CONTROL

A. Testing: Owner will 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. Cold-formed steel framing will be considered defective if it does not pass tests and inspections.

E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.8 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that cold-formed steel framing is without damage or deterioration at time of Substantial Completion.

END OF SECTION

SECTION 055000

METAL FABRICATIONS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Steel framing and supports for countertops.
2. Steel framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.
4. Shelf angles.
5. Metal ladders to roof.
6. Miscellaneous steel trim.

B. Products furnished, but not installed, under this Section include the following:
1. Loose steel lintels.
2. Anchor bolts, steel pipe sleeves, slotted-channel inserts, and wedge-type inserts indicated to be cast into concrete or built into unit masonry.
3. Steel weld plates and angles for casting into concrete for applications where they are not specified in other Sections.

1.2 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.

1.3 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 framing and supports for mechanical and electrical equipment.
3. Steel framing and supports for applications where framing and supports are not specified in other Sections.

4. Shelf angles.
5. Metal ladders.
6. Miscellaneous steel trim.
7. Loose steel lintels.

B. Delegated-Design Submittal: For ladders, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Mill Certificates: Signed by stainless-steel manufacturers, certifying that products furnished comply with requirements.

B. Welding certificates.

C. Research/Evaluation Reports: For post-installed anchors, from ICC-ES.

1.5 QUALITY ASSURANCE

A. 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."

1.6 FIELD CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design ladders.

B. 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, ambient; 180 deg F, 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.

E. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

F. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

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, Class Fe/Zn 5, at exterior walls. Select fasteners for type, grade, and class required.

B. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and flat washers where indicated.

C. Steel Bolts and Nuts: Regular hexagon-head bolts, ASTM A 325, Type 3; with hex nuts, ASTM A 563, Grade C3; and, where indicated, flat washers.

D. Stainless-Steel Bolts and Nuts: Regular hexagon-head annealed stainless-steel bolts, ASTM F 593; with hex nuts, ASTM F 594; and, where indicated, flat washers; Alloy Group 1.

E. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; 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, Class Fe/Zn 5, unless otherwise indicated.
   2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 1 stainless-steel bolts, ASTM F 593, and nuts, ASTM F 594.

2.4 MISCELLANEOUS MATERIALS

A. Shop Primers: Provide primers that comply with Section 099000 "Painting and Coating."

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.

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 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, with a minimum 6-inch embedment and 2-inch hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.6 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

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 primer specified in Section 099000 "Painting and Coating." 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 bolts, spaced not more than 6 inches from ends and 24 inches 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 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. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.8 METAL LADDERS

A. General:
   1. Comply with ANSI A14.3.

B. Steel Ladders:
   1. Space siderails 16 inches apart unless otherwise indicated.
   2. Siderails: Continuous, 3/8-by-2-1/2-inch steel flat bars, with eased edges.
   3. Rungs: 3/4-inch- diameter steel bars.

4. Fit rungs in centerline of siderails; plug-weld and grind smooth on outer rail faces.
5. Provide nonslip surfaces on top of each rung, either by coating rung with aluminum-oxide granules set in epoxy-resin adhesive or by using a type of manufactured rung filled with aluminum-oxide grout.
6. Provide nonslip surfaces on top of each rung by coating with abrasive material metallically bonded to rung.
    a. Products: Subject to compliance with requirements, provide one of the following:
        1) Harsco Industrial IKG, a division of Harsco Corporation; Mebac.
        2) SlipNOT Metal Safety Flooring, a division of W. S. Molnar Company; SlipNOT.
7. Provide platforms as indicated fabricated from welded or pressure-locked steel bar grating, supported by steel angles. Limit openings in gratings to no more than 1/2 inch in least dimension.
8. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted steel brackets.
9. Galvanize exterior ladders, including brackets.

2.9 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 primer specified in Section 099000 "Painting and Coating."

2.10 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 bearing and leveling plates that are not within the building’s exterior envelope.

2.11 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 unless otherwise indicated.

C. Galvanize loose steel lintels located in exterior walls.

2.12 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.

2.13 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.

2.14 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 not indicated to be galvanized unless they are to be embedded in concrete, sprayed-on fireproofing, or masonry, or unless otherwise indicated.
   1. Shop prime with primer specified in Section 099000 "Painting and Coating." unless indicated.

D. Preparation for Shop Priming: Prepare surfaces to comply with requirements indicated below:
   1. Exterior Items: SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
   2. Other Items: SSPC-SP 3, "Power Tool 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.

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.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for ceiling hung toilet partitions securely to, and rigidly brace from, building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.
   1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.
   1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 ADJUSTING AND CLEANING

A. Touchup Painting: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint are specified in Section 099000 "Painting and Coating."

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION

SECTION 055213

PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Aluminum railings.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one month, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Railing system components.
   2. Handrail brackets.
   3. Shop primer.
   4. Prefinished Components: Initial selection color charts.

B. Shop Drawings:
   1. Railing layout, profiles and sizes, and anchorage details.
   2. Railing connections.
   3. Anchorage accessories and fasteners.

C. Delegated Design Submittals:
   1. Guards and infill.
   2. Handrails.

D. Samples:
   1. Railings: 12 inches long, shop-finished Sample. Demonstrate bending radius.
   2. Assembly Samples: Assemble railing section, 12 inches by 42 inches in size showing guard and handrail with vertical post.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:
   1. Mill Certificates: Type 316 stainless steel.

B. Test and Evaluation Reports: Manufacturer test results showing:
   1. Code compliance of post-installed anchors.

C. Source Quality Control Submittals: Shop inspection reports.

D. Field Quality Control Submittals: Field inspection reports.

E. Manufacturer Reports: Field inspection reports.

F. Qualification Statements: Licensed professionals, fabricator, and installer.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Installer: Fabricator of railings.
   2. Licensed Professionals: Engineer experienced in designing railings, licensed in Pennsylvania.
   3. Welding:
      a. Steel Members: AWS D1.1.
      b. Aluminum: AWS D1.2.
      c. Steel Sheet: AWS D1.3.
      d. Stainless Steel: AWS D1.6.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Store products off ground and protected from water.
   2. Handle products to prevent impact damage.

1.7 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 ALUMINUM RAILINGS

A. Contractor Option: Use manufactured or shop-fabricated railings.

B. Shop-Fabricated Aluminum RailingsAs indicated on drawings: Extruded structural tubing, ASTM B429, manufacturer recommended alloy.
   1. Rails and Posts: 1-1/4 inch diameter.
   2. Joints and Connections: Extruded aluminum.
      a. Nonwelded: Connect members with concealed fittings and fasteners.
      b. Welded: Connect members with concealed sleeves and socket fittings, concealed

internal welds.

C. Materials:
1. Plate and Sheet: ASTM B209, manufacturer recommended alloy.
2. Forgings: ASTM B247, manufacturer recommended alloy.
3. Castings: ASTM B25, manufacturer recommended alloy.
4. Exposed Fasteners: Stainless steel, flush countersunk screws or bolts; consistent with railing design.
5. Anchors: Stainless steel; selected to meet structural performance requirements and substrate conditions.

D. Aluminum Finish: Clear anodized.
1. Color: Architect selected.

2.2 INSTALLATION ACCESSORIES

A. Welding Rods and Bare Electrodes: Selected per AWS for metal being welded and structural requirements.

B. Bituminous Paint: ASTM D1187 asphalt emulsion.

C. Grout: ASTM C1107, factory-packaged nonmetallic, shrinkage resistant exterior use grout.

D. Embedded Sleeves: Stainless steel tubes; sized to fit posts, 6 inches long, minimum, with closed bottoms.

2.3 PERFORMANCE

A. Delegated Design:
1. Delegate railing design to manufacturer, fabricator, and installer licensed Professional Engineer.
2. Structural Loads:
a. Handrail: 50 plf and 200 pounds concentrated, both omnidirectional and non-simultaneous.
b. Guard Infill: 50 pounds concentrated.
3. Structural Design Criteria: See Structural Drawings.
4. Allowable Deflection: 1/60 of unsupported height, maximum.

B. Accessibility Requirements: Applicable provisions in ICC/ANSI A117.1.

C. Handrail Continuity: Gripping surfaces uninterrupted by newel posts, structural elements, or obstructions.

2.4 FABRICATION

A. Accurately form components to suit ramps and landings, to each other, and to building structure.

B. Accommodate expansion and contraction of members and building movement without damage to member connections.

C. Fabricate components with joints tightly fitted and secured. Furnish spigots and sleeves to accommodate site assembly and installation.

D. Exposed Mechanical Fastenings: Flush countersunk screws or bolts; unobtrusively located; consistent with design of component.

E. Supply components required for anchorage of fabrications. Fabricate anchors and related components of same material and finish as railing assembly.

F. Railing Joints and Connections:
   1. Exterior Components: Continuously seal joined pieces by continuous welds. Drill condensate drainage holes at bottom of members at locations not encouraging water intrusion.
   2. Interior Components: Continuously seal joined pieces by continuous welds.
   3. Exposed Welded Joints: NOMMA Guideline 1 Joint Finish 1.

G. Changes in Direction:
   1. Uniform, without buckling, twisting, deforming or cracking surfaces.
   2. Formed by flush bending or with prefabricated elbow fittings.
   3. Radii: See Drawings.

H. Railing Ends: Closed, except when railing returns to within 1/4 inch of wall face.

I. Removable Railing Fittings: Stainless steel slip-fit sockets sized for a close fit with posts. Include socket covers designed and fabricated to resist being dislodged.

J. Factory Assembly: Fit and shop assemble components in largest practical sizes for delivery to site.

2.5 ALUMINUM FINISHES

A. Anodizing: AAMA 611 Class I or AAMA 612 with electrodeposition organic seal.
   1. Color: Clear and Architect selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify concealed blocking and reinforcement is installed and correctly located to receive wall mounted handrails.

3.2 PREPARATION

A. Clean and strip aluminum where site welding is required.

B. Supply setting templates for items required to be cast into concrete, embedded in masonry, and placed in partitions.

C. Apply separation coating to aluminum surfaces contacting dissimilar metals, concrete, and masonry.

3.3 INSTALLATION

A. Install components plumb and level, accurately fitted, free from distortions or defects.

B. Field weld components shown on Shop Drawings.
   1. Steel: AWS D1.1.
   2. Aluminum: AWS D1.2.
   3. Sheet Steel: AWS D1.3.
   4. Stainless Steel: AWS D1.6.

C. Anchor Posts to Structure:
   1. Posts: Preset sleeves in concrete; set posts in sleeves and fill space around posts with grout.
   2. Posts: Core drill concrete; set posts in cored holes and fill space around posts with grout.

D. Attach Railings:
   1. Wall Mounting: Mount with wall brackets and end flanges.
   2. Guardrail Mounting: Weld railing brackets to posts.

E. Field weld anchors as shown on Shop Drawings. Grind welds smooth. Touch up welds with primer.

F. Assemble with spigots and sleeves to accommodate tight joints and secure installation.

3.4 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to Work areas.
   1. Failed Test Retest Cost: Contractor responsibility.
   2. Do not begin construction until inspectors have verified compliance of materials.
   3. Do not use materials that fail tests and inspections.

B. Testing: ASTM E894 and ASTM E935 on randomly selected representative railing assemblies.

C. Field Weld Inspection:
   1. Steel: AWS D1.1.
   2. Aluminum: AWS D1.2.
   3. Sheet Steel: AWS D1.3.
   4. Stainless Steel: AWS D1.6.

D. Non-Conforming Work: Remove and replace, and retest.

3.5 CLEANING

A. Clean aluminum with soap and clean water.

3.6 REPAIR

A. Apply primer to field welds, bolted connections, and damaged areas of factory applied primer.

B. Apply galvanizing repair paint per ASTM A780 to field welds, bolted connections, and damaged areas of hot-dip galvanized members.

3.7 PROTECTION

A. Protect railings during construction period against soiling and damage.

END OF SECTION

SECTION 061000

ROUGH CARPENTRY

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Framing with dimension lumber.
2. Framing with engineered wood products.
3. Rooftop equipment bases and support curbs.
4. Wood blocking, cants, and nailers.
5. Plywood backing panels.

1.3 DEFINITIONS

A. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.

1.4 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.
1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.

4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:
1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Power-driven fasteners.
5. Post-installed anchors.
6. Metal framing anchors.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber 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 or omit grade stamp and provide certificates of grade compliance issued by grading agency.
3. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent unless otherwise indicated.

C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 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. Do not use inorganic boron (SBX) for sill plates.
   2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.

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.
   1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

D. Application: Treat items indicated on Drawings, and the following:
   1. Wood members in contact with masonry or concrete.
   2. Wood members at roof and exterior envelope openings.

2.3 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 E84, 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 beyond the centerline of the burners at any time during the test.
   1. Treatment shall not promote corrosion of metal fasteners.
   2. 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 D2898. Use for exterior locations and where indicated.
   3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
   4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for

Project's climatological zone.

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 plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

A. Joists, Rafters, and Other Framing:
   1. Species and Grade: As indicated on Structural Drawings.

2.5 ENGINEERED WOOD PRODUCTS

A. Source Limitations: Obtain each type of engineered wood product from single source from a single manufacturer.

B. Laminated-Veneer Lumber: Structural composite lumber made from wood veneers with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
   1. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal-depth members.
   2. Modulus of Elasticity, Edgewise: 2,000,000 psi.

C. Parallel-Strand Lumber: Structural composite lumber made from wood strand elements with grain primarily parallel to member lengths, evaluated and monitored according to ASTM D5456 and manufactured with an exterior-type adhesive complying with ASTM D2559.
   1. Extreme Fiber Stress in Bending, Edgewise: 2600 psi for 12-inch nominal-depth members.
   2. Modulus of Elasticity, Edgewise: 2,000,000 psi.

2.6 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. Rooftop equipment bases and support curbs.
   4. Cants.
   5. Furring.
   6. Grounds.

B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
   1. Hem-fir (north); NLGA.
   2. Mixed southern pine or southern pine; SPIB.
   3. Spruce-pine-fir; NLGA.
   4. Hem-fir; WCLIB or WWPA.
   5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
   6. Western woods; WCLIB or WWPA.
   7. Northern species; NLGA.
   8. Eastern softwoods; NeLMA.

C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
   1. Mixed southern pine or southern pine; No. 2, 3 grade; SPIB.
   2. Hem-fir or hem-fir (north); Construction or No. 2 Common, Standard or No. 3 Common, grade; NLGA, WCLIB, or WWPA.
   3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common, Standard or No. 3 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

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.

2.7 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, C-C Plugged fire-retardant treated, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

2.8 FASTENERS

A. General: Fasteners shall be of size and type indicated and shall 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 A153/A153M.

B. Nails, Brads, and Staples: ASTM F1667.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.
   1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
   2. Material: Stainless steel with bolts and nuts complying with ASTM F593 and ASTM F594, Alloy Group 1 or 2.

2.9 METAL FRAMING ANCHORS

A. Allowable design loads, as published by manufacturer, shall meet or exceed those of basis-of-design products. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency. Framing anchors shall be punched for fasteners adequate to withstand same loads as framing anchors.

B. Galvanized-Steel Sheet: Hot-dip, zinc-coated steel sheet complying with ASTM A653/A653M, G60 coating designation.
   1. Use for interior locations unless otherwise indicated.

C. Hot-Dip, Heavy-Galvanized Steel Sheet: ASTM A653/A653M; structural steel (SS), high-strength low-alloy steel Type A (HSLAS Type A), or high-strength low-alloy steel Type B (HSLAS Type B); G185 coating designation; and not less than 0.036 inch thick.
   1. Use for wood-preservative-treated lumber and where indicated.

D. Joist Hangers: U-shaped joist hangers with 2-inch-long seat and 1-1/4-inch-wide nailing flanges at least 85 percent of joist depth.
   1. Thickness: 0.050 inch minimum.

E. Top Flange Hangers: U-shaped joist hangers, full depth of joist, formed from metal strap with tabs bent to extend over and be fastened to supporting member.
   1. Strap Width: 1-1/2 inches minimum.
   2. Thickness: 0.050 inch minimum.

F. Rafter Tie-Downs (Hurricane or Seismic Ties): As indicated on Structural Drawings.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.

C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.

D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.

E. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

F. Do not splice structural members between supports unless otherwise indicated.

G. 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.

H. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
   1. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than 96 inches o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and 2-inch nominal thickness.
   2. Fire block concealed spaces behind combustible cornices and exterior trim at not more than 20 feet o. c.

I. Sort and select lumber so that natural characteristics do 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.

J. Comply with AWPA M4 for applying field treatment to cut surfaces of preservative-treated lumber.
   1. Use inorganic boron for items that are continuously protected from liquid water.
   2. Use copper naphthenate for items not continuously protected from liquid water.

K. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.

L. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
   1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
   2. ICC-ES evaluation report for fastener.

M. Use steel common 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. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

A. Install where indicated and where required for screeding or 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.

C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 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 enough that moisture content exceeds that specified, 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 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Roof sheathing.
2. Wall sheathing.
3. Subflooring.
4. Fire retardant treatment.
5. Wood preservative treatment.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:
1. Conduct meeting one month, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Rough carpentry materials.
1. Fire retardant treatment.
2. Wood preservative treatment.
3. Fasteners and connectors.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer test results showing:
1. Fire treated plywood performance.
2. Preservative treated plywood performance.

B. Qualification Statements: Manufacturer and installer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store sheathing elevated above grade, protected from moisture. Maintain ventilation.

PART 2 PRODUCTS

2.1 ROOF SHEATHING

A. Plywood Roof Sheathing, Tag: APA Rated Sheathing, Exterior.
   1. Span Rating: See Drawings.
   2. Thickness: See Drawings.
   3. Edges: Square.

2.2 WALL SHEATHING

A. Glass Mat Faced Gypsum Sheathing, Tag: ASTM C1177.
   1. Manufacturers and Products:
      a. CertainTeed GlasRoc.
      b. Georgia-Pacific DensGlass Sheathing.
      c. National Gypsum Gold Bond eXP Sheathing and Gold Bond eXP Fire-Shield Sheathing.
      d. USG Securock UltraLight Glass-Mat Sheathing Firecode X.
   2. Thickness: 5/8 inch, Type X.

B. Glass Mat Faced Parapet Sheathing, Tag: ASTM C1177.
   1. Manufacturers and Products:
      a. Georgia-Pacific DensDeck.
      b. National Gypsum DEXcell Glass Mat Roof Board.
      c. USG Securock UltraLight Glass-Mat Roof Board and Securock Ultra-Light Coated Glass Mat Roof Board.

C. Cementitious Backer Units, Tag: ASTM C1325, Type A.
   1. Manufacturers and Products:
      a. Custom Building Products Wonderboard.
      b. National Gypsum PermaBASE Cement Board.
      c. USG Durock Brand Cement Board with Edgeguard.
   2. Thickness: 5/8 inch.

2.3 PERFORMANCE

A. Fire Resistance:
   1. ASTM E119.
      a. See Drawings for fire assembly designs.
   2. NFPA 285.

2.4 FIRE RETARDANT TREATMENT

A. Fire Retardant by Pressure Process: ASTM D2898, exterior type.
   1. Kiln dry after treatment: 15 percent maximum moisture content.
   2. Surface Burning Characteristics per ASTM E84 with additional 20 minute testing period

and ASTM E2768.
a. Flame Spread: 25, maximum.
b. Smoke Developed: 450, maximum.
3. Labeling: Per IBC requirements.

2.5 WOOD PRESERVATIVE TREATMENT

A. Wood Preservative, Pressure Treatment: AWPA U1 Category UC2 and Category UC3b.
1. Kiln dry after treatment: 15 percent maximum moisture content.
2. Labeling: Per IBC requirements.

2.6 INSTALLATION ACCESSORIES

A. Fasteners: See Drawings for types, sizes, and spacing.
1. General: Follow requirements for wood member size and type.
a. Preservative Treated Wood: Type 304 stainless steel.
b. Other Applications: ASTM A153 hot-dip galvanized.
2. Polymer-Coated Fasteners: Resistant to salt spray for more than 800 hours per ASTM B117.
a. Color: Match item being fastened.
3. Nails, Brads, and Staples: ASTM F1667.
4. Screws for Gypsum Sheathing:
a. Steel Framing 0.0329 inch Thick and Less: ASTM C1002.
b. Steel Framing Greater than 0.0329 inch Thick: ASTM C954.
c. Wood Framing: ASTM C1002.
d. Include wafer heads and reamer wings.

B. Adhesives: Approved for use by sheathing and adhesive manufacturers, per APA AFG 01 or ASTM D3498.

C. Joint Materials: Tape, setting type taping compound, and setting type, sandable topping compound.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Install sound, undamaged materials.

B. Attach sheathing to substrate by anchoring and fastening per IBC Table 2304.10.2 Fastening Schedule and IBC Table 2304.10.1 Fastening Schedule.

C. Spacing: Leave expansion space at panel joints and adjacent assemblies as recommended by manufacturer.

D. Do not bridge building expansion joints with board materials.

3.2 INSTALLATION OF WOOD SHEATHING

A. Wall And Roof Sheathing:
   1. Nail or Screw panels to wood framing.
      a. Apply glue to framing before fastening sheathing.
   2. Screw panels to metal framing.

3.3 INSTALLATION OF GYPSUM SHEATHING

A. Follow ASTM C1280 and GA-253.

B. Screw gypsum sheathing to wood framing.

C. Screw gypsum sheathing to metal framing.

D. Install fasteners to bear against panel face. Do not install fasteners through panel face.

E. Fill joints and embed tape with setting type joint compound. Apply 3 coats, sandable product as third coat. Sand after each coat.

3.4 INSTALLATION OF CEMENTITIOUS BACKER UNITS

A. Screw panels to framing.

B. Install and finish joints per ANSI A108.11.

3.5 PROTECTION

A. Do not leave panels exposed to moisture. Replace wet panels or allow to dry completely before installing sealants, tape, weather barrier and siding and veneer.

END OF SECTION

SECTION 064023

INTERIOR ARCHITECTURAL WOODWORK

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following:
1. Interior standing and running trim.
2. Interior frames around all atrium doors and windows.
3. Custom display cases.
4. Shop finishing of interior woodwork.
5. Custom waterfall edge seating cushion.

1.2 ACTION SUBMITTALS

A. Product Data: For high-pressure decorative laminate, adhesive for bonding plastic laminate, cabinet hardware and accessories and finishing materials and processes.
1. ,

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, and other items installed in architectural woodwork.

C. Samples for Verification:
1. Lumber with or for transparent finish, not less than 50 sq. in., for each species and cut, finished on 1 side and 1 edge.
2. Plastic laminates, 8 by 10 inches, for each type, color, pattern, and surface finish.
3. Exposed cabinet hardware and accessories, one unit for each type and finish.
4. Melamine (MCP) finish for interior cabinet finish.
5. KV strips and clips.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For fabricator.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

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. Shop is a certified participant in AWI's Quality Certification Program.

B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
   1. Provide AWI Quality Certification Program labels indicating that woodwork, including installation, complies with requirements of grades specified.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Provide mockup of waterfall edge seating as directed by Architect, include fasteners and inserts.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

D. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not deliver woodwork until painting and similar operations that could damage woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas where environmental conditions comply with requirements specified in "Project Conditions" Article.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork 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 woodwork is 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 woodwork by field measurements before being enclosed, and indicate measurements on Shop Drawings.

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 interior architectural woodwork can be supported and installed as indicated.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Division 08 Section "Door Hardware (Scheduled by Describing Products)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of AWI's quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species and Cut for Transparent Finish: As selected by Architect.

C. Wood Products: Comply with the following:
1. Softwood Plywood: DOC PS 1.

D. Softwood Plywood: DOC PS 1.

E. MCP finish inside cabinet faces.
1. Color: Dark Charcoal Grey.

F. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or, if not indicated, as required by woodwork quality standard.
1. Basis of Design: Subject to compliance with requirements, provide high-pressure decorative laminates as indicated in Finish Schedule on Drawings or comparable product by one of the following:
a. Wilsonart International; Div. of Premark International, Inc.
b. Abet Laminati, Inc.
c. Arborite; Division of ITW Canada, Inc.
d. Formica Corporation.
e. Lamin-Art, Inc.
f. Nevamar Company, LLC; Decorative Products Div.
g. Panolam Industries International Incorporated.

G. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

2.2 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural

cabinets, except for items specified in Division 08 Section "Door Hardware."

B. Adjustable Shelf Standards and Supports: BHMA A156.9, B04102; with shelf brackets, B04112.
   1. Basis of Design: Knape and Vogt; 255 Series Steel Standards and Pilaster Shelf Supports.
   2. Finish: Provide the following finish at each casework finish type:
      a. PL-1:
         1) Steel Standards Color: Bright Zinc.
         2) Shelf Supports Color: Bright Zinc.

C. MCP finish:
   1. Color: As Selected by Architect form manufacturer's full range of colors.

D. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.
   1. Satin Stainless Steel: BHMA 630.

E. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.3 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 nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls and elsewhere as required for corrosion resistance. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

C. Adhesives, General: Adhesives shall not contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate.

2.4 FABRICATION, GENERAL

A. Interior Woodwork Grade: Unless otherwise indicated, provide Custom-grade interior woodwork complying with referenced quality standard.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to ambient relative humidity during fabrication and in installation areas.

C. Sand fire-retardant-treated wood lightly to remove raised grain on exposed surfaces before fabrication.

D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
   1. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members 3/4 Inch Thick or Less: 1/16 inch.
   2. Edges of Rails and Similar Members More Than 3/4 Inch Thick: 1/8 inch.
   3. Corners of Cabinets and Edges of Solid-Wood (Lumber) Members and Rails: 1/16 inch.

E. Complete fabrication, including assembly, finishing, 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.
   1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

F. Shop-cut openings to maximum extent possible to receive hardware, appliances, plumbing fixtures, 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.
   1. Seal edges of openings in countertops with a coat of varnish.

G. Install glass to comply with applicable requirements in Division 08 Section "Glazing" and in GANA's "Glazing Manual." For glass in wood frames, secure glass with removable stops.

2.5 INTERIOR FRAMES TRANSPARENT FINISH, WD-1

A. Grade: Custom.

B. Wood Species and Cut: Maple, to match Architect's sample.

C. For frames or jambs wider than available lumber, use veneered construction. Do not glue for width.

D. Fire-Rated Interior Frames and Jambs: Products fabricated from fire-retardant particleboard or fire-retardant medium-density fiberboard with veneered, exposed surfaces and listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252.
   1. Fire Rating: 20 minutes.

2.6 SHOP FINISHING

A. Grade: Provide finishes of same grades as items to be finished.

B. General: Finish architectural woodwork at fabrication shop as specified in this Section. Defer

only final touchup, cleaning, and polishing until after installation.

C. Shop Priming: Shop apply the prime coat including backpriming, if any, for transparent-finished items specified to be field finished. Refer to Division 09 painting Sections for material and application requirements.

D. Preparation for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
   1. Backpriming: Apply one coat of sealer or primer, compatible with finish coats, to concealed surfaces of woodwork. Apply two coats to back of paneling and to end-grain surfaces. Concealed surfaces of plastic-laminate-clad woodwork do not require backpriming when surfaced with plastic laminate, backing paper, or thermoset decorative panels.

PART 3 EXECUTION

3.1 PREPARATION

A. Before installation, condition woodwork to average prevailing humidity conditions in installation areas.

B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.

3.2 INSTALLATION

A. Grade: Install woodwork to comply with requirements for the same grade specified in Part 2 for fabrication of type of woodwork involved.

B. Assemble woodwork and complete fabrication at Project site to comply with requirements for fabrication in Part 2, to extent that it was not completed in the shop.

C. Install woodwork level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb (including tops) to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut woodwork to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor woodwork to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing as required for complete installation. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork and matching final finish if transparent finish is indicated.

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. Maintain veneer sequence matching of cabinets with transparent finish.
   3. Fasten wall cabinets through back, near top and bottom, at ends and not more than 16 inches o.c. with No. 10 wafer-head screws sized for 1-inch penetration into wood framing, blocking, or hanging strips.

G. Touch up finishing work specified in this Section after installation of woodwork. Fill nail holes with matching filler where exposed.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective woodwork, 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 woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION

SECTION 064116

PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Plastic-laminate-clad architectural cabinets.
2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-clad architectural cabinets that are not concealed within other construction.
3. Cabinet Hardware.

D. Related Requirements:
1. Section 061053 "Miscellaneous Rough Carpentry" for wood furring, blocking, shims, and hanging strips required for installing cabinets that are concealed within other construction before cabinet installation.

1.2 COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of Work specified in other Sections to support loads imposed by installed and fully loaded cabinets.

B. Hardware Coordination: Distribute copies of approved hardware schedule specified.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.

B. Shop Drawings:
1. Include plans, elevations, sections, and attachment details for every installation location.

2. Show large-scale details.
3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
4. Show locations and sizes of cutouts and holes for items installed in plastic-laminate architectural cabinets.

C. Samples: For each exposed product and for each color and texture specified, in manufacturer's or manufacturer's standard size.

D. Samples for Initial Selection: For each type of exposed finish.

E. Samples for Verification: For the following:
1. Plastic Laminates: 12 by 12 inches, for each type, color, pattern, and surface finish required.
a. Provide one sample applied to core material with specified edge material applied to one edge.
2. Thermoset Decorative Panels: 12 by 12 inches, for each color, pattern, and surface finish.
a. Provide edge banding on one edge.
3. Corner Pieces:
a. Cabinet-front frame joints between stiles and rails and at exposed end pieces, 18 inches high by 18 inches wide by 6 inches deep.
b. Miter joints for standing trim.
4. Exposed Cabinet Hardware and Accessories: One full-size unit for each type and finish.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer and Installer.

B. Product Certificates: For each type of product.

C. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Manufacturer's Qualifications: 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. Shop is a certified participant in AWI's Quality Certification Program.

B. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of interior architectural woodwork indicated for construction, finishes, installation, and other requirements.
1. Provide AWI Quality Certification Program labels indicating that woodwork, including installation, complies with requirements of grades specified.

C. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.
   1. Build mockups of typical architectural cabinets as shown on Drawings, finished.
      a. One full size, finished base cabinet complete with hardware and upper cabinet.
      b. One full size, finished accessible sink cabinet, complete with hardware and removable panel.
   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. Do not deliver cabinets until painting and similar finish operations that might damage architectural cabinets have been completed in installation areas. Store cabinets in installation areas or in areas where environmental conditions comply with requirements specified in "Field Conditions" Article.

1.8 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 levels planned for building occupants 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/concealed by construction, and indicate measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 PLASTIC-LAMINATE-CLAD ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the Architectural Woodwork Standards for grades of cabinets indicated for construction, finishes, installation, and other requirements.
   1. Provide labels from AWI certification program indicating that woodwork, including installation, complies with requirements of grades specified.

B. Architectural Woodwork Standards Grade: Custom.

C. Type of Construction: Frameless.

D. Door and Drawer-Front Style: Flush overlay.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by quality standard.

F. Laminate Cladding for Exposed Surfaces:
   1. Horizontal Surfaces:Grade HGS.
   2. Vertical Surfaces: Grade HGS.
   3. Edges: Grade HGS.

G. Materials for Semiexposed Surfaces:
   1. Surfaces Other Than Drawer Bodies: High-pressure decorative laminate, NEMA LD 3, Grade VGS.
      a. Edges of Plastic-Laminate Shelves: PVC tape, 0.018-inch (0.460-mm) minimum thickness, matching laminate in color, pattern, and finish.
      b. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
      c. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.
   2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
   3. Drawer Bottoms: Thermoset decorative panels.

H. Dust Panels: 1/4-inch plywood or tempered hardboard above compartments and drawers unless located directly under tops.

I. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

J. 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.

K. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   1. Refer to Architectural Drawings and finish schedule.

2.2 GENERAL CABINET CONSTRUCTION REQUIREMENTS

A. Lamination System: Doors, finished end panels, and other decorative exterior laminate surfaces shall be composed of minimum 3/4" core, laminated exterior, with.030 inch high pressure plastic laminate, and interior with.020" high pressure cabinet liner, which includes all open shelf storage units. Lamination with hybrid P.V.A. Type III water resistant adhesives. Total thickness 13/16".

B. Structural Cabinet Body: Cabinet backs shall be minimum 3/8" thick, inset from rear of body, Fully housed sides, and back shimmed. Provide 3/4" thick stiffeners glued and fastened to back/body as specified herein. Back perimeter and stiffeners to be fully sealed with hot melt adhesive.

C. Interior Space: All cabinets to have clear span interiors. No vertical dividers allowed, unless specifically noted on the drawings.

D. Heavy Components: Wall cabinet tops and bottoms, and all bookstack shelves shall be minimum 1" thick, for additional load support. Shelves in door cabinets 30" or wider shall be 1" thick. Shelves in open cabinets, regardless of width, shall be 1" thick.

E. Structural Drawer Body: Drawer body material shall be multi-directional fiberboard with bottom recessed, captured on all four sides, and sealed with hot melt adhesive. Provide under body stiffener as specified herein. Particleboard bodies and/or surface applied bottoms are not acceptable.

F. Drawer Suspension: Drawer slides shall be self-closing design, epoxy powder coated, with positive instop, outstop, and keeper. Dynamic (operational) load rating to be minimum 100 lbs. Static load rating to be minimum 150 lbs.

G. Structural Cabinet Support: Cabinet sub base shall be of a separate and continuous ladder-type platform design, leveled and floor mounted prior to cabinet body placement. Material to be exterior grade plywood. No cabinet sides-to-floor will be allowed.

2.3 WOOD MATERIALS

A. Wood Products: Provide materials that comply with requirements of referenced quality standard for each type of architectural cabinet 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 architectural cabinet and quality grade specified unless otherwise indicated.
   1. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade 130.
   2. Particleboard: ANSI A208.1, Grade M-2.
   3. Straw-Based Particleboard: ANSI A208.1, Grade M-2, except for density.
   4. Softwood Plywood: DOC PS 1, medium-density overlay.
   5. Thermoset Decorative Panels: Particleboard or MDF 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.
   6. Provide minimum core thicknesses, prior to lamination, as follows:
      a. 3/8" - cabinet backs, unless noted otherwise.
      b. 1/2" - dividers (where detailed).
      c. 3/4" - base and tall cabinet tops and bottoms, cabinet sides, drawer spreaders, doors, drawer head, cabinet back rear hangstrips, dividers (where detailed) and exposed cabinet backs.
      d. 1" - wall cabinet tops and bottoms, door-cabinet shelving thirty (30") inches wide and over, exposed cabinet shelving and off-wall shelving of all widths.
   7. Fiberboard components to be of the following minimum core thicknesses, prior to lamination:
      a. 3/8" - drawer bottom.

b. 1/2" - drawer sides, subfront, and back, and drawer under bottom stiffeners.
c. 3/4" - framed glass doors.

2.4 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets.
   1. Hinges:
      a. Heavy duty, five knuckle 2-3/4 inch institutional type hinge shall meet ANSI/BHMA A156.9 Grade 1 requirements. Mill ground, hospital tip, tight pin feature will all edges eased. Hinge to be full wrap around type of tempered steel.095 inch thick. Each hinge to have minimum nine (9) screws, #7, 5/8 inch FHMS to assure positive door attachment.
      b. One pair per door forty-eight (48") inches in height. One and one-half pair per door over forty-eight (48") inches in height. Hinge to accommodate 13/16" thick laminated door.
      c. Finish to be brushed chrome.

B. Drawer and Pulls: As indicated on Drawings or approved equal below:
   1. Richelieu Contemporary Metal Pull 5632, 4” Centers, Brushed Nickel Finish.
   2. Richelieu, Functional Metal Pull 1076, 4” Centers, Chrome Finish.
   3. Liberty Hardware 4” Centers Die Cast Aluminum Pulls. Length 4-3/8”, Width 4-3/8”, Projection 7/8”.
   4. Drawer Slides:
      a. Standard Drawers: self-closing design, with white epoxy powder coat finish. Positive in-stop, out-stop, and out-keeper to maintain drawer in eighty (80%) percent open position. Captive nylon rollers, front and rear. Minimum one-hundred (100) lb. dynamic load rating at 50,000 cycles. Minimum one-hundred fifty (150) lb static load rating.
   5. Catches: Shall provide opening resistance in compliance with the Americans with Disabilities Act. Provide one top-mounted catch for base, wall and tall cabinet doors. Inactive door on tall cases shall have one catch and one surface bolt. Catch housing to molded in white.
   6. Adjustable Shelf Supports: Refer to Architectural Drawings. BOD:Knape & Vogt Shelf Standard Components: Heavy-Duty 83 Standard single-slotted channel wall standards. Standards mounted to a suitable wall surface with mounting hardware 16 inches (406 mm) o.c. is capable of supporting 285 to 480 pounds per pair of standards when properly installed.
      a. Face: 3/4 inch (19 mm) wide by 1/2 inch (12 mm) deep, single slotted.
      b. Material: Steel, Anochrome, electro zinc-plated, clear lacquer, ROHS compliant.
      c. Lengths: As required to support shelving indicated.

C. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

D. For concealed hardware, provide manufacturer's standard finish that complies with product class requirements in BHMA A156.9.

2.5 CABINET CONSTRUCTION

A. Cabinet Sub Base: Unless more stringent requirements are shown or noted elsewhere, to be separate and continuous (no cabinet body sides-to-floor), water resistant exterior grade plywood, with concealed fastening to cabinet bottom. Ladder-type construction of front, back and intermediates to form a secure and level platform to which cabinets attach.

B. Cabinet Top and Bottom:
   1. Solid sub-top to be furnished for all base and tall cabinets.
   2. Wall cabinet and library stack bottoms and tops to be one (1") inch thick.
   3. Exterior exposed wall cabinet bottoms to be pressure fused laminate on both sides. Assembly devices to be concealed on bottom side of wall cabinets.

C. Cabinet Ends: Cabinet ends shall have holes drilled for adjustable shelves at 1-1/4" O.C. Exposed exterior cabinet ends to be laminated with high pressure plastic laminate, balanced with high pressure cabinet liner interior surface. All finished ends to extend to the wall, the full depth of the countertops, whether cabinets are same depth as countertops or shorter.

D. Coordinate raceway locations with Electrical Contractor and shop cut finished ends to accommodate raceways.

E. Fixed and Adjustable Shelves: shall be 3/4" thick behind doors and less than thirty (30") inches wide. Shelves to be one (1") inch thick for widths thirty (30") inches and wider, and for all open cabinet shelves (no doors).

F. Cabinet Backs:
   1. Cabinet backs to be fully housed into sides, top, and bottom, recessed 7/8" from cabinet rear. Rear, unexposed side of back panel to receive continuous bead of hot melt adhesive at joint between back and sides/top/bottom.
   2. Hang rails shall be glued to rear of cabinet back and mechanically fastened to cabinet sides. Provide minimum of two (2) fasteners at base, two (2) at wall, and three (3) at tall cabinets (typ.).
   3. Exposed exterior backs to be high pressure plastic laminate balanced with high pressure cabinet liner.

G. Door and Drawer Fronts:
   1. Laminated door and drawer fronts to be 13/16" thick for all hinged and sliding doors. Drawer fronts and hinged doors are to overlay the cabinet body. Maintain a maximum 1/8" reveal between pairs of doors, between door and drawer front, or between multiple drawer fronts within the cabinet.
   2. Stile and rail doors to be 13/16" thick with minimum full 1/4" tempered glass. All exposed lite opening edges to be trimmed and glazed with extruded vinyl glazing bead.

H. Drawers:
   1. Drawer fronts shall be applied to separate drawer body component sub front.
   2. Drawer sides shall be dadoed and glued to receive front and back, machine squared and held under pressure while hot melt glued and pinned together.
   3. Drawer bottom to be housed into front, sides, and back. Underside of drawer to receive continuous bead of hot melt adhesive at joint between bottom and back/sides/front, for

sealing and rigidity. Reinforce drawer bottoms with 1/2" by four (4") inch, front-to-back intermediate underbody stiffeners, hot melt glued and mechanically fastened. One (1) at twenty-four (24") inches, two (2) at thirty (36") inches, and four (4) at forty-eight (48") inches.

4. All drawers shall be fitted with roller guides, as specified in Item 2.2.E.3 above.

I. Vertical and Horizontal Dividers: provide one of the following, as indicated by unit model number.
   1. Natural hardboard, 1/4" thick, smooth on both faces. Secure in cabinet body with molded plastic clips.
   2. Pressure fused laminate, 3/4" thick. Secure to cabinet body with molded plastic clips or dowels.

J. Door/Drawer Front Rail: shall be minimum 3/4" by six (6") inches by full width of cabinet body, with rails immediately behind all door/drawer, and multiple drawer horizontal joints to maintain exact body dimensions, close off reveal, and be locator for lock strikes.

2.6 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood 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. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesive for Bonding Plastic Laminate: Unpigmented contact cement.
   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

2.7 FABRICATION

A. Fabricate architectural 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.
   1. Notify Architect seven days in advance of the dates and times architectural cabinet fabrication will be complete.
   2. Trial fit assemblies at manufacturer's shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

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 humidity conditions in installation areas for not less than 72 hours.

3.2 INSTALLATION

A. Architectural Woodwork Standards Grade: Install cabinets to comply with quality standard grade of item to be installed.

B. Assemble cabinets and complete fabrication at Project site to extent that it was not completed in the shop.

C. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with wafer-head cabinet installation screws.

D. Install cabinets level, plumb, and true in line to a tolerance of 1/8 inch in 96 inches using concealed shims.
   1. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.
   2. Install cabinets without distortion so doors and drawers fit openings 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.
   3. 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 FIELD QUALITY CONTROL

A. Inspections: Provide inspection of installed Work through AWI's Quality Certification Program certifying that woodwork, including installation, complies with requirements of the Architectural Woodwork Standards for the specified grade.
   1. Inspection entity shall prepare and submit report of inspection.

3.4 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual

defects. Where not possible to repair, replace architectural cabinets. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION

SECTION 070543

CLADDING SUPPORT SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Z-Girt supports.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
1. Coordinate cladding support with continuous insulation and cladding installation.

B. Preinstallation Meeting Attendees and Procedures:
1. Conduct meeting one month, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: For each component.

B. Shop Drawings: Show elevations, sections, details, size, spacing, fasteners, and attachment to other work.

C. Samples:
1. Clips: Full sized Samples. Approved Samples may not be incorporated into Work.
2. Rails: 12 inch long section.
3. Z-Girts: 12 inch long section.

1.4 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Certify cladding support systems meet or exceed specified project design criteria.

B. Delegated Design Submittals: Cladding support system, including anchorage component and fastener spacing engineering analysis.

C. Test and Evaluation Reports: Manufacturer and Independent testing agency test results showing:
   1. Fire Resistance.
   2. Thermal performance.

D. Manufacturer instructions.

E. Qualification Statements: Manufacturer, Installer, and Professional Engineer.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Licensed Professionals: Engineer specializing in cladding support system design, licensed in Pennsylvania.

B. Mockups: Construct exterior wall assembly mock-up, including cladding support systems; size and location per Drawings. Demonstrate product interfaces, intersections, and terminations.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Handle components to prevent bending, warping, twisting, and surface, edge, or corner damage.

1.7 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.8 WARRANTY

A. Manufacturer Warranty:
   1. Cladding Support System: Warrant against product and system failure.
      a. Includes structural failure of components.
      b. Warranty Period: 10 years.

PART 2 PRODUCTS

2.1 Z-GIRT SUPPORTS

A. Z Girts: Fiberglass and steel, sizes per Shop Drawings.
   1. Manufacturers and Products:
      a. Advanced Architectural Products GreenGirt Optima CMH.
      b. Cladiator Slotted-Z.

c. Knight Wall Systems KWS Thermazee.
2. Depth: See Drawings.
3. Rail Orientation: See Drawings.

B. Z-Girt Systems with Insulation: Fiberglass and steel subframing with profiled insulation panels and pressure seals installed over closed framing.
1. Manufacturers and Products:
a. Advanced Architectural Products SMARTci - Closed Framing.
2. Insulation: Dual foil-faced Class A polyisocyanurate.
3. Depth: See Drawings.
4. Rail Orientation: See Drawings.

2.2 INSTALLATION COMPONENTS

A. Nonstructural Accessories: Manufacturer recommended flashings, transitions, sealants, tapes, and shims suitable for project-specific applications, compatible with system components.

B. Fasteners: Corrosion resistant screws for support girt system substrate anchorage. Type, length, and spacing as recommended by manufacturer per structural loads.

C. Concealed Panel Fasteners: Non corroding, self tapping screws designed to withstand design loads.

2.3 PERFORMANCE

A. Delegated Design:
1. Delegate cladding support system design to licensed manufacturer Professional Engineer.
2. Structural Loads: Applicable code and ASCE 7 compliant.
a. Withstand supporting structure movements including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
b. Test Method: ASTM E330.
c. Deflection: Limited to flexure limit of panel material.
d. Allowable Fastener Loads: Coordinate with substrate, framing systems, and panel system to determine fastener types and sizes and required substrate framing member minimum thicknesses for screw pull-out resistance.
e. Fastener Creep and Durability Test: ASTM D7332-B.

B. Fire Resistance:
1. NFPA 285.

C. Surface Burning: ASTM E84 Class A.
1. Flame Spread Index: 25, maximum.
2. Smoke Developed Index: 450, maximum.

D. Environmental Performance:
   1. Thermal Performance: Combined exterior wall assemblies meeting ASHRAE Std 90.1, I-P minimum energy efficiency requirements.
   2. Expansion and Contraction: Withstand 120 degree F ambient and 180 degree F surface thermal cycling without failure.

2.4 MATERIALS

A. Aluminum: ASTM B221, manufacturer recommended alloy and temper.

B. Zinc-Aluminum-Magnesium Coated Steel Sheet: ASTM A1046, Designation SS, Grade 50, Class 2; Coating Designation ZM40.
   1. Finish: AAMA 2605, thermally cured PVDF system; multiple coats, finish one side only.

C. Stainless Steel Sheet: Type 304.

D. FRP: Polyester resin matrix with fire-retardant additives; reinforced with glass fibers and continuous strand glass mats or stitched reinforcements.

E. Thermal Spacer: Low conductivity thermal spacer; sized to depth of no less than continuous insulation layer indicated.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify masonry substrate, substrate framing, sheathing, air barrier, flashing, and insulation are ready for cladding support installation.

3.2 PREPARATION

A. Protect air barrier, flashing, and insulation from damage.

B. Prepare substrate surfaces per manufacturer instructions.

3.3 INSTALLATION

A. Install cladding support systems and fasteners per manufacturer instructions and approved shop drawings.

B. Install secondary members perpendicular to primary cladding systems.

C. Non-interlocking joints of adjacent girts require installation on 3 inch minimum surface or double-stud condition to allow minimum fastener margins.

D. Tolerances: Install cladding support systems with noncumulative maximum plumb variation of 1/4 inch in 20 feet.

END OF SECTION

SECTION 071113

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Cold-applied, emulsified-asphalt dampproofing.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for bituminous vapor retarders under slabs-on-grade.
   2. Section 042000 "Unit Masonry" for mortar parge coat on masonry surfaces.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 FIELD CONDITIONS

A. Weather Limitations: Proceed with application only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain primary dampproofing materials and primers from single source from single manufacturer. Provide auxiliary materials recommended in writing by manufacturer of primary materials.

2.2 PERFORMANCE REQUIREMENTS

A. VOC Content: Products shall comply with VOC content limits of authorities having jurisdiction unless otherwise indicated.

2.3 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Trowel Coats: ASTM D1227, Type II, Class 1.

B. Fibered Brush and Spray Coats: ASTM D1227, Type II, Class 1.

C. Brush and Spray Coats: ASTM D1227, Type III, Class 1.

2.4 AUXILIARY MATERIALS

A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.

B. Emulsified-Asphalt Primer: ASTM D1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

C. Patching Compound: latex-modified repair mortar of type recommended in writing by dampproofing manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.

B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.

D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.
   1. Apply dampproofing to provide continuous plane of protection.
   2. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Where dampproofing footings and foundation walls, apply from finished-grade line to top of footing; extend over top of footing and down a minimum of 6 inches (150 mm) over outside face of footing.
   1. Extend dampproofing 6 inches onto intersecting walls and footings, but do not extend onto surfaces exposed to view when Project is completed.
   2. Install flashings and corner protection stripping at internal and external corners, changes in plane, construction joints, cracks, and where indicated as "reinforced," by embedding an 8-inch- (200-mm-) wide strip of asphalt-coated glass fabric in a heavy coat of dampproofing. Dampproofing coat for embedding fabric is in addition to other coats required.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Unparged Masonry Foundation Walls: Apply primer and one fibered brush or spray coat at not less than 3 gal./100 sq. ft. (1.2 L/sq. m).

3.5 PROTECTION

A. Correct dampproofing that does not comply with requirements; repair substrates, and reapply dampproofing.

END OF SECTION

SECTION 072100

THERMAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Foam board insulation.
2. Blanket insulation.

1.2 REFERENCES

A. Abbreviations and Acronyms:

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
1. Coordinate Work results of this section with other Work.

B. Preinstallation Meeting Attendees and Procedures:
1. Conduct meeting one month, minimum, before starting Work of this Section.
2. Additional Attendees: Architect, Prime Contractor, Installer.

1.4 ACTION SUBMITTALS

A. Product Data.

B. Shop Drawings:
1. Show interfaces, terminations, and installation details, including areas where insulation contacts air barrier material.

C. Schedules:

1.5 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer and Independent testing agency test results showing:
   1. Thermal performance.
   2. Surface burning characteristics.
   3. Combustibility.
   4. Density.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. Installers: Minimum five years experience installing similar products.
   2. Testing Agencies: As determined by testing identical products according to ASTM E 84 by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Certifications: From Contractor for specified performance.

C. Mockups: Construct mockup of insulation installation with full exterior wall mock-up. Demonstrate product interfaces, intersections, and terminations.
   1. Mockups Location: Field.
   2. Approved mockups establish products and work results standard.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Store insulation in dry location, protected from elements.
   2. Handle insulation to prevent soiling and damage.
   3. Foam Board: Protect combustible insulation against ignition.

PART 2 PRODUCTS

2.1 FOAM BOARD INSULATION

A. Extruded Polystyrene Board, tag: ASTM C578.
   1. Manufacturers and Products:
      a. Kingspan GreenGuard.
      b. DuPont STYROFOAM.
      c. Owens Corning FOAMULAR NGX.
   2. Type IV, 25 psi, square edges.
   3. Surface Burning Characteristics: ASTM E84.
      a. Flame Spread Index: 75, maximum.
      b. Smoke Developed Index: 450, maximum.

2.2 BLANKET INSULATION

A. Unfaced Mineral Wool - Fiber Blankets, Tag: ASTM C665, Type I.
   1. Manufacturers and Products:
      a. Johns Manville TempControl Mineral Wool and MinWool Sound Attenuation Fire Batt.
      b. Owens Corning Thermafiber Fire & Sound Guard Plus.
      c. ROCKWOOL COMFORTBATT and AFB.
   2. Surface Burning Characteristics: ASTM E84.
      a. Flame Spread Index: 25, maximum.
      b. Smoke Developed Index: 50, maximum.
   3. Combustion: Passes ASTM E136.

2.3 INSULATION ATTACHMENT

A. Cladding Support Systems: See Section 070543.

B. Insulation Adhesives: Products compatible with insulation and substrates, capable of securing insulation to substrate without damaging insulation or substrates.

C. Mechanical Fasteners: Insulation manufacturer recommended screws with integrated insulation-retaining washers for attachment through sheathing to metal framing.

D. Spindle-Type Adhered Anchors for Temporary Support During Installation: Galvanized steel plate with galvanized or copper-coated steel spindle.
   1. Manufacturers and Products:
      a. AGM Industries.
      b. Gemco.
      c. Gripnail.
      d. Midwest Fasteners.
      e. TRUFAST Walls.
   2. Spindle Length: Suited to insulation depth.

E. Insulation-Retaining Washers: Galvanized steel self-locking washers.
   1. Washer Size: Recommended by anchor manufacturer.

F. Anchor Adhesive: Type recommended by anchor manufacturer for substrate.

2.4 EAVE VENTILATION

A. Eave Ventilation Troughs: Preformed, rigid fiberboard or plastic sheets sized to fit between roof framing members over eave vents.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean substrates and remove projections and appurtenances that may damage insulation or inhibit adhesion.

3.2 INSTALLATION - GENERAL

A. Extend insulation to cover entire area shown to be insulated.

B. Insulate tightly around obstructions and penetrations.

C. Fill voids with compressed fibrous insulation.

D. Foam Board Insulation: Protect from extended sunlight exposure beyond manufacturers stated limits.

3.3 INSTALLATION OF BELOW-GRADE INSULATION

A. Horizontal Surfaces: Loosely lay insulation, butt units tightly. Stagger end joints.
   1. Insulation Coverage: Entire surface.

B. Vertical Surfaces: Fully adhere insulation with units butted tightly.
   1. Insulation Coverage: Entire surface and Extend 24 inches below exterior grade line.
   2. Adhere insulation boards with mastic recommended by insulation manufacturer for use with required waterproofing membrane.
   3. Lap fabric facing over adjacent insulation boards and pin or tape in place to prevent displacement during backfilling.
   4. Close drainage channels at top edge with metal flashing or additional fabric pinned in place to prevent soil from entering drainage channels.
   5. Connect panels to subsurface drainage system.

3.4 INSTALLATION OF CAVITY WALL INSULATION

A. Foam Board Insulation: Adhere insulation boards firmly against substrate. Butt units tightly.

3.5 INSTALLATION OF WALL CONTINUOUS INSULATION

A. Foam Board Insulation: Adhere insulation boards firmly against substrate. Butt units tightly.

3.6 INSTALLATION OF FRAMED WALL INSULATION

A. Blanket Insulation: Fill cavities between framing members with insulation. Snugly fit insulation.
   1. Recessed Lighting Fixtures: Maintain 3-inch clearance between insulation and fixtures not rated for insulation contact.
   2. Eave Ventilation: Install eave ventilation troughs between roof framing members at vented eaves.
   3. Metal-Framed Wall Cavities over 96 Inches High:
      a. Unfaced Blankets: Apply insulation fasteners to stud faces before installing insulation.

3.7 PROTECTION

A. Protect insulation from damage due to weather, ultraviolet radiation, physical abuse, and other causes. Provide temporary coverings or enclosures until permanent construction is completed.

END OF SECTION

SECTION 072400

EXTERIOR INSULATION AND FINISH SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Exterior insulation and finish systems.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
1. Coordinate EIFS installation with sheathing and adjacent air barriers, windows, doors, storefront, louvers, and masonry.
2. Coordinate items anchored or fastened to substrate or EIFS.

B. Preinstallation Meeting Attendees and Procedures:
1. Conduct meeting one month, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Submit for system materials.
1. Primary Components:
a. Finish coats.
b. Reinforcing.
c. Insulation.
d. Air barrier.
e. Adhesive.
2. Associated Products:
a. Joint sealants.
b. Flashing.
3. Initial selection color and texture Samples.

B. Shop Drawings:
1. Assembly details.
2. Wall joint patterns.
3. Insulation Profiles: Moldings and Sills.
4. Transitions to other elements.

C. Samples:
   1. Assembly Samples: Assemble EIFS on 12 by 12 inch plywood. Demonstrate air barrier layer, adhesive, insulation, reinforcement, and finish system.
   2. Finish Samples: 6 by 6 inches illustrating color and texture.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:
   1. Manufacturer Certificates: Certify the following.
      a. Substrates are acceptable to EIFS manufacturer.
      b. EIFS complies with requirements.
      c. Accessory materials installed with EIFS are acceptable to EIFS manufacturer.

B. Test and Evaluation Reports: Manufacturer and Independent testing agency test results showing:
   1. Air barrier complies with requirements.

C. Manufacturer Reports: Field instruction, test, and inspection reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For EIFS.

B. Warranty Documentation: For EIFS.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. Installers: Certified in writing by EIFS manufacturer as qualified to install system.

B. Certifications: From Contractor for specified performance.

C. Field Samples: Construct 4'-0" x 8'-0", minimum size. Demonstrate texture, color, and pattern.
   1. Remove Samples when Architect directs.

D. Mockups: Construct EIFS wall mockup, full thickness including framing and sheathing and substrate, 4'-0" x 8'-0" minimum size. Demonstrate product interfaces, intersections, and terminations.
   1. Mockups Location: Field.
   2. Use stepped back assembly to demonstrate application of each material layer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect adhesives and finish materials from freezing, temperatures below 40 degrees F and temperatures in excess of 90 degrees F.

1.8 FIELD CONDITIONS

A. Prepare EIFS materials within manufacturer-recommended limitations.

B. Protect installed EIFS from inclement weather until dry.

C. Limit insulation board sun exposure to manufacturer-recommended duration. Apply base coat promptly.

1.9 WARRANTY

A. Manufacturer Warranty:
   1. EIFS: Warrant against total system failure.
   2. Failure includes:
      a. Bond integrity.
      b. Weathertightness.
      c. Deterioration beyond normal weathering.
   3. Warranty Period: 12 years.

PART 2 PRODUCTS

2.1 EXTERIOR INSULATION AND FINISH SYSTEM

A. Drainage Type EIFS: Reinforced finish coating on adhesively attached insulation board over an air- and water-resistive barrier and substrate, forming a continuous air- and water-resistive assembly.
   1. Manufacturers and Products:
      a. Dryvit Outsulation Plus MD.
      b. Master Wall Rollershield Drainage EIFS.
      c. Sika Facades Senergy Channeled Adhesive CI.
      d. Sto StoTherm ci.
   2. Finish Coat: Water-based, air curing acrylic or polymer-based finish with integral color and texture.
      a. Hydrophobic Finish: Manufacturer recommended product.
      b. Lightweight Finish: Manufacturer recommended product.
   3. Base Coat: Fiber-reinforced acrylic or polymer-based product.
   4. Reinforcing Mesh: EIFS manufacturer open weave, glass fiber fabric.
      a. Mesh Weight and Tensile Strength: Recommended by EIFS manufacturer for impact classification.
   5. Insulation Board:
      a. Molded expanded polystyrene board, ASTM C578, Type I.
      b. GPS Graphite-infused polystyrene board, ASTM C578, Type I.
      c. Extruded polystyrene board, ASTM C578, Type X.
      d. Thickness: See Drawings; 1 inch, minimum.
   6. Air- and Water-Resistive Barrier Coating: Fluid-applied membrane; EIFS manufacturer furnished or approved.
   7. Fluid-Applied Flashing: Flexible, water-based polymer material compatible with

reinforcing mesh.
8. Color and Texture: Architect selected.

B. Accessory Materials:
1. Insulation Adhesive: EIFS manufacturer recommended type.
2. Insulation Fasteners: EIFS manufacturer recommended type.
3. Trim: EIFS manufacturer-standard PVC trim accessories for project completion, including starter track and drainage accessories.
4. Joint Sealants and Recommended Sealant Primers: EIFS manufacturer recommended type.

2.2 PERFORMANCE

A. EIFS Performance: ASTM E2568 and ICC-ES AC219:
1. Water Penetration Resistance: No water penetration beyond the plane of the base coat/insulation board interface after 15 minutes per ASTM E331 at 6.24 psf differential pressure with tracer dye in the water spray.
2. Air Infiltration:
a. Material: ASTM E2178, 0.004 cfm/sf maximum at 1.57 psf pressure differential.
b. Assembly: ASTM E2357, 0.04 cfm/sf maximum at 1.57 psf pressure differential.
3. Thermal Transmission: 7.5 R-Value, minimum.
4. Average Minimum Drainage Efficiency: 90 percent; test per ASTM E2273 for 75 minutes.
5. Durability: No cracking, checking, crazing, erosion, blistering, peeling, delamination, or corrosion of finish coating when tested per the following:
a. Salt Spray Resistance: ASTM B117, 300 hours exposure.
b. Freeze Thaw Resistance: ICC-ES AC219, 10 cycles.
c. Weathering: ASTM G153 Cycle 1, 2000 hours.
d. Water Degradation: ASTM D2247, 14 days.
6. Mildew Resistance: ASTM D3273, no growth at 28 days.

B. Fire Performance:
1. Surface Burning: ASTM E84, 25, maximum.
2. Smoke Developed Index: ASTM E84, 450, maximum.
3. Fire Rated Wall Assemblies: Follow testing agency listed assembly requirements.
4. Exterior Wall Testing: Follow assembly tested per NFPA 285.

C. Impact Classification: ASTM E2568, tested per ASTM E2486.
1. Ultra High Performance:
a. Wall surfaces within occupant reach.
b. Corners.
2. High Performance: All other wall surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Verify substrates are sound and free of oil, dirt, surface contaminants, efflorescence, loose materials, and protrusions that could interfere with EIFS installation.
   2. Verify substrate is acceptable to EIFS manufacturer.

B. Substrate Tolerances:
   1. Deflection: 1/240 of span, maximum.
   2. Flatness: 1/4 inch in 48 inch radius.

C. Do not begin Work until substrate and adjacent materials are complete and thoroughly dry.

3.2 PREPARATION

A. Expansion Joints: Provide at the following locations:
   1. Where expansion joints occur in the substrate system.
   2. Where building expansion joints occur.
   3. At floor lines in wood frame construction.
   4. At floor lines of non-wood framed buildings where significant movement is expected.
   5. Where EIFS abuts dissimilar materials.
   6. Where the substrate type changes.
   7. In continuous elevations at maximum 75 foot intervals.
   8. Where significant structural movement occurs, including roofline changes, building shape changes, or structural system changes.

B. Protect adjoining Work and property during installation.

3.3 INSTALLATION - GENERAL

A. Install EIFS per ASTM C1397.

3.4 INSTALLATION - DRAINAGE-TYPE EIFS SYSTEM

A. Air and Water-resistive Barrier:
   1. Seal substrate transitions and intersections with other materials to form a continuous air and water resistive barrier on substrate.
   2. At door and window rough openings and other wall penetrations, seal the air- and water-resistive barrier and flexible flashings to the rough opening before installing metal flashings, sills, or frames.
   3. Lap flexible flashing or flashing tape 2 inches minimum on each side of joint or transition.

B. Insulation:
   1. Adhesive Attachment: Use method required by manufacturer to achieve drainage efficiency specified; do not close up drainage channels when placing insulation board.
      a. Supplemental Mechanical Attachment: Fasten insulation to substrate per applicable code or manufacturer recommendation.
   2. Place boards with tight, staggered vertical joints interlocked at corners. Butt edges and ends tight to adjacent boards and protrusions. Achieve a continuous flush surface with no gaps exceeding 1/16 inch.
      a. Interrupt insulation for control and expansion joints where shown on Drawings.
   3. Fill gaps greater than 1/16 inch with EPS.
   4. Rasp irregularities off surface of installed insulation board.
   5. Cut aesthetic reveals in insulation at locations and profiles shown on Drawings.
   6. Build up layers of insulation and carve to form projections shown on Drawings.
   7. Wrap reinforcing mesh over insulation at openings and terminations that are not to be protected with trim.
   8. Provide blocking at the insulation plane where required for items fastened to EIFS.

C. Finish:
   1. Base Coat: Apply at sufficient thickness to fully embed reinforcing mesh, wrinkle-free, with back-wrap at EIFS terminations.
      a. Lap reinforcing mesh edges and ends a minimum of 2-1/2 inches.
      b. Allow base coat to dry 24 hours minimum before applying next coat.
   2. Double Layer Reinforcing Mesh: Apply second base coat and second layer of reinforcing mesh where required for impact resistance. Lap layers 2-1/2 inches minimum.
   3. Additional Reinforcing: Embed additional minimum 8 inch wide reinforcing strips in base coat at outside corners and openings.
   4. Apply finish coat. Embed finish aggregate, and finish to match approved sample and match approved mockup.
   5. Finish Coat Thickness: Manufacturer recommended.
   6. Apply sealant at expansion joints and between EIFS and dissimilar materials.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to Work areas.
   1. Failed Test Retest Cost: Contractor responsibility.

B. Tests and Inspections:
   1. Air Barrier: Tests may include the following:
      a. Air Barrier Adhesion: Test per ASTM D4541 or ABAA T002.
      b. Air Leakage Location: Test per ASTM E1186, chamber pressurization or depressurization with smoke tracers and ASTM E1186, chamber depressurization using detection liquids.
      c. Assembly Air Leakage: Test per ASTM E2357.
   2. EIFS Assembly: Test per ASTM E2359 or ICC-ES AC219.

C. Non-Conforming Work: Remove and replace, and retest.

D. Prepare test and inspection reports.

3.6 CLEANING

A. Clean EIFS surfaces and Work areas of foreign materials resulting from EIFS operations.

3.7 PROTECTION

A. Protect completed Work from damage and soiling by subsequent Work.

END OF SECTION

SECTION 072500

WEATHER BARRIERS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Building wrap.
2. Water-Resistive barrier.
3. Flexible flashing.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For water-resistive barrier and flexible flashing, from ICC-ES.

PART 2 PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 25 and 450, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Dow Chemical Company (The); Styrofoam Weathermate Plus Brand Housewrap.
b. DuPont (E. I. du Pont de Nemours and Company); Tyvek CommercialWrap.
c. Kingspan.; GreenGuard Classic Wrap.
d. Raven Industries Inc.; Fortress Pro Weather Protective Barrier.
2. Water-Vapor Permeance: Not less than 75 perms per ASTM E 96/E 96M, Desiccant Method (Procedure A).
3. Air Permeance: Not more than 0.004 cfm/sq. ft. at 0.3-inch wg when tested according to ASTM E 2178.

4. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber 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.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. DuPont (E. I. du Pont de Nemours and Company); DuPont Flashing Tape.
      b. Grace Construction Products, a unit of W. R. Grace & Co. - Conn.; Vycor Butyl Self Adhered Flashing.
      c. Protecto Wrap Company; BT-25 XL.
      d. Raven Industries Inc.; Fortress Flashshield.

B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

C. Nails and Staples: ASTM F 1667.

PART 3 EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

B. Cover sheathing with water-resistive barrier as follows:
   1. Cut back barrier 1/2 inch on each side of the break in supporting members at expansion- or control-joint locations.
   2. Apply barrier to cover vertical flashing with a minimum 4-inch overlap unless otherwise indicated.

C. Building Wrap: Comply with manufacturer's written instructions.
   1. Seal seams, edges, fasteners, and penetrations with tape.
   2. Extend into jambs of openings and seal corners with tape.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.
   1. Prime substrates as recommended by flashing manufacturer.
   2. Lap seams and junctures with other materials at least 4 inches except that at flashing flanges of other construction, laps need not exceed flange width.
   3. Lap flashing over water-resistive barrier at bottom and sides of openings.

4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION

SECTION 072600

VAPOR RETARDERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Polyethylene vapor retarders.

B. Related Requirements:
   1. Section 033000 "Cast-in-Place Concrete" for under-slab vapor retarders.
   2. Section 072100 "Thermal Insulation" for vapor retarders integral with insulation products.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each product, for tests performed by a qualified testing agency.

PART 2 PRODUCTS

2.1 VAPOR RETARDERS

A. Polyethylene Vapor Retarders: ASTM D4397, 10-mil- (0.25-mm-) thick sheet, with maximum permeance rating of 0.1 perm (5.7 ng/Pa x s x sq. m).

B. Existing Opening Infill Sheet Retarder: Certainteed MemBrain, The SMART Vapor Retarder. Polyimide film vapor
retarder for use with unfaced, vapor permeable glass fiber and mineral wool insulation in wall and ceiling cavities. Material has a permeance of 1 perm or less when tested to ASTM E 86, dry cup method and increases to greater than 10 perms using the wet cup method.
   1. Water Vapor Permeance:
      a. ASTM E 86, dry cup method: 1.0 perms (57ng/Pa*s*m2).
      b. ASTM E 86, wet cup method: 10.0 perms (1144ng/Pa*s*m2).
   2. Fire Hazard Classification: ASTM E 84:
      a. Maximum Flame Spread Index; 25.
      b. Maximum Smoke Developed Index; 450.

C. Under slab Sheet Vapor Retarder, Class A: ASTM E1745, Class A; not less than 15 mil thick. Include manufacturer's recommended adhesive, pressure-sensitive tape, and accessories.
   1. Provide Stego Wrap 15 mil Vapor Barrier (no substitutions).

2.2 ACCESSORIES

A. Vapor-Retarder Tape: Pressure-sensitive tape of type recommended by vapor-retarder manufacturer for sealing joints and penetrations in vapor retarder.

B. Adhesive for Vapor Retarders: Product recommended by vapor-retarder manufacturer and has demonstrated capability to bond vapor retarders securely to substrates indicated.

C. Vapor-Retarder Fasteners: Pancake-head, self-tapping steel drill screws; with fender washers.

PART 3 EXECUTION

3.1 COPY OF PREPARATION

A. Clean substrates of substances that are harmful to vapor retarders, including removing projections capable of puncturing vapor retarders.

3.2 INSTALLATION OF VAPOR RETARDERS ON FRAMING

A. Place vapor retarders on side of construction indicated on Drawings.

B. Extend vapor retarders to extremities of areas to protect from vapor transmission. Secure vapor retarders in place with adhesives, vapor retarder fasteners, or other anchorage system as recommended by manufacturer. Extend vapor retarders to cover miscellaneous voids in insulated substrates, including those filled with loose-fiber insulation.

C. Seal vertical joints in vapor retarders over framing by lapping no fewer than two studs and sealing with vapor-retarder tape according to vapor-retarder manufacturer's written instructions. Locate all joints over framing members or other solid substrates.

D. 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 retarders.

E. Repair tears or punctures in vapor retarders immediately before concealment by other work. Cover with vapor-retarder tape or another layer of vapor retarders.

3.3 INSTALLATION OF VAPOR RETARDERS IN CRAWL SPACES AND UNDER SLABS

A. Install vapor retarders per specification Cast-In-Place Concrete 033000 section 3.8.

3.4 PROTECTION

A. Protect vapor retarders from damage until concealed by permanent construction.

END OF SECTION

SECTION 072726

FLUID APPLIED MEMBRANE AIR BARRIERS

PART 1 GENERAL

1.1 SUMMARY

1.2 GENERAL REQUIREMENTS

A. The General Conditions, Supplementary Conditions, Instructions to Bidders, and Division 01-General Requirements shall be read in conjunction with and govern this section.

B. Read this Specification as a whole by all parties concerned. Each Section may contain more or less than the complete Work of any trade. The Contractor is solely responsible to make clear to the installing Subcontractor the extent of their Work.

1.3 SUMMARY

A. This Section includes requirements for supplying labor, materials, tools, and equipment to complete the Work as shown on the Drawings Architectural Division as specified herein including, but not limited to, the following:
   1. Fluid Applied Vapor Permeable Air Barrier.
   2. Flashings.
   3. Flashing Primer.
   4. Sealant.
   5. Thru-wall Flashing.

1.4 RELATED REQUIREMENTS

A. DIVISION 03 - Concrete Section.

B. DIVISION 04 - Masonry Section 04 20 00 - Unit Masonry.

C. DIVISION 06 - Wood, Plastics, and Composites Section 06 16 00 Sheathing.

D. DIVISION 07 - Thermal and Moisture Protection Section 07 11 13 - Bituminous Dampproofing.

E. DIVISION 07 - Thermal and Moisture Protection Section 07 21 00 - Thermal Insulation.

F. DIVISION 07 - Thermal and Moisture Protection Section 07 26 00 - Vapor Retarders.

G. DIVISION 07 - Thermal and Moisture Protection Section 07 62 00 - Sheet Metal Flashing and

Trim.

H. DIVISION 07 - Thermal and Moisture Protection 07 50 00 Membrane Roofing.

I. DIVISION 07 - Thermal and Moisture Protection Section 07 92 00 - Joint Sealants.

J. DIVISION 08 - Openings Section 08 40 00 - Entrances, Storefronts, and Curtain Walls.

1.5 ALTERNATES

A. Submit requests for alternates in accordance with Section.

B. Air barrier assemblies must meet the following standards:
   1. Water-Resistive Barrier (WRB): Fluid applied, Silyl Terminated Polyether (STPE).
   2. STPE air barrier can be applied to damp surfaces.
   3. IBC Section 1402, Vertical and lateral flame propagation: meets NFPA 285 Exception #2 Per ASTM E1354 and ASTM E84.
   4. Application Temperature: 10 °F to 122 °F (-12 °C to +50 °C).
   5. Service Temperature: -40 °F to +300 °F (-40 °C to +149 °C).
   6. Rain ready within 30 minutes.
   7. Water Vapor Permeance (ASTM E96):
      a. Method B: 19 perms @ 20 mils.
   8. Water Resistance (AATCC TM127): Pass.
   9. Surface Burning Characteristics (ASTM E84):
      a. Flame Spread Index: 20, Class A.
      b. Smoke developed: 10, Class A.
   10. UV resistance:
      a. Accelerated Weathering (ASTM G154): >5000 hours.
      b. UV resistance during construction: 12 months.
      c. Permanent UV exposure under open joint cladding.
   11. VOC Content, max (EPA Method 24): 25g/L Method 24.
   12. Declaration Status: LBC Red List Free.

C. Alternate submission format to include:
   1. Documentation from an independent testing laboratory certifying the performance of the system, including auxiliary components, meet requirements of this specification.
   2. References indicating the Air Barrier Manufacturer has successfully completed projects of similar scope and nature on an annual basis for a minimum of ten (10) years.
   3. Product Data:
      a. Air Barrier Manufacturer’s guide specification.
      b. Air Barrier Manufacturer’s technical data sheets.
      c. Air Barrier Manufacturer’s details.
   4. Certificates:
      a. Product certification that the assembly components are supplied and warranted by single source Air Barrier Manufacturer.
   5. Sample warranty as specified.

D. Submit requests for alternates to this specification a minimum of ten (10) working days prior to bid date. Include a list of twenty-five (25) projects executed over the past five (5) years.

E. Issued addendums confirm acceptable alternates. Do not submit substitute materials after tender closing.

1.6 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. AMMA 2400-02, Standard Practice for Installation of Windows with a Mounting Flange in Stud Frame Construction.

B. American Society for Testing and Materials (ASTM):
   1. ASTM D412, Standard Test Method for Vulcanized Rubber and Thermoplastic Elastomers - Tension.
   2. ASTM D1970, Standard Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection.
   3. ASTM D2243, Standard Test Method for Freeze-Thaw Resistance of Water-Borne Coatings.
   4. ASTM D5590, Standard Test Method for Determining the Resistance of Paint Films and Related Coatings to Fungal Defacement by Accelerated Four-Week Agar Plate Assay.
   5. ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   6. ASTM E96, Standard Test Methods for Water Vapor Transmission of Materials.
   7. ASTM E1677, Standard Specification for Air Barrier (AB) Material or System for Low-Rise Framed Building Walls.
   8. ASTM E2112, Standard Practice for Installation of Exterior Windows, Doors and Skylights.
   9. ASTM E2178, Standard Test Method for Air Permeance of Building Materials.
   10. ASTM E2357, Standard Test Method for Determining Air Leakage of Air Barrier Assemblies.

C. National Fire and Protection Agency (NFPA):
   1. NFPA 285, Standard Fire Test Method for Evaluation of Fire Propagation Characteristics of Exterior Non-Load-Bearing Wall Assemblies Containing Combustible Components.

D. US Green Building Council (USGBC), Leadership in Energy and Environmental Design (LEED):
   1. LEED Reference Guide, Version 4.0, and USGBC Project Calculation Spreadsheet. Web Site http://www.usgbc.org.

1.7 ADMINISTRATIVE REQUIREMENTS

A. Pre-installation meetings:
   1. When required, and with prior notice, an Air Barrier Manufacturer representative will meet with the necessary parties at the jobsite to review and discuss project conditions as it relates to the integrity of the assembly.

1.8 SUBMITTALS

A. Provide the following requested information in accordance with Section 013300 Submittal Procedures.

B. Action Submittals:
   1. Product Data:
      a. Air Barrier Manufacturer’s guide specification.
      b. Air Barrier Manufacturer’s technical data sheets.
      c. Air Barrier Manufacturer’s details.
   2. Certificates:
      a. Product certification that the assembly components are supplied and warranted by single source Air Barrier Manufacturer.
      b. LEED HPD declaration.
      c. Declaration Status: LBC Red List Free.
   3. Tests and Evaluation Reports:
      a. NFPA 285 wall assembly compliance:
   4. Air Barrier Manufacturer statement that anticipated wall assembly complies with NFPA 285.
   5. Sample warranty as specified.
   6. QUALITY ASSURANCE.

C. Single Source Responsibility:
   1. Obtain air barrier, flashings, sealants and primers from a single Air Barrier Manufacturer regularly engaged in the manufacturing and supply of the specified products.
   2. Verify product compliance with federal, state, and local regulations.

D. Manufacturer Qualifications:
   1. Air Barrier Manufacturer must not issue warranties for terms longer than they have been manufacturing and supplying specified products for similar scope of Work.

E. Installer Qualifications:
   1. Perform Work in accordance with Air Barrier Manufacturer published literature and as specified in this section.
   2. Maintain one (1) copy of Air Barrier Manufacturer’s installation instructions on site.
   3. Allow the Air Barrier Manufacturer representative site access during installation.
   4. Contact the Air Barrier Manufacturer a minimum of two weeks prior to scheduling a meeting.

1.9 MOCK-UPS

A. Mock-ups:
   1. Where directed by architect, construct mock-ups to verify selections made under submittals and to set quality standards for materials and execution in accordance with specifications.
   2. DELIVERY, STORAGE, AND HANDLING.

B. Delivery of Materials:
   1. Deliver materials to the jobsite in undamaged and clearly marked containers and/or

wrapping indicating the name of the Air Barrier Manufacturer and product.

C. Storage of Materials:
   1. Store materials as recommended by the Air Barrier Manufacturer and conform to applicable safety regulatory agencies. Refer to all applicable data including, but not limited to, Safety Data Sheets, Product Data sheets, product labels, and specific instructions for personal protection.
   2. Keep solvents away from open flame or excessive heat.
   3. Store rolled materials on end.

D. Handling:
   1. Product requirements may vary. Refer to product specific Safety Data Sheet.

1.10 SITE CONDITIONS

A. Environmental Requirements:
   1. Do not perform Work during rain.
   2. Do not perform Work on frost covered or wet substrates; can be applied to damp surfaces.
   3. Product requirements may vary. Refer to product specific Technical Data Sheet.

B. Protection:
   1. It is the responsibility of the installing Subcontractor to protect all surfaces not included in scope of Work from damage.
   2. Protect top and backside of substrate walls against bulk water during and after application of air barrier.

C. Complete preparation Work prior to installing the air barrier assembly.

D. Ground electrical equipment during operations.

1.11 WARRANTY

A. Manufacturer Material Warranty:
   1. Provide Air Barrier Manufacturer’s standard 10 year material warranty.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. Acceptable Manufacturers:
   1. Henry Company
      999 N. Pacific Coast Highway, Suite 800
      El Segundo, CA 90245
      (800) 486-1278
      www.Henry.com.

2.2 MATERIALS

A. Obtain air barrier and auxiliary materials as a single-source from the Air Barrier Manufacturer to ensure compatibility and compliance with the following requirements:
   1. Water-Resistive Barrier (WRB): Fluid applied, Silyl Terminated Polyether (STPE).
   2. STPE air barrier can be applied to damp surfaces.
   3. IBC Section 1402, Vertical and lateral flame propagation: meets NFPA 285 Exception #2 Per ASTM E1354 and ASTM E84.
   4. Application Temperature: 10 °F to 122 °F (-12 °C to +50 °C).
   5. Service Temperature: -40 °F to +300 °F (-40 °C to +149 °C).
   6. Rain ready within 30 minutes.
   7. Water Vapor Permeance (ASTM E96):
      a. Method B: 19 perms @ 20 mils.
   8. Water Resistance (AATCC TM127): Pass.
   9. Surface Burning Characteristics (ASTM E84):
      a. Flame Spread Index: 20, Class A.
      b. Smoke developed: 10, Class A.
   10. UV resistance:
      a. Accelerated Weathering (ASTM G154): >5000 hours.
      b. UV resistance during construction: 12 months.
      c. Permanent UV exposure under open joint cladding.
   11. VOC Content, max (EPA Method 24): 25g/L Method 24.
      a. Declaration Status: LBC Red List Free.

B. Fluid Applied Vapor Permeable Air Barrier (Basis of Design):
   1. UV and fire resistant, single-component, moisture cure Silyl Terminated Polyether (STPE) water-resistive air barrier designed to provide a vapor permeable air and water barrier when applied on above-grade wall assemblies, having the following typical properties:
      a. Basis of design: Air-Bloc All Weather STPE Fluid Applied Vapor Permeable Air Barrier.
      b. Color: Black.
      c. STPE air barrier can be applied to damp surfaces.
      d. IBC Section 1402, Vertical and lateral flame propagation: meets NFPA 285 Exception #2 Per ASTM E1354 and ASTM E84.
      e. Recommended Film Thickness: 20 mils WFT/DFT.
      f. Solids Content: >98%.
      g. Application Temperature: 10 °F to 122 °F (-12 °C to +50 °C).
      h. Service Temperature: -40 °F to +300 °F (-40 °C to +149 °C).
      i. Rain ready within 30 minutes.
      j. Water Vapor Permeance (ASTM E96):
   2. Method B: 19 perms @ 20 mils.
      a. Air Permeance:
   3. Material (ASTM E2178): 0.003 cfm/ft2 (0.0147 L/s.m.2).
   4. Air Leakage - Assembly (ASTM E2357): Pass.
      a. Elongation (ASTM D412): 350%.
      b. Tensile Strength (ASTM D412): 100 psi.
      c. Nail Sealability (AAMA 711-07 (ASTM D1970 modified): Pass.
      d. Water Resistance (AATCC TM127): Pass.
      e. Surface Burning Characteristics (ASTM E84):

5. Flame Spread Index: 20, Class A.
6. Smoke developed: 10, Class A.
    a. Fire Testing (NFPA 285): Complies in various assemblies.
    b. UV Resistance:
7. Accelerated Weathering (ASTM G154): >5000 hours.
8. UV resistance during construction: 12 months.
9. Permanent UV exposure under open joint cladding.
    a. VOC Content, max (EPA Method 24): 25g/L Method 24.
    b. Declaration Status: LBC Red List Free.

C. Auxiliary Materials.
1. Flashings; choose from the following:
    a. Liquid-applied flashing:
2. Moisture-cure one component elastomeric liquid applied flashing using an STPE (Silyl-Terminated Polyether) polymer, having the following typical properties:
    a. Basis of Design Product: Henry Air-Bloc LF® Liquid Applied Flashing.
    b. Color: Blue.
3. Sealants:
    a. Moisture cure, medium modulus polymer modified sealing compound, having the following typical properties:
4. Basis of Design Product: Henry 925 BES Sealant.
5. Complies with Fed. Spec. TT-S-00230C, Type II, Class A.
6. Complies with ASTM C920, Type S, Grade NS, Class 35.
7. Thru-Wall Flashing:
    a. Vapor impermeable, self-adhered water resistive air and vapor barrier consisting of an SBS rubberized asphalt compound, integrally laminated to a yellow engineered thermoplastic film, having the following typical properties:
8. Basis of Design Product: Henry Blueskin TWF Self-Adhered Thru-Wall Flashing.
9. Color: Yellow.

PART 3 EXECUTION

3.1 EXAMINATION

A. It is the installing Subcontractor’s responsibility to verify the substrate is in accordance with Air Barrier Manufacturer requirements and as specified in this Section prior to installation of air barrier. Commencement of the Work or any parts thereof, indicates installer acceptance of the substrate.
1. Acceptable substrates include exterior-grade gypsum sheathing, plywood, OSB, precast or cast-in-place concrete, CMU, primed steel, aluminum mill finish, anodized aluminum, and galvanized metal.
2. Verify surfaces are sound, clean and free of frost, oil, grease, dirt, excess mortar or other contaminants.
3. Substrate must be continuous and secure.
4. Sheathing fasteners must be installed into solid backing and set flush with sheathing.
5. Masonry joints must be struck flush. Allow fresh CMU mortar joints to cure for a minimum of thirty-six (36) hours.
6. Tie holes/voids in poured concrete to be flush and smooth shall be filled. Allow new

concrete to cure a minimum of thirty-six (36) hours after forms are removed.

7. Top and backside of substrate walls must be protected against bulk water during and after application of air barrier.
8. Curing compounds must be resin based without oil, wax or pigments. Substrates must be free of form release agents.

B. Notify contractor in writing of any conditions that are not acceptable.

C. Do not apply air barrier assembly components until substrate and environmental conditions are in accordance with Air Barrier Manufacturer's published literature.

3.2 PREPARATION

A. Verify surfaces are in accordance with the product specific technical data sheet and as stated in this specification.

B. Protection:
   1. Protect top and backside of substrate walls against bulk water during and after application of air barrier.

3.3 INSTALLATION

A. Environmental Requirements:
   1. Do not perform Work during rain or inclement weather.
   2. Do not perform Work on frost covered or wet substrates; can be applied to damp surfaces.
   3. Do not perform Work when ambient (air) and substrate temperatures are below 10 °F (-12 °C).

B. Refer to Air Barrier Manufacturer detail drawings for installation procedures including, but not limited to, the following:
   1. Changes in substrate.
   2. Control joints.
   3. Crack treatment.
   4. Inside corners.
   5. Outside corners.
   6. Penetrations.
   7. Rough openings.
   8. Sheathing Joints.

C. Moving Joints:
   1. Contact Air Barrier Manufacturer.

D. Contact Air Barrier Manufacturer to coordinate transition of air barrier to adjacent areas including, but not limited to, the following:
   1. Roofing.
   2. Waterproofing.
   3. Fastener penetrations.

E. Thru-Wall Flashing:
   1. Coordinate with Section project specific.

F. Primary Air Barrier.
   1. Install air barrier assembly in accordance with Air Barrier Manufacturer product specific TDS, details, guide specification, and technical bulletins to create a monolithic air and watertight application without sags, runs or voids.
   2. Lap air barrier onto flashing (1) inch (2.5 cm) minimum.
   3. Application Rate:
      a. Application rates and cured dry film thickness are approximate, and may vary depending on texture and porosity of surface.
      b. Wet film thickness (WFT): 20 mils.
      c. Dry film thickness (DFT): 20 mils.

3.4 FIELD QUALITY CONTROL

A. Final Observation and Verification:
   1. Architect and General Contractor and Air Barrier Manufacturer to complete final observation of air barrier assembly as required by warranty.

3.5 CLEANING

A. 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.

B. Clean soiled surfaces, spatters, and damage to adjacent areas caused by Work of this Section.

C. Check area to ensure cleanliness and remove debris, equipment, and excess material from the site.

END OF SECTION

SECTION 073113

ASPHALT SHINGLES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes.
   1. Asphalt shingles.
   2. Flashing.
   3. Underlayment.
   4. Vents.
   5. Installation accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one month, minimum, before starting Work of this Section.
   2. Additional Attendees: Installer, Prime Contractor, CMa, and Architect.
   3. Additional Agenda Items:
      a. Installation procedure overview.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Asphalt shingles.
      a. Wind uplift resistance performance.
      b. Fire hazard classification.
      c. Impact resistance class.
      d. Solar Reflectance Index.
   2. Ice dam membrane.
   3. Underlayment.
   4. Ridge and Roof vents.
   5. Metal flashing and accessories.
   6. Initial selection color Samples.

B. Shop Drawings:
   1. Metal flashings.

C. Samples:
   1. Shingles: Full size.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:
   1. Ice dam membrane.
   2. Underlayment.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For shingles.

B. Warranty Documentation: For total system.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:
   1. Supply 100 square feet of extra shingles in each color.

1.7 QUALITY ASSURANCE

A. Field Samples: Install sample area, approximately 8 by 10 feet, to demonstrate materials and work quality.
   1. Include eave, soffit, hip, gable edge, and vent pipe in sample.
   2. Approved Samples establish Work results standard.

1.8 FIELD CONDITIONS

A. Ambient Conditions: Do not install ice dam membrane and shingles when ambient air or wind chill temperature is below 45 deg F.

B. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.9 WARRANTY

A. Manufacturer Warranty:
   1. Shingles: Warrant against total system failure.
      a. Failure includes wind blow off and damage under design wind conditions.
      b. Warranty Period: 30 years.
      c. Algae Discoloration Warranty: Ten years.

PART 2 PRODUCTS

2.1 ASPHALT SHINGLES

A. Laminated Strip Shingles Roof Type 3 and As indicated on drawings: ASTM D3462; SBS-modified asphalt multi-ply overlay construction, glass fiber reinforced, mineral granule surfacing, self sealing, algae resistant.
   1. Manufacturers and Products:
      a. Basis of Design: GAF Building Materials Corporation, Timberline HDZ.
      b. CertainTeed Corporation.
      c. Owens Corning Fiberglas Corp.
   2. Substitutions: Not Permitted.
   3. Roof Covering Fire Classification: ASTM E108 or UL 790, Class A.
   4. Apply label from agency approved by authority having jurisdiction to identify each roof assembly component.
   5. Butt Edge: Straight.
   6. Energy Star certified.
   7. Hail Resistance: UL 2218, Class 3.
   8. Initial Solar Reflectance: 0.25 minimum.
   9. Color Blend: Architect selected and "Weathered Wood".

B. Ridge and Hip Shingles: Manufacturer asphalt units in same color blend.

2.2 FLASHING

A. Form flashings to profiles shown on Drawings, to protect roofing materials from physical damage, and to shed water. Follow SMACNA Architectural Sheet Metal Manual.
   1. Form flashing sections square and accurate to profile, in maximum possible lengths, free from distortion or defects detrimental to appearance or performance.
   2. Hem exposed edges of flashings minimum 1/4 inch on underside.
   3. Apply bituminous paint on concealed surfaces of flashings where in contact with treated lumber, steel, or cementitious substrates.
   4. Counterflashing: See Section 076200.

B. Flashing Material:
   1. Aluminum: 0.032 inch thick, minimum.
   2. Finish: Factory applied color finish.
      a. Color: Architect selected.

C. Flashing Fasteners: Stainless steel roofing nails.

D. Apron Flashing: Lower edge extending 4 inches over and to each side of downslope shingles, and 6 inch vertical leg.

E. Open Valley Flashing: 12 inch flanges with inverted-V profile at center.

F. Step Flashing: 2 inch minimum head lap, 4 inch base over underlying shingle, and 4 inch vertical leg.

G. Eave and Gable Edge Flashing: 2 inch minimum anchorage flange on roof deck and extending 3/8 inch minimum below roof sheathing.

H. Vent Pipe Flashing: ASTM B749; lead sleeve soldered to skirt at roof slope, extending 4 inches onto deck from pipe.

2.3 UNDERLAYMENT

A. Ice Dam Membrane, Roof Type 3: ASTM D1970; self adhering SBS-modified bituminous sheet material, slip resistant surface, 30 mil minimum thickness.
   1. Manufacturers and Products:
      a. GAF Materials Corporation WeatherWatch and StormGuard.
      b. Owens Corning WeatherLock.
      c. GCP Applied Technologies Ice & Water Shield.
      d. Atlas Roofing Corporation WeatherMaster Ice & Water 216.
      e. Tamko Building Products, Inc. TW Underlayment.

B. Synthetic Underlayment, Roof Type 3: UV-resistant polymer sheets with slip-resistant surface.
   1. Manufacturers and Products:
      a. GAF Materials Corporation FeltBuster.
      b. Atlas Roofing Corporation Summit 180.
      c. GCP Applied Technologies Tri-Flex 15.
      d. Owens Corning Deck Defense.
      e. Tamko Building Products, Inc. Synthetic Guard.
   2. Fasteners: Plastic washer fasteners supplied by underlayment manufacturer.

2.4 VENTS

A. Ridge and Hip Vents: Polypropylene or other UV-resistant plastic units designed to receive to receive cap shingles.
   1. Width: Nominal 12 inches.
   2. Free Area: 12 sq inches minimum per lineal foot.
   3. Venting: Openings that do not permit direct water or weather entry and insect screening.
   4. Starter and End Caps: As appropriate for Project applications.

2.5 INSTALLATION ACCESSORIES

A. Roofing Nails: ASTM F1667; standard round wire galvanized steel roofing nails, 0.105 inch minimum diameter shank, 0.375 inch minimum diameter head; of sufficient length to penetrate through roof sheathing.

B. Plastic Cement: ASTM D4586 Type II, with mineral fiber components, free of toxic solvents, capable of setting within 24 hours at temperatures of 75 degrees F and 50 percent RH.

C. Bituminous Paint: Acid and alkali resistant type; black color.

2.6 PERFORMANCE

A. Design Wind Speed Criteria: See Structural Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify roof penetrations and plumbing stacks are in place and flashed to deck surface.

B. Verify roof openings are correctly framed.

C. Verify deck surfaces are dry, free of ridges, warps, or voids.

3.2 PREPARATION

A. Fill knot holes and surface cracks with latex filler at areas of bonded ice dam membrane.

B. Cover knot holes with sheet metal.

C. Broom clean deck surfaces under ice dam membrane and underlayment.

3.3 INSTALLATION - GENERAL

A. Follow NRCA Roofing Manual and SMACNA Architectural Sheet Metal Manual.

3.4 INSTALLATION - METAL FLASHING

A. Weather lap joints 2 inches minimum, seal watertight with plastic cement, and nail flanges 12 inches maximum on center.

B. Fasten eave edge and gable edge metal flashings tight to fascia boards.

C. Place other flashings in full contact with vertical surfaces. Nail to deck in weather lap area for concealment.

D. Apply plastic cement to edges and fastener heads.

3.5 INSTALLATION - ICE DAM MEMBRANE

A. Install ice dam membrane parallel with eave edge, flush with face of eave edge flashing with edges lapped shingle style and ends lapped and staggered between rows.

B. Starting from lower edge of starter strip, lay additional 36 inch wide strips of ice dam membrane in lap cement, to produce two ply membrane. Weather lap plies minimum 18 inches

and nail in place. Lap ends minimum 6 inches. Stagger end joints of each consecutive ply.

C. Extend ice dam membrane 4 feet minimum upslope beyond interior face of exterior wall.

D. Valleys: Install ice dam membrane in valleys 18 inches minimum to each side.

E. Penetrations: Extend ice dam membrane 18 inches beyond penetrating element and 4 inches up vertical surfaces.

3.6 INSTALLATION - UNDERLAYMENT

A. Place one ply of underlayment over substrate not covered by ice dam membrane, with edges weather lapped 2 inches and end lapped 4 inches.

B. Stagger end laps of each consecutive layer. Weather lap ice dam membrane 4 inches minimum.

C. Nail underlayment in place.

3.7 INSTALLATION - SHINGLES

A. Place shingles in straight coursing pattern with manufacturer recommended weather exposure to produce double thickness over full roof area. Install double course of shingles at eaves.

B. Project first course of shingles 3/4 inch beyond fascia boards.

C. Extend shingles 1/2 inch beyond face of gable fascia boards.

D. Ridge Vents: Install centered over ridges. Coordinate required ridge opening with Section 076200 for required free area vent to shingles.

E. Cap hips and ridges with individual shingles, maintaining uniform weather exposure. Place to avoid exposed nails.

F. Coordinate installation of roof mounted components or items projecting through roof with weathertight placement of counterflashing.

3.8 CLEANING

A. Clean completed roofing to remove waste and staining materials.

B. Collect and discard loose roofing materials from adjacent surfaces.

END OF SECTION

SECTION 074243

COMPOSITE WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. Work Results:

B. Principal Products:

C. Exterior, panelized fiber cement cladding system and accessories to complete a drained and back-ventilated rainscreen.

D. Interior fiber cement panelized cladding system and accessories.

1.2 RELATED SECTIONS

A. Section 054100 - Structural Metal Stud Framing.

B. Section 061000 - Rough Carpentry.

C. Section 061600 - Sheathing.

D. Section 072000 - Thermal Protection.

E. Section 072500 - Weather Barriers.

F. Section 076000 - Flashing and Sheet Metal.

G. Section 079000 - Joint Protection.

1.3 REFERENCES

A. American Architectural Manufacturers Association (AAMA):
   1. AAMA 509 - Voluntary Test and Classification Method of Drained and Back Ventilated Rain Screen Wall Cladding Systems.

B. ASTM International (ASTM):
   1. ASTM C518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.
   2. ASTM C1186 - Standard Specification for Flat Fiber-Cement Sheets.
      a. ASTM C1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber Cement.

3. ASTM E84 - Standard Test for Surface Burning Characteristics of Building Materials.
4. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
5. ASTM E228 - Standard Test Method for Linear Thermal Expansion of Solid Materials with a Vitreous Silica Dilatometer.
6. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.
7. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference.

C. Florida Building Code - Test Protocol HVHZ.
1. Testing Application Standard (TAS) 202, 203 - HVHZ Test Procedures.

D. National Fire Protection Association (NFPA):
1. NFPA 285 - Fire Test Method for Exterior Wall Assemblies Containing Combustible Material.
2. NFPA 268 - Ignition Resistance of Exterior Wall Assemblies.

E. Standards Council of Canada & Underwriters Laboratories Canada (ULC):
1. CAN/ULC S102 - Standard Method of Test for Surface Burning Characteristics.
2. CAN/ULC S134 - Standard Method of Fire Test of Exterior Wall Assembly.

1.4 SUBMITTALS

A. Submit under provisions of Section 01 33 00.

B. Product Data: Submit manufacturer’s product description, storage and handling requirements, and installation instructions.

C. Product Test Reports and Code Compliance: Documents demonstrating product compliance with local building code, such as test reports or Evaluation Reports from qualified, independent testing agencies.

D. Manufacturer’s Details: Submit drawings (.dwg,.rvt, and/or.pdf formats), including plans, sections, showing installation details that demonstrate product dimensions, edge/termination conditions/treatments, compression and control joints, corners, openings, and penetrations.

E. Samples: Submit samples of each product type proposed for use.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. All fiber cement panels specified in this section must be supplied by a manufacturer with a minimum of 10 years of experience in fabricating and supplying fiber cement cladding systems.
2. Provide technical and design support as needed regarding installation requirements and warranty compliance provisions.

B. Installer Qualifications: All products listed in this section are to be installed by a single installer trained by manufacturer or representative.

C. Mock-Up Wall: Provide a mock-up wall as evaluation tool for product and installation workmanship.

D. Pre-Installation Meetings: Prior to beginning installation, conduct conference to verify and discuss substrate conditions, manufacturer's installation instructions and warranty requirements, and project requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Panels must be stored flat and kept dry before installation. A waterproof cover over panels and accessories should be used at all times prior to installation. Do not stack pallets more than two high. Refer to the information included on each pallet.

B. If panels are exposed to water or water vapor prior to installation, allow to completely dry before installing. Failure to do so may result in panel shrinkage at ship lap joints, and such action may void warranty.

C. Panels MUST be carried on edge. Do not carry or lift panels flat. Improper handling may cause cracking or panel damage.

D. Direct contact between the panels and the ground should be avoided at all times. It is necessary to keep panels clean during installation process.

1.7 WARRANTY

A. Provide manufacturer's 15-year warranty against manufactured defects in fiber cement panels. Additional 5-year extension available when refinished in year 14-15.

B. Provide manufacturer's 15-year warranty against manufactured defects in panel finish.

C. Warranty provides for the original purchaser. See warranty for detailed information on terms, conditions and limitations.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:
   1. Nichiha USA, Inc., 3150 Avondale Mill Rd, Macon, GA 301216, USA.
   2. Nichiha Corporation, 18-19 Nishiki 2-chome Naka-ku, Nagoya, Aichi 460-8610, Japan.

B. B. Acceptable Manufacturer's Representative: Nichiha USA, Inc., 6465 E. Johns Crossing, Suite 250, Johns Creek, GA 30097. Toll free: 1.866.424.4421, Office: 770.805.9466, Fax: 770.805.9467, www.nichiha.com.
   1. Basis of Design Product: Nichiha Latura V-Groove.
      a. Profile colors: Designer-specified custom color (finished in US).
      b. Profiles:
         1) AWP-1818 Panel: Smooth, with three, 3/8" grooves running lengthwise, spaced 5-5/8" apart.
         2) AWP-3030 Panel: Smooth, with three, 3/8" grooves running lengthwise, spaced 5-5/8" apart. Wider, soft-U chamfered edge at horizontal joints.
            a) Do not pair the different sizes directly together.
      c. Accessory/Component Options:
         1) Manufactured Corners with 3-1/2" returns for each profile size and color.
            a) Do not use AWP-1818 Corners with AWP-3030 Panels.
         2) Aluminum trim options: Corner Key, Open Outside Corner, H-Mold, J-Mold, Compression Joint, Inside Corner.
            a) Finish: Custom Color, Clear Anodized, Primed, or Stock White and Gray.
         3) Essential Flashing System: Starter, Overhang.
            a) Finish: Matte black.
      d. d. Dimensions:
         1) AWP-1818: 455mm (17-7/8") (h) x 1,818 mm (71-9/16") (l).
         2) AWP-3030: 455mm (17-7/8") (h) x 3,030 mm (119-5/16") (l).
      e. e. Panel Thickness: 16 mm (5/8").
         1) Weight: AWP-1818: 35.27 lbs. per panel, AWP-3030: 57.32 lbs. per panel.
         2) Coverage: 8.88 sq. ft. per panel (1818), 14.81 sq. ft. per panel (3030).
         3) Factory sealed on six 6 sides.

C. Substitutions: Not permitted.

D. Requests for substitutions will be considered in accordance with provisions of Section 01 25 00.

2.2 MATERIALS

A. Fiber cement panels manufactured from a pressed, stamped, and autoclaved mix of Portland cement, fly ash, silica, recycled rejects, and wood fiber bundles.

B. Panel surface pre-finished and machine applied.

C. AWP-1818 profiled along all four edges, such that both horizontal and vertical joints between the installed panels are ship-lapped.

D. Panels profiled along 3030mm edges so that the long joints between the installed panels are ship-lapped.

E. Factory-applied sealant gasket added to top panel edge; all 3030mm edge joints contain a factory sealant.

2.3 PERFORMANCE REQUIREMENTS:

A. Fiber Cement Cladding - Must comply with ASTM C1186, Type A, Grade II requirements:
   1. ASTM C1185 - Standard Test Methods for Sampling and Testing Non-Asbestos Fiber Cement:
      a. Wet Flexural Strength: Result: 1418 psi, Lower Limit: 1015 psi.
      b. Water Tightness: No water droplets observed on any specimen.
      c. Freeze-thaw: No damage or defects observed.
      d. Warm Water: No evidence of cracking, delamination, swelling, or other defects observed.
      e. Heat-Rain: No crazing, cracking, or other deleterious effects, surface or joint changes observed in any specimen.

B. Mean Coefficient of Linear Thermal Expansion (ASTM E228): Max 1.0*10^-5 in./in. F.

C. Surface Burning (CAN-ULC S102/ASTM E84): Flame Spread: 0, Smoke Developed: 0.

D. Wind Load (ASTM E330): Contact manufacturer for ultimate test pressure data corresponding to framing type, dimensions, fastener type, and attachment clips. Project engineer(s) must determine Zone 4 and 5 design pressures based on project specifics.
   1. Maximum lateral deflection: L/180.

E. Water Penetration (ASTM E331): No water leakage observed into wall cavity.

F. Steady-State Heat Flux and Thermal Transmission Properties Test (ASTM C518): 16mm thick panel thermal resistance R Value of 0.47.

G. Fire Resistant (ASTM E119): The wall assembly must successfully endure 60-minute fire exposure without developing excessive unexposed surface temperature or allowing flaming on the unexposed side of the assembly.

H. Ignition Resistance (NFPA 268): No sustained flaming of panels, assembly when subjected to a minimum radiant heat flux of 12.5 kW/m2 ± 5% in the presence of a pilot ignition source for a 20-minute period.

I. Fire Propagation (NFPA 285): Wall assembly of Nichiha AWP, Ultimate Clips and Starter Track, Tyvek Commercial Wrap, ½” Densglass Gold Sheathing, 16” o.c. 18 gauge steel studs, mineral wool in-cavity insulation, and interior 5/8” Type X gypsum met the acceptance criteria of NFPA 285.

J. Fire Propagation (CAN/ULC S-134): Wall assembly of Nichiha AWP, Ultimate Clips and Starter Track, Tyvek Housewrap, 5/8” FRT plywood, 16” o.c. 2x wood studs, fiberglass in-cavity insulation, and interior 5/8” Type X gypsum met the acceptance criteria of CAN/ULC S-134.

K. Drained and Back Ventilated Rainscreen (AAMA 509): System classifications: W1, V1.

L. Florida Building Code - Test Protocol HVHZ (TAS 202, 203): Horizontal Application Design Pressure: 95 psf, Vertical Application Design Pressure: 85 psf.

2.4 INSTALLATION COMPONENTS

A. Ultimate Clip System:
   1. Starter Track:
      a. Horizontal Panel Installations - FA 700 - 3,030mm (l) galvalume coated steel.
      b. Vertical Panel Installations (AWP-3030 only) - FA 710T - 3,030mm (l) galvalume coated steel.
   2. Panel Clips: JEL 778 “Ultimate Clip II” (10mm rainscreen for 16mm AWP) - Zinc-Aluminum-Magnesium alloy coated steel.
      a. Joint Tab Attachments (included) - used at all AWP-1818 panel to panel vertical joints, NOT used with AWP-3030 installations.
   3. Corner Clips: JE 777C (10mm rainscreen for 5/8” AWP Manufactured Corners) -- Zinc-Aluminum-Magnesium alloy coated steel.
   4. Single Flange Sealant Backer - FHK 1015 R (10mm) - 6.5’ (l) fluorine coated galvalume.
   5. Double Flange Sealant Backer - FH 1015 R (10mm) - 10’ (l) fluorine coated galvalume.
   6. Corrugated Spacer - FS 1005 (5mm), FS 1010 (10mm) - 4’ (l).

B. Aluminum Trim (optional): Paint primed trim as specified in finish schedule.

C. Essential Flashing System (optional):
   1. Starter - main segments (3,030mm), inside corners, outside corners.
   2. Overhang - main segments (3,030mm), inside corners, outside corners, joint clips.

D. Fasteners: Corrosion resistant fasteners, such as hot-dipped galvanized screws appropriate to local building codes and practices must be used. Use Stainless Steel fasteners in high humidity and high-moisture regions. Panel manufacturer is not liable for corrosion resistance of fasteners. Do not use aluminum fasteners, staples or fasteners that are not rated or designed for intended use. See manufacturer’s instructions for appropriate fasteners for construction method used.

E. Flashing: Flash all areas specified in manufacturer’s instructions. Do not use raw aluminum flashing. Flashing must be galvanized, anodized, or PVC coated.

F. Sealant: Sealant shall comply with ASTM C920, Class 35.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Fiber cement panels can be installed over braced wood, steel studs and sheathing including plywood, OSB, plastic foam (1” or less) or fiberboard sheathing. Fiber cement panels can also be installed over Structural Insulated Panels (SIP’s), Concrete Masonry Units (CMU’s) and Concrete Block Structures (CBS’s) with furring strips, and Pre-Engineered Metal Construction. Insulated Concrete Forms (ICFs) require added measures. Consult with Nichiha Technical Services.
   2. Allowable stud spacing: 16” o.c. maximum.
   3. A weather resistive barrier is required when installing fiber cement panels. Use an

approved weather resistive barrier (WRB) as defined by the IBC or IRC. Refer to local building codes.

4. Appropriate metal flashing should be used to prevent moisture penetration around all doors, windows, wall bottoms, material transitions and penetrations. Refer to local building codes for best practices.

B. Examine site to ensure substrate conditions are within alignment tolerances for proper installation.

C. Do not begin installation until unacceptable conditions have been corrected.

D. Do not install panels or components that appear to be damaged or defective. Do not install wet panels.

3.2 TOLERANCE

A. Wall surface plane must be plumb and level within +/- ¼ inch in 20 feet in any direction.
   1. One layer of Nichiha 5mm (~3/16”) Spacer may be used as shim.

3.3 INSTALLATION

A. General: Install products in accordance with the latest installation guidelines of the manufacturer and all applicable building codes and other laws, rules, regulations and ordinances. Review all manufacturer installation, maintenance instructions, and other applicable documents before installation.
   1. Consult with your local dealer or Nichiha Technical Department before installing any Nichiha fiber cement product on a building higher than 45 feet or three stories or for conditions not matching prescribed standard installation guide requirements and methods. A Technical Design Review (TDR) process is available to evaluate project feasibility.
   2. Vertical Control/Expansion Joints are required with AWP-1818, for walls wider than 30 feet, within 2-12 feet of outside corners finished with metal trim and approximately every 30 feet thereafter.
      a. Vertical Control/Expansion Joints are required at each AWP-3030 vertical joint, or H-Mold trim may be used instead.
   3. Horizontal/Compression Joints are required for multi-story installations of AWP. Locate joints at floor lines. Joints are flashed minimum ½” breaks. Do not caulk. Refer to installation guide(s).
      a. Wood framed buildings of three or more floors require a compression joint at each floor.
      b. Steel framed buildings (including reinforced concrete core with LGMF exterior walls) of more than three floors (or 45 feet) require a compression joint every 25 feet at a floor line.

B. Panel Cutting.
   1. Always cut fiber cement panels outside or in a well ventilated area. Do not cut the products in an enclosed area.
   2. Always wear safety glasses and NIOSH/OSHA approved respirator whenever cutting, drilling, sawing, sanding or abrading the products. Refer to manufacturer SDS for more

information.

3. Use a dust-reducing circular saw with a diamond-tipped or carbide-tipped blade.
    a. Recommended circular saw: Makita 7-1/4” Circular Saw with Dust Collector (#5057KB).
    b. Recommended blade: Tenryu Board-Pro Plus PCD Blade (#BP-18505).
    c. Shears (electric or pneumatic) or jig saw can be used for complicated cuttings, such as service openings, curves, radii and scrollwork.
4. Silica Dust Warning: Fiber cement products may contain some amounts of crystalline silica, a naturally occurring, potentially hazardous mineral when airborne in dust form. Consult product SDS or visit https://www.osha.gov/dsg/topics/silicacrystalline/.
5. Immediately clean dust from cut panels as it may bind to the finish.

3.4 CLEANING AND MAINTENANCE

A. Review manufacturer guidelines for detailed care instructions.

END OF SECTION

SECTION 075200

MODIFIED BITUMINOUS MEMBRANE ROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. SBS-modified bituminous membrane roofing system.
2. Substrate boards.
3. Vapor retarder.
4. Roof insulation.
5. Cover boards.

D. Related Requirements:
1. Section 077100: Manufactured metal copings and roof edges included in roofing warranty.

1.2 REFERENCES

A. Definitions:
1. Roofing Terminology: See ASTM D1079 and NRCA Roofing and Waterproofing Manual glossary.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting Attendees and Procedures:
1. Conduct meeting one month minimum before starting Work of this Section.
2. Additional Attendees:
a. Testing agency representative.
b. Installer of substrate deck.
3. Agenda Items:
a. Preparation procedures.
b. Installation procedures.
c. Coordination and scheduling required with related Work.
d. Protection of construction and site.

1.4 ACTION SUBMITTALS

A. System Submittal: FM Approvals RoofNav listing.

B. Product Data:
   1. Roofing membrane and accessory products.
   2. Substrate boards.
   3. Vapor retarders.
   4. Roof insulation and cover board.
   5. Initial selection color Samples.

C. Shop Drawings: Include plans, elevations, sections, details, intersections with adjacent assemblies, terminations, and attachments, including:
   1. Base flashings.
   2. Membrane terminations.
   3. Flat and tapered insulation, including cants and slopes.
   4. Mechanically Fastened Insulation: Provide roof plan. Show orientation of roof deck, insulation, fastening patterns, and spacing.

D. Samples:
   1. Cap Sheet: 6 by 6 inch sample of each type and color.

1.5 INFORMATIONAL SUBMITTALS

A. Certificates: Manufacturer affidavit that Project design and conditions have been reviewed and that the installation will be fully warrantable if correctly installed. This submittal may be in the form of a photocopy of manufacturer authorization to Installer to proceed with installation.

B. Test and Evaluation Reports: Manufacturer test results showing:
   1. Certification that products meet or exceed specified requirements.

C. Field Quality Control Submittals: Field inspection reports.

D. Manufacturer Reports: Field inspection reports.

E. Qualification Statements:
   1. Installer: Manufacturer authorization.

1.6 CLOSEOUT SUBMITTALS

A. Maintenance Data: Roof system maintenance requirements.

B. Warranty Documentation: For complete roof system.

C. Project Plaque: Provide permanent sign or framed document with the following information attached to wall near primary access to main roof.
   1. Roofing installer name, address, and telephone number.
   2. Roofing system manufacturer name, address, and telephone number.

3. Starting date of warranty and length of warranty period.

1.7 QUALITY ASSURANCE

A. Qualifications:
   1. Manufacturers: UL listed for roofing system.
   2. Installer: Licensed, authorized, or approved by roofing manufacturer to install manufacturer roofing system and provide full specified warranty.
   3. Infrared Roof Moisture Survey Technician: NDT test technician certified to Level 2 minimum in thermal/infrared test method per American Society for Nondestructive Testing Recommended Practice SNT-TC-1A.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements: Store roofing system components protected from the elements, precipitation and standing water, freeze/thaw cycling, and protected from sunlight, if required.

1.9 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations:
   1. Temperature: 45 degrees F, minimum, and rising.
   2. Precipitation: None occurring and none predicted within 8 hours.

B. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.10 WARRANTY

A. Manufacturer Warranty: Warrant roofing system against failure.
   1. Total System Warranty: Include primary roof membrane and substrate boards, vapor retarder, roof insulation, cover boards, flashings, and metal edge assemblies, and other components of roofing system.
      a. Warranty Period: 20 years.
      b. Dollar Limit: None.

PART 2 PRODUCTS

2.1 SBS-MODIFIED BITUMINOUS MEMBRANE ROOFING SYSTEM

A. General: Provide components of roofing system recommended by manufacturer for a complete system.
   1. Component materials are compatible with each other and adjacent materials.

B. Cold Applied SBS Modified Bituminous Membrane Roofing, Roof Type 2: Multi component roofing system consisting of base sheet, intermediate sheet, and granule surfaced cap sheet.
   1. Environmental Performance:
      a. Three Year Aged Solar Reflectance Index: ASTM E1980; 64, minimum.
   2. Color: Architect selected.

C. Base Sheet: ASTM D6164, Type I, Grade S, styrene-butadiene-styrene modified bituminous sheet, non-woven fiberglass-reinforced polyester mat reinforced, smooth surfaced.
   1. Manufacturers and Products:
      a. Basis of Design: GAF RUBEROID MOP Smooth.
      b. CertaintTeed Flintlastic Premium FR-P.
      c. Elevate SBS Poly Base.
      d. Johns Manville Dynalastic 180 S.
      e. Polyglass Elastoflex S6 or V 2.2.
      f. Sika SikaShield E54 SF.
      g. Siplast Paratech 180 Base.
      h. Soprema Sopralene 180 SANDED.
      i. Tremco POWERply Heavy Duty Base Sheet.

D. Interply Sheet: Same as base sheet.

E. Cap Sheet: ASTM D6164, Type II, Grade G, styrene-butadiene-styrene modified bituminous sheet, fire-retardant, polyester mat reinforced, granule surfaced.
   1. Manufacturers and Products:
      a. Basis of Design: GAF RUBEROID EnergyCap HW Plus Granule FR.
      b. CertaintTeed Flintlastic Premium FR-P.
      c. Elevate SBS Premium.
      d. Johns Manville DynaLastic 250.
      e. Polyglass Elastoflex S6 G HP FR.
      f. Soprema SOPRALENE Flam 250 FR GR.
      g. Tremco POWERply Endure 200.

F. Flashing Sheet: Same material as cap sheet.

G. Liquid-Applied Flashing: Thixotropic, flexible, acrylic, PMMA based resin applied with fleece fabric to form a monolithic, reinforced flashing membrane.
   1. Manufacturers and Products:
      a. GAF PMMA Flashing Resin.
      b. Henry Pumadeq.
      c. Sika Liquid Flashing SW or WW.
      d. Tremco Alphaguard PUMA.

H. Cold Application Adhesive: ASTM D3019, Type III.

I. Concrete Primer: Roofing system manufacturer recommended product.

J. Termination Bars: Manufacturer standard stainless steel, pre-drilled for included anchors.

K. Fasteners: Compliant with FM Global 4470 for corrosion resistance, including metal or plastic

washers, roof system manufacturer accepted.

L. Insulation Cant Strips: ASTM C208, Type II, Grade 1, cellulosic fiber insulation board.

2.2 SUBSTRATE BOARDS

A. Substrate Boards: ASTM C1177, gypsum core, glass-mat facing, water resistant.
   1. Manufacturers and Products:
      a. Georgia-Pacific DensDeck.
      b. National Gypsum Gold Bond Dexcell Glass Mat Roof Board.
      c. USG Securock Gypsum-Fiber Roof Board.
   2. Thickness: 5/8 inch, Type X.

B. Substrate Boards: ASTM C1278, cellulosic fiber, water resistant gypsum.
   1. Manufacturers and Products:
      a. USG Securock Gypsum-Fiber Roof Board.
   2. Thickness: 5/8 inch.

C. Fasteners: FM Global 4470 compliant for corrosion resistance, including metal or plastic washers.

2.3 VAPOR RETARDER

A. Self-Adhering Sheet Vapor Retarder: ASTM D1970, tri-laminated woven polyethylene facer combined with an advanced, high-tack adhesive.
   1. Basis of Design: GAF SA Vapor Retarder XL.
   2. Thickness: Minimum 30 mils.
   3. Permeance: 0.03 perm. max, ASTM E96.
   4. Manufacturer may recommend priming with manufacturer standard primer.

2.4 ROOF INSULATION

A. General: Roof insulation, preformed boards, manufactured or approved by roof system manufacturer, manufacturer standard sizes, thicknesses shown on Drawings.

B. Polyisocyanurate Board Insulation: ASTM C1289, Type II Class 2 Grade 3.
   1. Manufacturers and Products:
      a. GAF.
      b. Atlas Roofing.
      c. Carlisle.
      d. Elevate.
      e. Hunter Panels.
      f. Insulfoam.
      g. Johns Manville.
      h. Polyglass Polytherm-25.
      i. Rmax.

j. Sika.

2. Thickness: 2.7 inches maximum per layer.

C. Composite Polyisocyanurate Board Insulation: ASTM C1289.
1. Facing Layers:
a. One side glass fiber mat or felt.
b. Strong Side:
1) Cellulosic fiber, Type IV, Grade 4, 1/2 inch thick.
2) Glass mat faced gypsum board, Type VII, 1/4 inch thick.

D. Special Shapes: Provide preformed insulation shapes to form crickets, saddles, tapers, and other shapes to facilitate drainage.

E. Fasteners: FM Global 4470 compliant for corrosion resistance, including metal or plastic washers.

2.5 COVER BOARDS

A. Water Resistant Glass Mat Faced Gypsum: ASTM C1177, 1/2 inch thick.
1. Manufacturers and Products:
a. Georgia-Pacific DensDeck Prime with Eonic Technology.
b. National Gypsum DEXcell FA Glass Mat Roof Board.
c. USG Securock UltraLight Coated Glass-Mat Roof Board.

B. Polyisocyanurate Cover Board: ASTM C1289 Type II, Class 4, Grade 2, 1/2 inch thick.
1. Manufacturers and Products:
a. GAF EnergyGuard NH HD.
b. Atlas Roofing ACFoam-HD.
c. Elevate ISOGARD HD.
d. Johns Manville ENRGY 3.
e. Rmax Ultra-Max HD.
f. Soprema SOPRA-ISO HD.

2.6 PERFORMANCE

A. Accelerated Weathering: ASTM G152, ASTM G154 or ASTM G155; withstand 2,000 hours of testing.

B. Impact Resistance: ASTM D3746 or ASTM D4272.

C. Exterior Fire Test Exposure: ASTM E108 or UL 790 testing by a qualified testing agency, Class A, products marked as compliant by testing agency.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine and verify conditions for compliance with roof system manufacturer recommendations:
   1. Substrates.
   2. Roof openings and penetrations.
   3. Curbs, nailers, and cants.

3.2 PREPARATION

A. Clean and prepare substrate.

B. Protect roof drainage and other equipment and surfaces from roofing materials.

C. Acoustical Deck Insulation: Install insulation strips in roof deck ribs per deck manufacturer instructions.

3.3 ROOFING INSTALLATION - GENERAL

A. Complete terminations, flashings, roofing installation, and temporary measures by end of each workday and during rain events.

B. Tie-in to Existing Roof Systems: Use only compatible materials, maintaining weathertight condition and existing warranties.

3.4 INSTALLATION OF SUBSTRATE BOARDS

A. Install substrate boards with long sides perpendicular to roof slopes in straight lines, stagger end joints. Install with tight butt joints.
   1. Fasten substrate boards to top flanges of steel deck per roofing system manufacturer instructions.
   2. Fasten substrate boards to steel deck flanges per FM Global RoofNav and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.

3.5 INSTALLATION OF VAPOR RETARDER

A. Self-Adhering Sheet Vapor Retarder: Prime substrate. Install self-adhering sheet vapor retarder in place; lap side seams minimum 3-1/2 inches and ends minimum 6 inches. Seal laps by rolling.

B. Install vapor retarder to provide complete seal against air movement at penetrations and terminations.

3.6 INSTALLATION OF INSULATION

A. Do not allow insulation to be exposed to precipitation or left exposed at the end of the workday.

B. Install insulation to required thickness. Where overall insulation thickness is 2.7 inches or greater, install in layers with staggered joints from joints of previous layer. Stagger joints a minimum of 6 inches in each direction.

C. Install insulation with long sides in straight rows with end joints staggered between rows, butt joints at edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.
   1. Fit insulation by trimming, within 1/4 inch of nailers, obstructions, and penetrations.
   2. Trim and fit insulation at roof drains.

D. Mechanically Fastened Insulation: Install each layer of insulation and secure to deck using mechanical fasteners specifically designed and sized for fastening specified board type roof insulation to deck type.
   1. Fasten insulation per FM Global RoofNav for specified Windstorm Resistance Classification.
   2. Fasten insulation to resist uplift pressure at corners, perimeter, and field of roof.

3.7 INSTALLATION OF COVER BOARD

A. Install cover boards over insulation with long sides in straight lines and end joints staggered between rows. Offset joints from insulation layer below a minimum of 6 inches in each direction. Loosely butt cover boards together and fasten to roof deck.
   1. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.8 INSTALLATION OF MEMBRANE

A. Unroll and relax SBS sheets for approximately 30 minutes prior to installation.

B. Start installation of roofing in presence of roofing system manufacturer technical personnel.

C. Align roofing to an accurate layout, maintaining side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Prime substrate; apply membrane smooth, free from air pockets, wrinkles, or tears. Ensure full bond of membrane to substrate.

E. Extend membrane up cant strips and 8 inches minimum onto vertical surfaces and secure in roof edge metal.

F. Seal roofing membrane to wall construction air barrier.

G. Mop and seal membrane around roof protrusions and penetrations.

H. Provide waterproof cut-off to membrane at end of operation each day. Remove cut-off before

resuming roofing.

3.9 INSTALLATION OF BASE SHEET FLASHING

A. Adhere flashings and flashing accessories to substrates.

B. Apply adhesive to substrate and underside of sheet flashing, and allow to partially dry. Do not apply to seam area of flashing.

C. Flash penetrations and field-formed inside and outside corners per roofing manufacturer recommendations.

D. Clean splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets per manufacturer requirements. Seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate using termination bars.

3.10 APPLICATION OF LIQUID FLASHING

A. Mixing: Mix resins. Catalyze only the amount of material that can be used within its pot life.

B. Priming: Apply primer to prepared substrates.

C. Flashing Installation: Apply flashing. Apply membrane and fleece reinforcement fabric to the thickness required by manufacturer, using number of coats required.
   1. Extend resin onto vertical surfaces to height shown. Make exposed terminations straight and neat.

3.11 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to inspect and generate reports. Allow inspectors access to Work areas.
   1. Failed Test Retest Cost: Contractor responsibility.

B. Inspections may include the following:
   1. Substrate conditions.
   2. Substrate preparation.
   3. Vapor barrier application, if required.
   4. Membrane application.
   5. Flashings.
   6. Protection components.
   7. Penetrations and drainage components.

C. Infrared Roof Moisture Survey: ASTM C1153, ground-based, walk-over type.
   1. Electronically record the entire survey and report results.
   2. Report thermograms of suspect areas and corresponding daytime photos of the same

locations.

D. Final Roof Inspection: Arrange for roofing system manufacturer technical personnel or approved agency to inspect roofing installation on completion.
   1. After completing testing, repair leaks, then repeat tests.
   2. Continue to make further repairs until roofing and flashings are watertight.

E. Provide test and inspection reports.

3.12 PROTECTION AND CLEANING

A. Protect membrane roofing system from damage and wear during remainder of construction period. Upon completion of the Work, inspect roofing for deterioration and damage, describing same in a written report, and provide copies to Architect and Owner.

B. Correct deficiencies in membrane roofing system by repairing or replacing components or the entire roofing membrane system as required, to an undamaged condition at the time of Substantial Completion and per warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 075323

ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. EPDM thermoset single-ply roofing.
2. Membrane flashings.
3. Metal flashings.
4. Roof insulation.
5. Walkway Pads.

1.2 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. ASTM C 1289 - Standard Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
2. ASTM D 4637 - Standard Specification for EPDM Sheet Used In Single-Ply Roof **

C. International Code Council (ICC):
1. International Building Code (IBC).

D. National Roofing Contractors Association (NRCA) - Low Slope Roofing and Waterproofing Manual, Current Edition.

1.3 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. Roof System is designed to achieve 90-psf of uplift testing.

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.

1.4 SUBMITTALS

A. Submit under provisions of Section 01.

B. Qualification Data: For qualified Installer.
   1. Approved Installer Letter: Signed by the roofing manufacturer certifying the installer is approved by manufacturer to install their product.

C. Manufacturer Certificate: Signed by roofing manufacturer certifying that membrane roofing system complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of complying with performance requirements.

D. 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.

E. 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.

F. Selection Samples: For each finish product specified, two complete sets of chips representing manufacturer's full range of available colors, membranes, and thicknesses.

G. Closeout Submittals.
   1. Maintenance Data: For membrane roofing system to include in maintenance manuals.
   2. Warranties: Sample of special warranties.

1.5 PREINSTALLATION MEETINGS

A. Preinstallation Roofing Conference: Conduct conference at Project site.
   1. Meet with Owner, Architect, Owner's insurer if applicable, testing and inspecting agency representative, roofing Installer, roofing system manufacturer's representative, deck Installer, and installers whose work interfaces with or affects roofing, including installers

of roof accessories and roof-mounted equipment.
2. Review methods and procedures related to roofing installation, including manufacturer's written instructions.
3. Review and finalize construction schedule and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
4. Examine deck substrate conditions and finishes for compliance with requirements, including flatness and fastening.
5. Review structural loading limitations of roof deck during and after roofing.
6. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.
7. Review governing regulations and requirements for insurance and certificates if applicable.
8. Review temporary protection requirements for roofing system during and after installation.
9. Review roof observation and repair procedures after roofing installation.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: All products specified in this section will be supplied by a single manufacturer with a minimum of twenty (20) 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 must be capable of extending the Manufacturer's Labor and Materials guarantee.
3. Installer must be capable of extending the Manufacturer's No Dollar Limit guarantee.

1.7 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.

1.8 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 Carlisle's Roofing System specification, Part II - Application, 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. 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.

E. When loading materials onto the roof, the Carlisle Authorized Roofing Applicator must comply with the requirements of the building owner to prevent overloading and possible disturbance to the building structure.

F. Proceed with roofing work only when weather conditions are in compliance with the manufacturer's recommended limitations, and when conditions will permit the work to proceed in accordance with the manufacturer's requirements and recommendations.

G. 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.

H. Provide protection, such as 3/4 inch thick plywood, for all roof areas exposed to traffic during construction. Plywood must be smooth and free of fasteners and splinters.

I. 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.

J. New roofing shall be complete and weathertight at the end of the work day.

K. Contaminants such as grease, fats and oils shall not be allowed to come in direct contact with the roofing membrane.

1.9 WARRANTY

A. At project closeout, provide to Owner or Owners Representative an executed copy of the manufacturer's Total-System warranty, outlining its terms, conditions, and exclusions from coverage.
   1. Warranty: 30yr | 72mph Total System Warranty.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Carlisle SynTec Systems.
   2. Elevate.
   3. Johns Manville.

B. Requests for substitutions will be considered in accordance with provisions of Section 01.

2.2 SCOPE / APPLICATION

A. Roof System: Provide a waterproof roof system, capable of withstanding uplift forces as specified in Design Criteria.

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.

D. Insulation: Provide 1.5” Secure Shield HD Composite mechanically attached through the existing membrane and metal deck.

2.3 MEMBRANE BASE SHEET/VAPOR BARRIER

A. VapAir Seal MD Air/Vapor Barrier: reinforced composite aluminum foil with self-adhesive SBS backing and removable poly release film. Used for direct application over metal decks.

2.4 INSULATION

A. Polyisocyanurate InsulBase: Carlisle InsulBase. Rigid board with glass fiber reinforced facers (GRF) on both sides, meeting or exceeding the requirements of ASTM C 1289, Type II, Class 1.
   1. Compressive Strength: Grade 3 (25 psi) (138 kPa).

B. Composite Board: Composite insulation panel comprised of 1/2 inch (13 mm) high-density Polyiso cover board laminated during the manufacturing process to SecurShield rigid Polyiso roof insulation meeting ASTM C1289. Carlisle SecurShield HD Composite.
   1. Top Layer: ASTM C1289 Type II, Class 4, Grade 1.
   2. Compressive Strength: 80 psi min. (751 kPa).
   3. Board Thickness: 1/2 inch (13 mm).
   4. Bottom Layer: ASTM C1289 Type II, Class 2.
   5. Compressive Strength: Grade 2 (20 psi) (138 kPa).

2.5 COVERBOARD

A. Moisture-, mold- and impact-resistant, nonstructural fiber-reinforced gypsum panel made from 95 percent recycled materials. Securock, distributed by Carlisle.
   1. Board Thickness: 1/2 inch (13 mm).

2.6 INSULATION ADHESIVE

A. Flexible FAST 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.

2.7 ETHYLENE, PROPYLENE, DIENE TERPOLYMER (EPDM) MEMBRANE

A. Sure-Seal 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. Membrane Thickness: 90 mil nominal.
   4. Performance:
      a. Tensile Strength: 1550 psi (10.7 MPa) minimum.
      b. Tear Resistance: 200 lbf/in (35 kN/m) minimum.
      c. Elongation: 480 percent.

2.8 FLASHING ACCESSORIES

A. Sure-Seal (black) Pressure-Sensitive Pipe Seals with Factory-Applied TAPE on the deck flange are available for use with Sure-Seal Roofing systems.

B. Sure-Seal Pressure-Sensitive Pourable Sealer Pocket: Pre-fabricated Pourable Sealer Pocket consisting of a 2 inch (51 mm) wide plastic support strip with Pressure-Sensitive, Factory-Applied, adhesive backed uncured Elastoform Flashing.

C. Sure-Seal Pressure-Sensitive (PS) Inside/Outside Corner: A 7 inch by 9 inch precut 60-mil thick Elastoform Flashing with a 30-mil Factory-Applied TAPE.

D. Sure-Seal Pressure-Sensitive Overlayment Strip: A nominal 40-mil black, semi-cured EPDM membrane laminated to a nominal 35-mil cured, Factory-Applied TAPE for flashing gravel stops, metal edgings and Seam Fastening Plates.

E. Sure-Seal Pressure-Sensitive Cured Cover Strip: Sure-Seal 60-mil cured EPDM membrane laminated to a nominal 35-mil cured Factory-Applied TAPE.

F. Sure-Seal Pressure-Sensitive "T" Joint Covers: A factory cut uncured 60-mil thick EPDM flashing laminated to a nominal 35-mil Factory-Applied TAPE, used to overlay field splice intersections and to cover field splices at angle changes. Available in 6 inch by 6 inch and 12 inch by 12 inch for Sure-Seal applications, and 6 inch by 6 inch for Sure-White applications.

G. Sure-Seal Pressure-Sensitive Elastoform Flashing: 60-mil thick uncured EPDM Flashing laminated to a 30-mil Factory-Applied Pressure-Sensitive TAPE used in conjunction with Sure-Seal Primer.

H. Sure-Seal Pressure-Sensitive RUSS (Reinforced Universal Securement Strip):
   1. 6 inch (152 mm) RUSS: A nominal 6 inch (152 mm) wide.

2.9 CLEANERS, PRIMERS, ADHESIVES AND SEALANTS

A. Carlisle Weathered Membrane Cleaner: Clear, solvent-based cleaner used to loosen and remove contaminants from the surface of exposed EPDM membrane prior to applying EPDM Primer.

B. Sure-Seal SecurTAPE: 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.

C. Low VOC EPDM and TPO Primer - A low VOC (volatile organic compound) primer (less than 250 grams/liter) for use with SecurTAPE or Pressure-Sensitive products.

D. Sure-Sealt: A high-strength, butyl-based contact cement which is used for splicing adjoining sections of EPDM membrane (cured or uncured).
   1. Sure-Seal Splicing Cement: Black splicing cement for use with Sure-Seal (black) Roofing Systems.

E. Sure-Seal Lap Sealant: A heavy-bodied material (trowel or gun-consistency) used to seal the exposed edges of a membrane splice.
   1. Sure-Seal Lap Sealant: Black sealant for use with Sure-Seal (black) Roofing Systems.

F. EPDM x-23 Low-VOC Bonding Adhesive: A Low-VOC (volatile organic compound) bonding adhesive (less than 250 grams/liter) used for bonding Sure-Seal/Sure-White EPDM membranes to various surfaces.

G. Low-VOC Bonding Adhesive: A Low-VOC (volatile organic compound) bonding adhesive (less than 250 grams/liter) used for bonding Sure-Seal/Sure-White EPDM membranes to various surfaces.

H. Flexible FAST Adhesive: A spray or extruded applied, two-component, polyurethane, low-rise expanding foam adhesive used to securely bond FleeceBACK membranes to a variety of substrates.

I. Water Cut-Off Mastic: A one-component, low viscosity, self wetting, Butyl blend mastic used as a compression sealing agent between EPDM membranes and applicable substrates.

J. Two-Part Pourable Sealer: A black, two-component, solvent-free, polyurethane based product used for tie-ins and as a sealant around hard-to-flash membrane penetrating objects such as clusters of pipes and for a daily seal when the completion of flashings and terminations cannot be completed by the end of each work day. Can also be used for attaching lightning rod bases and ground cable clips to the membrane surface.

K. Sure-Seal One-Part Pourable Sealer: A one-component, moisture curing, elastomeric polyether sealant used as a sealant around hard-to-flash penetrations such as clusters of pipes, and is

available in black.

L. CAV-GRIP III 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 FAST Adhesive, adhering Sure-Seal EPDM, horizontally, for the field of the roof, and for adhering Sure-Seal FleeceBACK and Sure-Seal EPDM membrane to vertical walls. Coverage rate is approximately 2,000-2,500 sq. ft. per 40 lb cylinder and 4,000-5,000 sq. ft. per 85 lb cylinder as a primer, in a single-sided application and 750 sq. ft. per 40 lb cylinder and 1,500 sq. ft. per 85 lb cylinder as an adhesive for vertical walls, in a double-sided application; 1,000 sq. ft. per 40 lb cylinder and 2,000 sq. ft. per 85 lb cylinder as an adhesive, horizontally, for the field of the roof, in a double-sided application.

2.10 FASTENING COMPONENTS

A. Sure-Seal Termination Bar: 1 inch (13 mm) wide,.098 inch (2.5 mm) thick extruded aluminum bar pre-punched 6 inches (152 mm) on center with sealant ledge to support Lap Sealant.

PART 3 EXECUTION

3.1 EXAMINATION

A. Do not begin installation until substrates have been properly prepared.

B. If substrate preparation is the responsibility of another installer, notify Architect of unsatisfactory preparation before proceeding.

3.2 FIELD QUALITY CONTROL

3.3 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 Carlisle VapAir Seal MD Air & Vapor Barrier) may be applied to protect the inside of the structure prior to the roof system installation.

3.4 INSULATION - SYSTEM DESIGN

A. Base Layer:
   1. Type: Insulbase.
   2. Thickness: 2.6”.
   3. Attachment Method: Loose Laid.

B. Top Layer:
   1. Type: InsulBase.
   2. Thickness: 2.6”.
   3. Attachment Method: Mechanically Fastened.

C. Tapered System:
   1. Type: InsulBase.
   2. Cricket Slope: ½” inch per foot.

D. Top Layer:
   1. Type: SecurShield HD Composite.
   2. Thickness: 1.8 inches.
   3. Attachment Method: Mechanically Fastened.

E. Tapered System:
   1. Type: Crickets.

3.5 INSULATION PLACEMENT

A. Install insulation or membrane underlayment in multiple layers 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.

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 must be at least 3 1/2 inches (89 mm) wide or 1 inch (25 mm) wider than adjacent metal flange. Thickness must 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.

3.6 INSULATION/COVERBOARD ATTACHMENT

A. ½" USG Securock Gypsum-Fiber Board set in Flexible Fast Adhesive.

B. Top Layer of 2.6" 25psi InsulBase mechanically fastened through steel deck.

C. Base layer of 2.6" 25psi Insulbase and ½" Tapered 25psi Insulbase Crickets loose laid over steel deck.

3.7 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.

3.8 MEMBRANE SPLICING (ADHESIVE SPLICE)

A. Fold the top sheet back and clean the dry splice area (minimum 3 inches wide) of both membrane sheets by scrubbing with clean natural fiber rags saturated with Splice Cleaner or HP-250 Primer. When using Sure-Seal (black) PRE-KLEENED membrane, cleaning the splice area is not required unless contaminated with field dirt or other residue.

B. Apply Splicing Cement in accordance with the manufacturer's current application guidelines, and roll the top sheet onto the mating surface.

C. Roll the splice with a 2 inch wide steel roller and wait at least 2 hours before applying Lap Sealant to the splice edge following the manufacturer's requirements.

D. Field splices without In-Seam Sealant must be overlaid with uncured flashing.

3.9 MEMBRANE SPLICING (TAPE SPLICE)

A. Overlap adjacent sheets and mark a line 1/2 inch out from the top sheet.

B. Fold the top sheet back and clean the dry splice area (minimum 2 1/2 inches (64 mm wide) of both membrane sheets with Sure-Seal Primer as required by the membrane manufacturer.

C. Where Splice Tape is not Factory-Applied, apply Splice 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 (13 mm).

D. Remove the release film and press the top sheet onto the tape using hand pressure.

E. Roll the seam toward the splice edge with a 2 inch (51 mm) wide steel roller.

F. Install Pressure-Sensitive "T" Joint Cover, a 6 inch wide (152 mm) section of Pressure-Sensitive Elastoform Flashing over all field splice intersections.

G. When using non-Pressure-Sensitive Elastoform Flashing or Elastoform 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.

3.10 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.

3.11 WALKWAYS

A. Install walkways at all traffic concentration points (such as roof hatches, access doors, rooftop ladders, etc.) and all locations as identified on the Contract Drawings.

B. Adhere walkways pads to the EPDM membrane in accordance with the manufacturer's current application guidelines.

3.12 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 must be performed to temporarily close the membrane to prevent water infiltration.

B. Use Sure-Seal Pourable Sealer or other acceptable membrane seal in accordance with the manufacturer's requirements.

3.13 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 must be disposed of in a legally acceptable manner.

B. Prior to the manufacturer's inspection for warranty, the applicator must perform a pre-inspection to review all work and to verify all flashing has been completed as well as the application of all caulking.

3.14 PROTECTION

A. Protect installed products until completion of project.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 076200

SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Sheet metal flashing and counterflashing.
   2. Roof drainage components, including scuppers, conductor heads, downspouts, and downspout boots.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordinate sheet metal flashing and roof accesssories with roof installtion.

B. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one month, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Coil-coated sheet metal.
   2. Initial selection color charts.

B. Shop Drawings.
   1. Show fabrication and profiles for each item.
   2. Show base metals, thicknesses, and finishes.
   3. Include attachment and connection details.
   4. Include details for corners, changes in plane, expansion joints, and terminations.
   5. Show locations of expansion joints.

C. Samples:
   1. Gutters, Downspouts, Copings, and Roof Edge Fascia Trim: 12 inch lengths in required finish.
   2. Coil-Coated Trim: 12 inch long sections in required finish.

1.4 INFORMATIONAL SUBMITTALS

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Coil-coated sheet metal.

B. Warranty Documentation: Coil-coated sheet metal finish, Roof edge warranty, and Coping warranty.

1.6 QUALITY ASSURANCE

A. Field Samples: Construct 4'-0" long, minimum size. Demonstrate texture, color, and pattern.
   1. Approved Samples establish work results standard.
   2. Remove Samples when Architect directs.

B. Mockups: Provide sheet metal fabrications for exterior wall mockup assemblies.
   1. Approved mockups establish work results standard.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Store sheet metal elevated above grade, protected from precipitation and stormwater runoff.
   2. Handle fabrications to prevent twisting, bending, and abrasion.
   3. Prevent contact with materials causing discoloration or staining.

1.8 WARRANTY

A. Include roof edges, coping, gutters, scuppers, and downspouts in warranty for roofing system specified in Section 075200, 075323, and 073113.

B. Finish Warranty: Repair deteriorated finishes or replace components.
   1. Deterioration includes the following:
      a. Color Fading: More than 5 Hunter units per ASTM D2244.
      b. Chalking: More than No. 8 rating per ASTM D4214.
      c. Paint cracking, peeling or checking.
   2. Warranty Period: Five years.

C. Installer Warranty:
   1. Roof drainage components: Warrant against installation failure.
      a. Failure includes damage by wind under stated wind design and thermal movement.
      b. Warranty Period: Two years.

PART 2 PRODUCTS

2.1 PERFORMANCE

A. Design Wind Load Criteria: See Structural Drawings.

B. Environmental Performance:
1. Expansion and Contraction: Withstand thermal cycling over 120 degrees F ambient and 180 degrees F on material surfaces.

2.2 MATERIALS

A. Galvanized Steel Sheet: ASTM A653; structural steel sheet, G90 zinc coating.
1. Finish: Three coat fluoropolymer.
2. Color: Architect selected ; standard ; non-metallic.

B. Aluminum Sheet: ASTM B209, alloy and temper required for use and finish.
1. Finish: Three coat fluoropolymer.
2. Coil-Coating Color: Architect selected ; standard ; non-metallic.

2.3 ACCESSORIES

A. Fasteners for Aluminum: Stainless steel, Type 304 , with soft neoprene washers where exposed.

B. Fasteners for Metals Other Than Aluminum: Same material and finish as item being fastened, with soft neoprene washers where exposed.

C. Solder: ASTM B32; type suitable for application and material being soldered.

D. Synthetic Underlayment: Manufactured roof underlayment sheets meeting ICC-ES AC188 acceptance criteria. Supply recommended fasteners.
1. Manufacturers and Products:
a. GCP Applied Technologies TRI-FLEX XT.
b. Owens Corning Duck Defense High Performance Roof Underlayment.
c. Tamko Building Products Synthetic Guard Plus.
d. Or approved equal.

E. Waterproof Underlayment: Self adhesive sheets manufactured to withstand high temperature below metal components; minimum 30 mils thick. Supply recommended primer.
1. Manufacturers and Products:
a. Carlisle Coatings & Waterproofing CCW WIP 300HT.
b. GCP Applied Technologies Ice and Water Shield HT.
c. Henry Company Blueskin PE200 HT.
d. Owens Corning WeatherLock Specialty Tile & Metal or Titanium PSU30 Synthetic Roofing Underlayment.
e. Polyguard Products Deck-Guard HT Roofing & Watershield Underlayment.

F. Slip Sheet: Rosin-sized building paper.

G. Concealed Sealant: Butyl, ASTM C1311.
   1. Manufacturers and Products:
      a. Pecora Corporation BA-98.
      b. Tremco Butyl Sealant.

H. Exposed Sealant: See Section 079200.

I. Separation Coating: Bituminous paint; SSPC-Paint 12.

J. Plastic Cement: ASTM D4586, Type I.

K. Surface-Applied Reglets: Extruded aluminum with bottom edge drip and top edge sealant recess. Supply with stainless steel screws with neoprene washers and anchorage devices appropriate to substrate.

L. Splash Pads: Precast concrete; minimum 3,000 psi compressive strength; minimum 5 percent air entrainment.

2.4 FABRICATION

A. Fabrication Reference Standards:
   1. SMACNA Architectural Sheet Metal Manual.
   2. NRCA Roofing Manual.

B. Form section shapes shown on Drawings, accurate in size, square, and free from distortion or defects.

C. Fabricate cleats of same material as sheet metal, interlocking with sheet.

D. Hem exposed edges on underside 1/2 inch; miter and seam corners.

E. Moving Joints: Sealed lapped, bayonet-type, or interlocking hooked seams.

F. Non Moving Joints: Soldered watertight.

G. Fabricate corners, changes in plane, and terminations in shop with minimum 18 inch legs.

H. Counterflashing:
   1. Material:
      a. Galvanized Steel; SMACNA recommended base metal thickness.
      b. Aluminum: SMACNA recommended base metal thickness.
   2. Fabricate to extend minimum 4 inches over protected construction, with hemmed bottom drip edge.
   3. Shop fabricate interior and exterior corners.

I. Downspouts:
   1. Material:

a. Aluminum: SMACNA recommended base metal thickness.
2. Profile: Rectangular.
3. Supports: Straps spaced maximum 5 feet on center, same metal as downspouts.

J. Conductor Heads: Fabricate with joints sealed watertight.
1. Material:
a. Aluminum: SMACNA recommended base metal thickness.

K. Parapet Scuppers: Two-piece fabrications, with mounting flanges. Lap pieces 4 inches minimum in direction of water flow.
1. Material:
a. Aluminum: SMACNA recommended base metal thickness.

L. Roof Drain Flashing:
1. Material:
a. Stainless Steel: SMACNA recommended minimum thickness.

M. Downspout boots:Contoured interior flow design with no boxed corners, weld seams or choke points; include integral lug slots and stainless steel fasteners, and clean-out.
1. Configuration: Offset/O-Series.
2. Material: Galvanized Cast iron; ASTM A48/A48.
3. Finish: Manufacturer's standard powder coat finish.
4. Color: To be selected by Architect from manufacturer's standard range.
5. Accessories:
a. Manufacturer's standard stainless steel fasteners for mounting onto building wall.
b. Flexible rubber adapter for connection to drainage pipe.
6. Manufacturers:
a. J.R. Hoe.
b. Jay R. Smith.
c. Zurn.

2.5 FINISHES

A. Aluminum Color Coating: Two coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color; AAMA 2605.

B. Steel Sheet Coil Coating: ASTM A755; Three coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color coat.
1. Pencil Hardness, ASTM D3363, HB - H.
2. Salt Spray Resistance, ASTM G85, 1,000 hours.
3. Humidity Resistance, ASTM D2247, 1,000 hours.
4. Dry Film Thickness: ASTM D1400, Paint system manufacturer recommended.
5. Color and Gloss: Architect selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that roof openings, penetrations, and curbs through roof are solidly set, reglets in place, and nailing strips located.

B. Verify that roofing base flashings are in place, sealed, and secure.

3.2 PREPARATION

A. Paint concealed uncoated metal surfaces with 15 mil minimum thickness separation coating.

3.3 INSTALLATION

A. Installation Reference Standards:
   1. SMACNA Architectural Sheet Metal Manual.
   2. NRCA Roofing Manual.

B. Install flashing with concealed fasteners.

C. Secure fabrications with concealed fasteners where possible.

D. Apply plastic cement between metal and bituminous materials.

E. Separate dissimilar metals with separation coating or non absorptive gaskets.

F. Underlayment:
   1. Synthetic: Install and adhered according to manufacturer instructions.
   2. Self-Adhered: Prime surfaces and install according to manufacturer instructions.

G. Slip Sheet: Apply on top of underlayment prior to installing sheet metal flashing work.

H. Counterflashing: Install counterflashing in contact with base flashing.
   1. Anchor counterflashing in reglets with wedges and apply sealant to joint per Section 079200.
   2. Drill counterflashing installed with surface mounted reglets so that anchorage fasteners go through the sheet metal. Apply sealant to back side of top edge and fasten reglet to wall construction. Apply sealant to top edge per Section 079200.
   3. Lap ends of counterflashing minimum 6 inches.

I. Install downspouts plumb; anchored maximum 5 feet on center and within 2 feet of elbows and ends.
   1. Connect downspouts to downspout boots and underground drain piping with watertight joints.
   2. Where downspouts discharge to roof surface provide splash pads.

J. Parapet Scuppers: Anchor securely in place and seal flanges watertight to wall face and to roof base flashing.

3.4 CLEANING

A. Remove soiling, stains, and hand prints.

B. Uncoated Galvanized Steel Sheet: Remove substances that would impair paint bond.

END OF SECTION

SECTION 077100

ROOF SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Manufactured roof edge systems.
   2. Manufactured roof expansion joints.

B. Related Requirements:
   1. Section 075323: EPDM Roofing.
   2. Section 077200: Roofing accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordinate work results of this Section with roofing and wall air and water barrier membrane for continuity of protection against water and air infiltration.

B. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting in conjunction with roofing preinstallation meeting.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Manufactured coping system; include factory-fabricated termination and transition shapes.
   2. Manufactured edge securement trim for low slope roofing; include factory fabricated termination and transition shapes.
   3. Manufactured gutter system.
   4. Manufactured roof expansion joint system; include factory fabricated termination and transition shapes.
   5. Initial selection color charts.

B. Shop Drawings: Show profiles and dimensions, joining methods, accessory item locations, anchorage and flashing details, and adjacent construction interfaces.

C. Samples: Specified metal and finish.
   1. Coping Covers: 12 inches long, minimum.
   2. Edge Securement Trim: 12 inches long, minimum.
   3. Gutters: 12 inches long, minimum.

4. Roof expansion joints: 12 inches long, minimum.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer or Independent testing agency test results showing wind uplift resistance as tested per ANSI/SPRI/FM 4435 ES-1.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

B. Warranty documentation.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. Coping and Roof Edge Manufacturers: Listed by UL, FM, or other agency acceptable to authority having jurisdiction to fabricate copings, roof edge fascia, and gutters per NRCA tested designs to meet ANSI/SPRI/FM 4435 ES-1 securement requirements.
   2. Gutter Manufacturers: Listed by UL, FM, or other agency acceptable to authority having jurisdiction to fabricate gutters per NRCA tested designs to meet SPRI GT-1 securement requirements.
   3. Installer Qualifications: Section 075200, 075323, and 073113 roofing system installer.

B. Mockups: Provide components for exterior wall mockup assemblies.
   1. Approved mockups establish work results standard.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Prevent deformation, abrasion, and other damage during handling and installation.

B. Remove strippable finish protection film when recommended by manufacturer.

1.8 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.9 WARRANTY

A. Include roof specialties in roof system warranty specified in Section 075200, 075323, and 073113.

B. Manufacturer Warranty: Warrant against product and installation failure.
   1. Failure includes products blowing off, deforming, leaking, or causing membrane roofing failure when exposed to specified wind conditions.
   2. Warranty Period: 20 years.

C. Finish Warranty: Repair deteriorated finishes or replace components.
   1. Deterioration includes the following:
      a. Color Fading: More than 5 Hunter units per ASTM D2244.
      b. Chalking: More than No. 8 rating per ASTM D4214.
      c. Paint cracking, peeling or checking.
   2. Warranty Period: Five years.

PART 2 PRODUCTS

2.1 MANUFACTURED ROOF EDGE SYSTEMS

A. Roof Edge Requirements: Engineered systems tested per ANSI/SPRI/FM 4435 ES-1 for roofing securement.
   1. FM Approvals: 60 psf RoofNav minimum wind rating.

B. Manufactured Coping System, as indicated on drawings: Snap-on cover with concealed gasketed splice plates that accommodate thermal movement and drain water out of system; no exposed fasteners.
   1. Manufacturers and Products:
      a. PAC-CLAD.
      b. ATAS International.
      c. Carlisle Drexel Metals.
      d. Hickman Edge Systems.
      e. Metal-Era.
      f. SAF Perimeter Systems.
   2. Configuration: Full width of wall and Cantilever system extending over wall cladding.
   3. Cover Material: Aluminum sheet, smooth finish.
   4. Cover Thickness: 0.050 inch.
   5. Cover Finish: PVDF coil coating.
   6. Cover Profile: Sloped toward roof.
   7. Cover Face: Drip edge.
   8. Cover Dimensions: See Drawings.
   9. Securement: Anchor clips spaced for design wind speed.
   10. Anchorage Fasteners: Stainless steel screws.
   11. Accessories: Factory fabricated units for terminations and changes in direction or plane.

C. Manufactured Roof Edge Trim, as indicated on drawings: Snap-on cover with concealed gasketed splice plates that accommodate thermal movement and drain water out of system; no exposed fasteners.
   1. Manufacturers and Products:
      a. PAC-CLAD.
      b. ATAS International.
      c. Carlisle Drexel Metals.

d. Hickman Edge Systems.
e. Metal-Era.
f. SAF Perimeter Systems.

2. Profile: See Drawings.
3. Cover Material: Aluminum sheet, smooth finish.
4. Cover Thickness: 0.050 inch.
5. Cover Finish: PVDF coil coating.
6. Cover Dimensions: See Drawings.
7. Securement: Continuous cleats.
8. Anchorage Fasteners: Stainless steel screws.
9. Accessories: Factory fabricated units for terminations and changes in direction or plane.

D. Manufactured Gutter System, as indicated on drawings: Engineered internally supported gutter system with bracket and tested per SPRI GT-1.

1. Manufacturers and Products:
   a. PAC-CLAD.
   b. ATAS International.
   c. Hickman Edge Systems.
   d. Metal-Era.
2. Material: Aluminum sheet, smooth finish.
3. Thickness: 0.050 inch.
4. Finish: PVDF coil coating.
5. Cover Dimensions: See Drawings.
6. Securement: Continuous cleats.
7. Anchorage Fasteners: Stainless steel screws.
8. Accessories: Factory fabricated units for terminations and changes in direction or plane.

2.2 MANUFACTURED ROOF EXPANSION JOINTS

A. Flanged Bellows Expansion Joints, as indicate on drawings: Continuous metal flanges laminated to flexible membrane bellows.

1. Manufacturers and Products:
   a. Architectural Art Manufacturing T Series.
   b. Balco BRB Series.
   c. Construction Specialties BRJ Series.
   d. Johns Manville Expand-O-Flash Series.
2. Configuration: See Drawings.
3. Joint Width: See Drawings.
4. Joint Movement Capability: 50 percent expansion/contraction and 50 percent vertical shear.
5. Flanges: Stainless steel.
6. Bellows: PVC flexible membrane, 60 mil thick.
7. Secondary Seals: Continuous waterproof membrane attached to both sides of joint below bellows.
   a. Drainage: Connect drain tubes to secondary seal and direct collected moisture to drainage assembly.
8. Fire Barriers: Manufacturer standard tested fire rated joint system.

2.3 PERFORMANCE

A. Structural Loads: See Structural Drawings.

B. Wind Borne Debris Resistance:
   1. ASTM E1886, missile impact and cyclic pressure for basic wind speed requirements noted in Structural Drawings.

C. Expansion Joint Fire Resistance: UL 2079 or ASTM E1966 tested for specified ratings through full range of movement.
   1. Fire Rating: 2 hours.

D. Environmental Performance:
   1. Expansion and Contraction: Accommodate 180 degree F surface and 120 degree F ambient temperature differential without failure.

2.4 FINISHES

A. Aluminum Color Coating: Two coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color; AAMA 2605.
   1. Color: Architect selected.

B. Steel Sheet Coil Coating: ASTM A755; Three coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color coat.
   1. Pencil Hardness, ASTM D3363: HB - H.
   2. Salt Spray Resistance, ASTM G85: 1,000 hours, minimum.
   3. Humidity Resistance, ASTM D2247: 1,000 hours, minimum.
   4. Dry Film Thickness: ASTM D1400, Paint system manufacturer recommended.
   5. Color and Gloss: Architect selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify wood blocking for support and anchorage is positioned correctly, securely fastened, level, and in plane.

B. Verify installation surfaces are clean, dry, and free of foreign matter.

C. Verify wall air barrier membrane extends under roof membrane flashing on the anchorage blocking.

D. Verify roof membrane flashing extends over anchorage blocking and is securely fastened to the blocking.

3.2 INSTALLATION

A. Install roof specialties to provide weatherproof performance and prevent water intrusion into building enclosure elements or interior.

B. Copings:
   1. Install copings in straight lines with accurately aligned profiles.
   2. Install anchorage base and cleats with screws.
   3. Install splice plates with continuous gaskets that prevent lateral movement of water to void below cover.
   4. Install covers with full anchorage cleat engagement and uniform joint width.

C. Edge Securement Trim:
   1. Install trim in straight lines with accurately aligned profiles.
   2. Install anchorage base and cleats with screws.
   3. Install splice plates with continuous gaskets that prevent lateral movement of water to void below cover.
   4. Install covers with full anchorage cleat engagement and uniform joint width.

D. Gutters:
   1. Join sections with lapped and sealed joints.
   2. Attach gutters to eaves with gutter anchors space to provide performance required.
   3. Install watertight end closures.
   4. Provide stainless steel beehive strainers in each outlet.

E. Expansion Joints: Install for watertight performance.
   1. Anchor roof expansion joints in straight lines, true to line and elevation, with accurately aligned profiles. Allow for required movement.
   2. Allow for expansion joint assembly linear thermal expansion and contraction.
   3. Splices and Joints: Make uniform, tight, and neat.
   4. Align roof expansion joints with exterior wall joints specified in Section 079500. Make joint systems continuously waterproof.
   5. Fire Barrier: Install per tested assembly requirements to provide continuous fire resistance for length of joint.

3.3 PROTECTION

A. Protect roof specialties from foot traffic and damage.

3.4 CLEANING

A. Remove soiling and stains from installed components.

END OF SECTION

SECTION 077200

ROOF ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:
   1. Roof hatch with ladder access and protective rails.

B. Principal Products:

C. Section Includes.
   1. Roof access hatches.

D. Related Requirements.
   1. Section 075000: Roofing system.
   2. Section 077100: Roofing specialties.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordinate roof accessories with roofing installation.

B. Preinstallation Meeting Attendees and Procedures:
   1. Require roof hatch installer to attend roofing system preinstallation meeting.

1.3 ACTION SUBMITTALS

A. Product Data: Each roof accessory type and size.
   1. Mounting type, materials, and hardware.
   2. Initial selection color Samples.

B. Shop Drawings: Plans, elevations, and attachment details.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer and Independent testing agency test results showing:

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

B. Warranty Documentation: For roof hatches.

1.6 WARRANTY

A. Manufacturer Warranty:
   1. Warrant roof hatches against product failure.
      a. Warranty Period: Five years.

PART 2 PRODUCTS

2.1 ROOF ACCESS HATCHES

A. Roof Personnel Access Hatches As indicated on drawings: Seamless welded construction.
   1. Manufacturers:
      a. Basis of Design: Bilco Company.
      b. Babcock-Davis.
      c. Milcor Company.
      d. Nystrom, Inc.
      e. Williams Brothers Corporation of America.
   2. Size: See Drawings.
   3. Hatch Curb: Insulated double wall thermally broken construction with integral counterflashing and anchorage flanges.
      a. Material: Aluminum.
      b. Insulation: Polyisocyanurate, 3 inch thickness.
   4. Hatch Lid: Insulated double wall construction; single leaf.
      a. Material: Aluminum.
      b. Metal Thickness: Manufacturer recommended for design wind and live load criteria.
      c. Insulation: Same as curb.
   5. Hardware: Stainless steel.
      a. Automatic opening with hold open arm when latch is released.
      b. Latch Handles: Interior and exterior.
      c. Perimeter Gasket: Continuous.
      d. Locking: Interior padlock hasp.
   6. Steel Deck Anchorage: Hot-dip galvanized steel fasteners.
   7. Finish: Mill.
      a. Color: Architect selected.

B. Safety Posts: Hatch manufacturer telescoping aluminum tube.
   1. Anchorage: Supply components for attachment to roof access ladder.
   2. Finish:
      a. Mill finish.

C. Hatch Mounted Safety Railings.
   1. Safety Railings: Hatch manufacturer standard or recommended systemsized to fit hatch, 29 CFR 1910.29 compliant.
      a. Posts and Rails: 1-1/2 inch diameter, 42 inch overall height above roof surface.
      b. Construction: Aluminum; pipes or tubes.
      c. Gate: Hinged, self-closing and self-latching.
      d. Gate Hardware: Corrosion resistant hinges and latching mechanism.
      e. Mounting Hardware: Corrosion resistant type for attachment to curb without penetrating roof membrane.
   2. Performance: Engineered and tested by manufacturer.
      a. Top Rail Concentrated Load: 200 pounds applied at any point in any direction.
      b. Top and Intermediate Rail Uniform Load: 50 plf applied in any direction.
      c. Concentrated and uniform loads need not be assumed to act concurrently.
   3. Finish: Mill finish.

2.2 PERFORMANCE

A. Structural Loads: See Drawings and Applicable code compliant.

B. Environmental Performance:
   1. Expansion and Contraction: Withstand 120 degree F ambient and 180 degree F surface thermal cycling without failure.

2.3 INSTALLATION MATERIALS

A. Protective Coating: Bituminous, ASTM D1187 Type 1 or II.

B. Anchorage Fasteners: Stainless steel screws.

2.4 FABRICATION

A. Fabricate curbs and hatches for 12 inch height above roof surface.

B. Where deck slope exceeds 1:48, fabricate tapered curbs to provide level lid.

PART 3 EXECUTION

3.1 INSTALLERS

3.2 EXAMINATION

A. Verify that deck surfaces and roof openings are ready to receive Work of this Section.

3.3 PREPARATION

A. Apply protective coating on aluminum surfaces contacting cementitious materials, wood, and dissimilar metals.

3.4 INSTALLATION

A. Set curbs in full contact with roof deck.

B. Anchor roof accessories to resist specified loads.

C. Attach safety railings securely to hatch curbs.

D. Lubricate and adjust hardware for smooth, accurate operation.

E. Touch up damaged factory-applied finishes.

3.5 CLEANING

A. Cleaning: Remove soiling and stains.

END OF SECTION

SECTION 078400

FIRESTOPPING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes.
   1. Penetration and joint firestopping.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordinate joint construction and penetrations to accommodate firestopping.

B. Scheduling: Notify Construction Manager testing agency seven days minimum before firestopping installation and provide access for inspection.

C. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one month, minimum, before starting Work of this Section.
   2. Additional Attendees: Installer and prime contractor.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Product characteristics, performance and limitation criteria.
   2. Repair procedures.
   3. Describe use of product in each tested design.

B. Schedule: List opening locations and sizes, penetrating items, and testing agency system design listings.

C. Engineering Judgments: For conditions not covered by listed designs, provide judgments on systems or assemblies to meet fire protection requirements by a licensed professional engineer, for presentation to authority having jurisdiction.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:
   1. Manufacturer: Certify products meet or exceed specified requirements and applicable code requirements.

B. Qualification Statements:
   1. Applicator UL Qualified Firestop Contractor certification and approval letter from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For Firestopping.

B. Warranty Documentation: For Firestopping.

C. Fire-Resistance Inventory: Provide locations and details of firestop installations, with Listed Systems, engineering judgments, and equivalent fire-resistance rated assemblies, on record Life Safety Drawings and Operations and Maintenance manuals.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. Specialty Firestop Contractor: Assign installation of through-penetration firestop systems and fire-resistive joint systems in Project to a single sole source firestop specialty contractor with one of the following qualifications.
      a. Firm approved per UL Qualified Firestop Program.
      b. FCIA Contractor Member in good standing.
      c. Manufacturer approval.
   2. Licensed Professionals: Registered in state in which Project is located.

B. Certifications: From Installer that firestopping is installed properly.

C. Field Samples: Construct example of each different firestop system. Demonstrate qualities of materials and execution, and acceptance criteria.
   1. Obtain AHJ acceptance of field samples before start of Work.
   2. Approved Samples establish work results standard.

1.7 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations:
   1. Ambient and Substrate Temperature: Within limits permitted by manufacturer.
   2. Building enclosed and environmental systems maintaining design conditions for Owner occupancy.

B. Ventilation: Ventilate building spaces during and after application, providing complete air exchanges to manufacturer instructions. Use natural means; if inadequate, use forced-air circulation until firestopping dries thoroughly.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Firestopping Product Manufacturers:
   1. 3M Fire Protection Products.
   2. Hilti, Inc.
   3. HOLDRITE.
   4. RectorSeal.
   5. Specified Technologies, Inc.

2.2 PENETRATION AND JOINT FIRESTOPPING

A. General:
   1. Firestopping: Materials manufactured and installed to resist the spread of fire, smoke, and gasses, that maintain the fire resistance ratings of the horizontal and vertical assemblies into which they are installed.
   2. Firestopping Materials and Systems: Compatible with each other and substrates where installed.

B. Fire Rated Wall Penetrations: Firestopping rated per ASTM E814 or UL 1479, positive pressure differential tested at 0.01 inch wg.
   1. Wall Types: Fire barriers, Smoke partitions, and Fire partitions.
   2. F-Rating: Equal to or greater than assembly where installed.

C. Fire Rated Joint Assemblies: Firestopping rated per ASTM E1966 or UL 2079.
   1. Fire Resistance Rating: Equal to or greater than assembly where installed.

D. Exposed Firestopping Materials: ASTM E84; Flame Spread 25, Smoke Developed 450, maximum.
   1. Color: Architect selected.

E. Accessory Materials: Firestopping manufacturer materials and components, approved by qualified testing and inspection agency, required for complete installation and fire rating of each firestopping assembly.
   1. Forming and Backing Materials:
      a. Rock wool and mineral wool insulation.
      b. Sealants.
      c. Form boards.
      d. Sealant backers or fillers.
      e. Temporary forms.
   2. Primers.
   3. Collars.
   4. Sleeves.

2.3 PERFORMANCE

A. Provide firestopping systems that are tested by a qualified testing agency acceptable to authorities having jurisdiction.

B. Mark firestopping systems with classification markings by one of the following, as acceptable to authorities having jurisdiction.
   1. UL Fire Resistance Directory.
   2. FM Global Building Materials Approval Guide.

2.4 MATERIALS AND COMPONENTS

A. Collars and Sleeves: Factory assembled collars and sleeves, consisting of a metal outer sleeve lined with intumescent material, and flanges and gaskets to mount the unit and seal the ends.

B. Sealants:
   1. Latex: Single component, moisture resistant after curing.
   2. Silicone: Single component, neutral curing, pourable for horizontal and nonsag for vertical or sloped applications.

C. Intumescent Sheets: Composite sheets of galvanized steel and intumescent material designed for various opening sizes.

D. Wrap Strips: Foil faced, intumescent, elastomeric sheets.

E. Pillows: Compressible, intumescent cases.

F. Putties: Non-hardening, water-resistant, dielectric materials containing no inorganic fibers, silicones, or solvents.

G. Mortars: Prepackaged dry mixes of hydraulic cement, binders, and lightweight aggregates, mixed with water at installation site.

H. Silicone Foam: Multicomponent, site mixed elastomer that expands and cures in place as a stable, flexible foam.

2.5 MIXING

A. Mix materials to produce product characteristics required by manufacturer and testing agency.

2.6 SOURCE QUALITY CONTROL

A. Single Source Responsibility: Obtain firestop systems for each kind of penetration and construction condition from a single primary firestop systems manufacturer, to the greatest extent possible.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions:
   1. Verify pipes, conduit, cable, ductwork, and other items have been permanently installed.
   2. Verify field dimensions are as shown tested systems or Engineering Judgments.
   3. Verify system components are dry, clean, and ready for installation.

3.2 PREPARATION

A. Surface Preparation:
   1. Mask surfaces that will remain exposed after installation of firestopping.

3.3 INSTALLATION

A. Forming Materials: Install to retain and properly shape installed firestopping to achieve required fire rating.
   1. Remove combustible or temporary forming materials after curing firestopping.

B. Install firestopping materials to achieve required fire ratings.
   1. Apply materials to adhere to all contact surfaces.
   2. Fill all voids around openings.
   3. Finish firestopping that will be exposed after curing.

3.4 IDENTIFICATION

A. Permanently attach identification labels within 6 inches of edge of firestopping installations. Make labels visible toward the direction from which a person might approach to remove or alter the firestopping.

B. Provide labels that contain the following:
   1. Required Text: "Warning - Firestop System - Do Not Disturb. Notify Building Management of Any Damage."
   2. Installing Contractor Company name, contact information.
   3. Firestopping testing agency design designation.
   4. Installation date.
   5. Manufacturer name.
   6. Installer name.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Owner will engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to Work areas.
   1. Failed Test Retest Cost: Contractor responsibility.

2. Do not begin construction until inspectors have verified compliance of materials.
3. Do not use materials that fail tests and inspections.

B. Tests and Inspections:
1. Joint Firestopping: ASTM E2393.
2. Penetration firestopping: ASTM E2174.

C. Repair or replace firestopping that is damaged or removed during inspection and testing.

D. Non-Conforming Work: Make corrections or replace, and retest.

E. Enclose firestopping after inspection reports confirm firestopping follows requirements.

3.6 CLEANING AND PROTECTION

A. Remove excess firestopping materials. Do not damage adjacent materials.

B. Protect firestopping installations from damage or deterioration. Repair or replace firestopping that is damaged or removed before Substantial Completion.

END OF SECTION

SECTION 079200

JOINT SEALANTS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Mildew-resistant joint sealants.
5. Latex joint sealants.
6. Spray foam sealant.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product.

B. Samples for Initial Selection: Manufacturer's color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

C. Samples for Verification: For each kind 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.

D. Joint-Sealant Schedule: Include the following information:
1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Product Test Reports: For each kind of joint sealant, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
   1. Joint-sealant location and designation.
   2. Manufacturer and product name.
   3. Type of substrate material.
   4. Proposed test.
   5. Number of samples required.

D. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.

E. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.

F. Field-Adhesion-Test Reports: For each sealant application tested.

G. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

B. Product Testing: Test joint sealants using a qualified testing agency.
   1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
   1. Adhesion Testing: Use ASTM C 794 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
   2. Compatibility Testing: Use ASTM C 1087 to determine sealant compatibility when in contact with glazing and gasket materials.
   3. Stain Testing: Use ASTM C 1248 to determine stain potential of sealant when in contact with masonry substrates.
   4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
   5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:
1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
   a. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1.1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
5. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
6. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

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.

1.8 WARRANTY

A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
   1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
   2. Disintegration of joint substrates from causes exceeding design specifications.
   3. Mechanical damage caused by individuals, tools, or other outside agents.
   4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 PRODUCTS

2.1 JOINT SEALANTS, 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 joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Silicone, S, NS, 50, NT: Single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 795.
      b. GE Construction Sealants; SCS2000 SilPruf.
      c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 265 LTS.
      d. Pecora Corporation; PCS.
      e. Sika Corporation U.S.; Sikasil WS-295.
   2. Locations: Exterior non-traffic joints.

2.3 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 756 SMS.
      b. GE Construction Sealants; SilPruf NB.
      c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 295 FPS NB.
      d. Pecora Corporation; 864NST.
      e. Tremco Incorporated; Spectrem 2.
   2. Joints adjacent to masonry or that may drain onto masonry.

2.4 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, T, NT: Single-component, nonsag, plus 25 percent and minus 25 percent movement capability, traffic- and nontraffic-use, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Uses T and NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. LymTal International, Inc.; Iso-Flex 875R.
   2. Locations: Joints in floor slab.

2.5 MILDEW-RESISTANT JOINT SEALANTS

A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 786-M White.
      b. GE Construction Sealants; SCS1700 Sanitary.
      c. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex Sil 100 WF.
      d. Soudal USA; RTV GP.
      e. Tremco Incorporated; Tremsil 200.
   2. Interior bathrooms and other wet locations.

2.6 LATEX JOINT SEALANTS

A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. BASF Construction Chemicals, LLC, Building Systems; MasterSeal NP 520.

b. May National Associates, Inc., a subsidiary of Sika Corporation U.S.; Bondaflex 600.
c. Pecora Corporation; AC-20.
d. Sherwin-Williams Company (The); 850A.
e. Tremco Incorporated; Tremflex 834.

2. Interior static joints.

2.7 SPRAY FOAM SEALANT

A. Spray Foam Gap and Crack Sealant: AAMA 812; one- or two-component, foamed-in-place, polyurethane foam with the following characteristics:
1. Density: 2.9 PCF maximum.
2. Surface Burning Characteristics: ASTM E84.
3. Flame Spread Index: 25, maximum.
4. Smoke Developed Index: 450, maximum.
5. Initial R-Value: ASTM C518; 4 per inch thickness, minimum.
6. Maximum Pressure: 1.25 psig.
7. Products:
a. The Dow Chemical Company; Great Stuff Pro Window and Door Insulating Foam Sealant.
b. Tremco; TremGlaze Low Expansion Polyurethane Foam Sealant.

2.8 JOINT-SEALANT BACKING

A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. BASF Construction Chemicals, LLC, Building Systems.
b. Construction Foam Products, a division of Nomaco, Inc.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) 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.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.9 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

3.1 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 performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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, 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 joint substrate 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 by joint-sealant manufacturer or as indicated by 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 or primer 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.

3.3 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 kind 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 bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. 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.

F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs 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 profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 SPRAY FOAM SEALANT INSTALLATION

A. Install spray foam sealant in accordance with manufacturer's instructions.

B. Fill cracks and gaps at wall framing openings to provide continuous thermal barrier.

C. Install foam without causing deflection in adjacent window and door frames in excess of allowable tolerances for proper operation and performance of windows and doors.

D. Trim excess foam flush with adjacent surfaces.

3.5 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
   1. Extent of Testing: Test completed and cured sealant joints as follows:
      a. Perform 10 tests for the first 1000 feet of joint length for each kind of sealant and joint substrate.
      b. Perform one test for each 1000 feet of joint length thereafter or one test per each floor per elevation.
   2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.
      a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
   3. Inspect tested joints and report on the following:
      a. Whether sealants filled joint cavities and are free of voids.
      b. Whether sealant dimensions and configurations comply with specified requirements.
      c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
   4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
   5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.6 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.

3.7 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, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION

SECTION 079500

EXPANSION CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior floor expansion joint covers.
   2. Interior wall expansion joint covers.
   3. Exterior wall expansion joints.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordinate concrete blockouts and finished floor surface dimensions and tolerances with finishing of concrete surfaces.

B. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one month, minimum, before starting Work of this Section.
   2. Additional Attendees:
   3. Additional Agenda Items:

1.3 ACTION SUBMITTALS

A. Product Data: Submit for each expansion joint type.
   1. Technical data and standard details.
   2. Initial selection color Samples.

B. Shop Drawings:
   1. Show plan and section view installation details including product dimension, splices, terminations, and attachment.
   2. Include diagram showing entire length of each joint.

C. Samples:
   1. Expansion Joints: 6 inch long, full width Samples.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports: Manufacturer and Independent testing agency test results showing fire barrier performance.

B. Qualification Statements: Manufacturer, Fabricator, and Installer.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For expansion joints.

B. Warranty Documentation: For expansion joints.

1.6 QUALITY ASSURANCE

A. Qualifications:
   1. Installers: Manufacturer trained.

B. Certifications: From Contractor for specified performance.

C. Field Samples: Construct each unique condition at 1 '-0" length, minimum size. Demonstrate texture, color, and pattern.
   1. Approved Samples establish Work results standard.

D. Mockups: Construct each unique condition at 1 '-0" length, minimum size. Demonstrate product interfaces, intersections, and terminations.
   1. Mockups Location: Field.
   2. Approved mockups establish products and Work results standard.

1.7 FIELD CONDITIONS

A. Ambient Conditions:
   1. Building enclosed and environmental systems maintaining design conditions for Owner occupancy.
   2. Temperature: 40 degrees F, minimum and rising, maximum temperature as required by manufacturer.
   3. Precipitation: None occurring and none predicted within 24 hours.
   4. Establish ambient conditions 8 hours, minimum before and maintain conditions during and 8 hours, minimum after installation.

B. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.8 WARRANTY

A. Manufacturer Warranty:
   1. Expansion Joint Covers: Warrant against product failure.
      a. Failure includes manufacturing and material defects.
      b. Warranty Period: Five years.

PART 2 PRODUCTS

2.1 EXPANSION JOINT SYSTEMS - GENERAL

A. Interior Joints: Provide products that interface with one another from a single manufacturer.

2.2 INTERIOR FLOOR EXPANSION JOINTS

A. Floor to Wall JointsAs indicated on drawings: Plate supported elastomeric compression seal flush with adjacent floor finish; aluminum frame mounted on depressed structural slab.
   1. Manufacturers and Products:
      a. Construction Specialties FB-22 Series as Basis of Design.
      b. Inpro Corp 101 Series.
      c. MM Systems Corp Flushline FS Series.
      d. Nystrom LCF.
      e. Sika Emseal Wabo CorridorWrap Model CWFF.
   2. Joint Width: See Drawings.
   3. Fire Resistance: 2 hours.
   4. Compression Seal Color: Architect selected.

B. Installation Materials:
   1. Fire Barriers: Manufacturer standard fire tested products designed for installation below joint covers, capable of same movement as joint.
   2. Waterproof Foam Seal: Preformed, pre compressed closed cell foam.
   3. Fasteners: Manufacturer standard clips, fasteners, set screws, spacers, and other items compatible with joint frames and substrate.

2.3 INTERIOR WALL EXPANSION JOINTS

A. Wall to Corner and to wall JointsAs indicated on drawings: Independent recessed mounted anchors either side of joint with two elastomeric compression seals, centering bar, and exposed cover plate.
   1. Manufacturers and Products:
      a. Construction Specialties FB-24 Series as Basis of Design.
      b. Balco 95 Series.
      c. Inpro Corp 221 Series.
      d. MM Systems Corp Flushline Dual Seal WD System.
      e. Nystrom SWNB.
      f. Sika Emseal Wabo SeisMaxPlus NBW.
   2. Joint Width: See Drawings.
   3. Fire Resistance: 2 hours.
   4. Compression Seal Color: Architect selected.

B. Installation Materials:
   1. Fire Barriers: Manufacturer standard fire tested products designed for installation behind joint covers, capable of same movement as joint.
   2. Fasteners: Manufacturer standard clips, fasteners, set screws, spacers, and other items

compatible with joint frames and substrate.

2.4 EXTERIOR WALL EXPANSION JOINTS

A. Wall to Wall JointsAs indicated on drawings: Preformed cellular foam with silicone face, adhered to substrate.
   1. Manufacturers and Products:
      a. Balco BCSW Series.
      b. Construction Specialties VF Series.
      c. Inpro Corp 1200 Series.
      d. MM Systems Corp SCE Series.
      e. Nystrom SES.
      f. Sika Emseal Seismic Colorseal.
      g. Or approved equal.
   2. Joint Width: See Drawings.
   3. Seal Face Color: Architect selected.
   4. Adhesive: Manufacturer recommended product for substrates.

B. Wall to Wall JointsAs indicated on drawings: Extruded flexible elastomeric seal mounted to rigid frame and aluminum pantograph support, and secondary moisture barrier.
   1. Manufacturers and Products:
      a. Balco EV Series.
      b. Construction Specialties SC Series.
      c. Inpro Corp 615 Series.
      d. MM Systems Corp VSS Series.
      e. Nystrom EWN.
      f. Sika Emseal Wabo WeatherSeam WSW, WSE, and WSC Series.
      g. Or approved equal.
   2. Joint Width: See Drawings.
   3. Compression Seal Color: Architect selected.
   4. Secondary Moisture Barrier: Continuous elastomeric sheet.

C. Installation Materials:
   1. Fasteners: Manufacturer standard clips, fasteners, set screws, spacers, and other items compatible with joint frames and substrate.

2.5 EXTERIOR ROOF TO WALL JOINTS

A. Exterior Roof to Wall Joint Systems: Provide expansion control as indicated on drawings to meet roof manufacturer’s warranty requirements.

B. Design Criteria: As indicated on Drawings.
   1. Manufacturers:
      a. Construction Specialties.
      b. Sika Emseal.
      c. Nystrom.

C. Fire Resistance: Equal to or greater than adjacent assemblies where required.

2.6 PERFORMANCE

A. Fire Resistance: UL 2079 or ASTM E1966 tested for specified ratings.

B. Smoke Resistance: UL 2079 tested; 5 cfm/linear foot maximum air leakage.

C. Seismic Movement: Withstand remain functional after ASCE/SEI 7 design earthquake movement.

2.7 MATERIALS

A. Aluminum: Manufacturer recommended alloy and temper.
   1. Extruded Profiles: ASTM B221.
   2. Sheet and Plate: ASTM B209.

B. Steel Plates: ASTM A588.

C. Grout: ASTM C1107, Nonmetallic, shrinkage resistant.

D. Separation Coating: Bituminous paint; SSPC-Paint 12.

2.8 FABRICATION

A. Fabricate transitions and corner fittings.

B. Miter and heat weld splices and transitions in elastomeric and compression seals.

2.9 ALUMINUM FINISHES

A. Anodizing: AAMA 611 Class I or AAMA 612 with electrodeposition organic seal.
   1. Color: Architect selected.

B. Powder Coating: Thermoset polyester; AAMA 2603 but 1.5 mil minimum thickness.
   1. Color and Gloss: Architect selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine surfaces for installation tolerance. Verify joint preparation and dimensions are acceptable in accordance with manufacturer requirements.

3.2 PREPARATION

A. Provide anchoring devices for installation.

B. Install anchoring devices.

3.3 INSTALLATION

A. Install expansion joint components and accessories plumb and level and flush with adjacent surfaces.

B. Terminate exposed ends of expansion joint cover assemblies with field- or factory-fabricated termination devices.

C. Fire Rated Systems: Install fire resistant barriers in conjunction with expansion joint covers to achieve the specified fire ratings per manufacturer tested assemblies.

D. Moisture Barrier and Drainage: Install membrane. Provide fittings and connect gutters to drains.

3.4 PROTECTION

A. Protection: Do not permit construction traffic over unprotected floor joints.

END OF SECTION

SECTION 080671

DOOR HARDWARE SCHEDULE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 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".

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.

1.3 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.

1.4 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".

1.5 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.

1.6 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.

C. Manufacturer's Abbreviations:
   1. MK - McKinney.
   2. PE - Pemko.
   3. SU - Securitron.
   4. RO - Rockwood.
   5. SA - SARGENT.
   6. NO - Norton Rixson.

7. OT - Other.
8. AK - Alarm Controls

Hardware Sets:						
Set: 1.0						
Doors: 140B						
1	Continuous Hinge	CFM_SLF-HD1 PT x Length Required		PE	087100	
1	Electric Power Transfer	EL-CEPT	630	SU	087100	⚡
1	Rim Exit Device, Storeroom	16 55 56 72 AD8504 Less Pull	US32D	SA	087100	⚡
2	Small Format Inter Core	7300B	US15	SA	087100	
1	Door Pull	RM7330-24 Mtg-Type 12HD	US32D	RO	087100	
1	Concealed Overhead Stop	6-X36	630	NO	087100	
1	Surface Closer	351 P10/O (as required)	EN	SA	087100	
1	Drop Plate	351D	EN	SA	087100	
1	Blade Stop Spacer	581-2	EN	SA	087100	
1	Door Sweep	3452CNB x Length Required		PE	087100	
1	Threshold	25_x_AFG MSES25 SS-2 x Length Required		PE	087100	

1	ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡
1	ElectroLynx Harness - Door	QC-CXXX (Size as required)		MK	087100	⚡
1	Door Position Switch	CP1-1026 DPDT		AK	087100	⚡
1	Power Supply	LSP-12-24		SA	087100	⚡
1	Card Reader	Furnished by Security				
1	Wiring Diagram	Elevation and Point to Point as Specified				
1	Gasket	Furnished with Aluminum Door/Frame				
Notes: Operational Narrative: 1. Doors normally closed and secure. 2. Authorized access by card reader retracting latch, allowing for authorized entry. 3. Egress free for immediate exit. 4. REX switch in push rail allows authorized exit without alarm condition. 5. Door position switch monitor open/closed status. 6. Exit device lever remains locked (fail secure) in event of power loss. Keyed cylinder override for emergency access.						
Set: 2.0						
Doors: 165						
1	Continuous Hinge	CFM_HD 1-M x Length Required		PE	087100	
1	Rim Exit Device, Storeroom	16 72 8804 ETP	US32D	SA	087100	

2	Small Format Inter Core	7300B	US15	SA	087100	
1	Surface Closer	351 CPS	EN	SA	087100	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
1	Gasketing	303AS (Head & Jambs)		PE	087100	
1	Door Sweep	3452CNB x Length Required		PE	087100	
1	Threshold	25_x_AFG MSES25 SS-2 x Length Required		PE	087100	
Set: 3.0						
Doors: 139B						
2	Continuous Hinge	CFM_SLF-HD1-M x Length Required		PE	087100	
1	Concealed Vert Rod Exit, Nightlatch	16 72 AD8410 106 x Less Pull	US32D	SA	087100	
1	Concealed Vert Rod Exit, Exit Only	16 72 AD8410 EO	US32D	SA	087100	
3	Small Format Inter Core	7300B	US15	SA	087100	

2	Door Pull	RM5277-24 Mtg-Type 12HD	US32D	RO	087100	
2	Concealed Overhead Stop	6-X36	630	NO	087100	
2	Surface Closer	351 P10/O (as required)	EN	SA	087100	
2	Drop Plate	351D	EN	SA	087100	
2	Blade Stop Spacer	581-2	EN	SA	087100	
1	Gasket	Furnished with Aluminum Door/Frame				
Set: 4.0						
Doors: 142						
1	Magnetic Lock	M380EBDX	630	SU	087100	⚡
1	Emergency Pushbutton	EEB2		SU	087100	⚡
Notes: NOTE: Built-in Door Position Switch and Motion Sensor integrated with wall mounted card reader. Operational Narrative: 1. Door normally closed and secure. 2. Authorized access by card reader or remote release from the receptionist desk. 3. Maglock bond sensor monitors open/closed status. Balance of existing hardware to remain. General contractor and door supplier must field survey and confirm or revise the specified hardware based on existing conditions.						
Set: 5.0						
Doors: 148A, 148B						

6	Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100	
2	Conceale d Vert Rod Exit, Classroo m	12 NB 72 MD8613 ETP	US32D	SA	087100	
2	Small Format Inter Core	7300B	US15	SA	087100	
2	Surface Closer	351 P10/O (as required)	EN	SA	087100	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
2	Electrom agnetic Holder	996M	689	NO	087100	⚡
2	Silencer	608-RKW		RO	087100	
1	Wiring Diagram	Elevation and Point to Point as Specified				
Notes: Operation: 1. Doors normally held open via electromagnetic hold open. 2. Upon loss of power or fire alarm activation magnets to release allowing doors to close and positively latch. 3. Always free egress.						
Set: 6.0						
Doors: 140A, 145						
3	Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100	
1	Classroo m Lock	72 10XG37 LP	US26D	SA	087100	

1	Small Format Inter Core	7300B	US15	SA	087100	
1	Surface Closer	351 P10/O (as required)	EN	SA	087100	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
1	Door Stop	409 (or) 441CU (As Required)	US32D	RO	087100	
3	Silencer	608-RKW		RO	087100	
Set: 7.0						
Doors: 166A, 166B						
6	Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100	
2	Concealed Vert Rod Exit, Classroom	NB 16 72 MD8613 ETP	US32D	SA	087100	
4	Small Format Inter Core	7300B	US15	SA	087100	
2	Surface Closer	351 P10/O (as required)	EN	SA	087100	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
2	Door Stop	409 (or) 441CU (As Required)	US32D	RO	087100	

2	Silencer	608-RKW		RO	087100	
Set: 8.0						
Doors: 144, 150, 153C						
3	Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100	
1	Storeroom/Closet Lock	72 10XG04 LP	US26D	SA	087100	
1	Small Format Inter Core	7300B	US15	SA	087100	
1	Surface Closer	351 CPS	EN	SA	087100	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
3	Silencer	608-RKW		RO	087100	
Set: 9.0						
Doors: 167						
3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100	
1	Entry/ Office Lock	72 10XG05 LP	US26D	SA	087100	
1	Small Format Inter Core	7300B	US15	SA	087100	
1	Surface Closer (w/Hold Open)	351 H/PH9 (as required)	EN	SA	087100	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	

1	Door Stop	409 (or) 441CU (As Required)	US32D	RO	087100	
3	Silencer	608-RKW		RO	087100	
Set: 10.0						
Doors: 106, 107, 108, 109, 110, 111, 141, 149, 156, 157, 158, 159, 160, 161, 162, 163						
3	Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100	
1	Storeroom/Closet Lock	72 10XG04 LP	US26D	SA	087100	
1	Small Format Inter Core	7300B	US15	SA	087100	
1	Surface Closer (w/Hold Open)	351 H/PH9 (as required)	EN	SA	087100	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
1	Door Stop	409 (or) 441CU (As Required)	US32D	RO	087100	
3	Silencer	608-RKW		RO	087100	
Set: 11.0						
Doors: 146						
3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100	
1	Privacy Lock (w/Indicator)	V33 10XU65 VSLL	US26D	SA	087100	

1	Mop Plate	K1050 6" high CSK BEV	US32D	RO	087100	
1	Door Stop	409 (or) 441CU (As Required)	US32D	RO	087100	
3	Silencer	608-RKW		RO	087100	
Set: 12.0						
Doors: 154, 155						
3	Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100	
1	Push Plate	70C-RKW	US32D	RO	087100	
1	Pull Plate	BF 111x70C	US32D	RO	087100	
1	Surface Closer	351 P10/O (as required)	EN	SA	087100	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
1	Mop Plate	K1050 6" high CSK BEV	US32D	RO	087100	
1	Door Stop	409 (or) 441CU (As Required)	US32D	RO	087100	
3	Silencer	608-RKW		RO	087100	
Set: 13.0						
Doors: 152						
1	Hardware	All existing hardware to remain				
Set: 14.0						
Doors: 139A						

2	Continuous Hinge	CFM_SLF-HD1-Mx Length Required		PE	087100	
1	Concealed Vert Rod Exit, Nightlatch	16 72 AD8410 106 x Less Pull	US32D	SA	087100	
1	Concealed Vert Rod Exit, Exit Only	16 72 AD8410 EO	US32D	SA	087100	
3	Small Format Inter Core	7300B	US15	SA	087100	
2	Door Pull	RM5277-24 Mtg-Type 12HD	US32D	RO	087100	
2	Concealed Overhead Stop	6-X36	630	NO	087100	
2	Surface Closer	351 P10/O (as required)	EN	SA	087100	
2	Drop Plate	351D	EN	SA	087100	
2	Blade Stop Spacer	581-2	EN	SA	087100	
2	Door Sweep	3452CNB x Length Required		PE	087100	
1	Threshold	25_x_AFG MSES25 SS-2 x Length Required		PE	087100	

1	Gasket	Furnished with Aluminum Door/Frame				
Set: 15.0						
Doors: 147						
3	Hinge, Full Mortise	TA2714-MCK [NRP]	US26D	MK	087100	
1	Privacy Lock (w/Indicator)	V33 10XU65 VSLL	US26D	SA	087100	
1	Surface Closer	351 P10/O (as required)	EN	SA	087100	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
1	Mop Plate	K1050 6" high CSK BEV	US32D	RO	087100	
1	Door Stop	409 (or) 441CU (As Required)	US32D	RO	087100	
3	Silencer	608-RKW		RO	087100	
Set: 16.0						
Doors: 151						
1	Continuous Hinge	CFM_SLF-HD1-Mx Length Required		PE	087100	
1	Rim Exit Device, Storeroom	16 72 AD8504 Less Pull	US32D	SA	087100	

2	Small Format Inter Core	7300B	US15	SA	087100	
1	Door Pull	RM5277-24 Mtg-Type 12HD	US32D	RO	087100	
1	Concealed Overhead Stop	6-X36	630	NO	087100	
1	Surface Closer	351 P10/O (as required)	EN	SA	087100	
1	Drop Plate	351D	EN	SA	087100	
1	Blade Stop Spacer	581-2	EN	SA	087100	
1	Gasket	Furnished with Aluminum Door/Frame				
Set: 17.0						
Doors: 153						
3	Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100	
1	Storeroom/Closet Lock	72 10XG04 LP	US26D	SA	087100	
1	Small Format Inter Core	7300B	US15	SA	087100	
1	Concealed Overhead Stop	6-X36	630	NO	087100	

1	Mounting Plate	351B (Template A7532C)	EN	SA	087100	
1	Surface Closer (w/Hold Open)	351 H/PH9 (as required)	EN	SA	087100	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
3	Silencer	608-RKW		RO	087100	
Set: 18.0						
Doors: 153B, 168						
6	Hinge, Full Mortise, Hvy Wt	T4A3786 [NRP]	US26D	MK	087100	
2	Flush Bolt	555	US26D	RO	087100	
1	Dust Proof Strike	570	US26D	RO	087100	
1	Storeroom/Closet Lock	72 10XG04 LP	US26D	SA	087100	
1	Small Format Inter Core	7300B	US15	SA	087100	
2	Surface Closer (w/Hold Open)	351 H/PH9 (as required)	EN	SA	087100	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
2	Door Stop	409 (or) 441CU (As Required)	US32D	RO	087100	

1	Astragal	Furnished by Door Supplier		OT		
2	Silencer	608-RKW		RO	087100	
Set: 19.0						
Doors: 164						
1	Continuous Hinge	CFM_HD 1-M x Length Required		PE	087100	
1	Storeroom/Closet Lock	72 10XG04 LP	US26D	SA	087100	
1	Small Format Inter Core	7300B	US15	SA	087100	
1	Surface Closer	351 CPS	EN	SA	087100	
1	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
1	Gasketing	303AS (Head & Jambs)		PE	087100	
1	Door Sweep	3452CNB x Length Required		PE	087100	
1	Threshold	25_x_AFG MSES25 SS-2 x Length Required		PE	087100	
1	Latch Protector	320CXL	US32D	RO	087100	
Set: 20.0						
Doors: 166C						

2	Continuous Hinge	CFM__HD1 PT x Length Required		PE	087100	
2	Electric Power Transfer	EL-CEPT	630	SU	087100	⚡
1	Concealed Vert Rod Exit	16 55 56 72 MD8606 ETP	US32D	SA	087100	⚡
1	Concealed Vert Rod Exit, Exit Only	16 55 72 MD8610 EO	US32D	SA	087100	⚡
3	Small Format Inter Core	7300B	US15	SA	087100	
2	Surface Closer	351 CPS	EN	SA	087100	
2	Kick Plate	K1050 10" high CSK BEV	US32D	RO	087100	
2	Astragal	18061CNB TKSP x Length Required		PE	087100	
1	Gasketing	303AS (Head & Jambs)		PE	087100	
2	Door Sweep	3452CNB x Length Required		PE	087100	
1	Threshold	25_x_AFG MSES25 SS-2 x Length Required		PE	087100	
2	ElectroLynx Harness - Frame	QC-C1500P		MK	087100	⚡

2	ElectroLynx Harness - Door	QC-CXXX (Size as required)		MK	087100	⚡
2	Door Position Switch	CP1-1026 DPDT		AK	087100	⚡
1	Power Supply	LSP-12-24		SA	087100	⚡
1	Card Reader	Furnished by Security				
1	Wiring Diagram	Elevation and Point to Point as Specified				

Notes: Operational Narrative:
1. Doors normally closed and secure.
2. Authorized access by card reader retracting exit device latches for predetermined time limit. Exit device latches can be electrically held retracted for open access.
3. Egress free for immediate exit.
4. REX switch in push rail allows authorized exit without alarm condition.
5. Door position switches monitor open/closed status.
6. Exit device latches release (fail secure) in event of power loss. Keyed cylinder override for emergency access.

END OF SECTION

SECTION 081113

HOLLOW METAL DOORS AND FRAMES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 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. Related Sections:
   1. Division 01 Section "General Conditions”.
   2. Division 04 Section "Masonry".
   3. Division 06 Section “Rough Carpentry”.
   4. Division 06 Section “Finish Carpentry”.
   5. Division 08 Section “Operations and Maintenance”.
   6. Division 08 Section “Flush Wood Doors”.
   7. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
   8. Division 08 Section "Glazing".
   9. Division 08 Section "Door Hardware”.
   10. Division 09 Sections "Painting".
   11. Division 26 Section "Electrical”.

C. 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. Energy Efficient Exterior Openings: Comply with minimum thermal ratings, based on SDI-113, ASTM C1363, ASTM C1199 and ASTM E1423. Openings to be fabricated and tested as fully operable, thermal insulating door and frame assemblies.
   1. Thermal Performance (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with SDI-113, ASTM C1363, ASTM C1199 and ASTM E143 and meet or exceed the following requirements:
      a. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.34, R-Value 2.92, including insulated door, thermal-break frame and threshold.
   2. Air Infiltration (Exterior Openings): Independent testing laboratory certification for exterior door assemblies being tested in accordance with ASTM E283 to meet or exceed the following requirements:
      a. Rate of leakage of the door assembly shall not exceed 0.25 cfm per square foot of static differential air pressure of 1.567 psf (equivalent to 25 mph wind velocity).

F. 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).

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 (Energy Efficient): Face sheets fabricated of commercial quality hot-dipped zinc coated steel that complies with ASTM A924 A60. Provide doors complying with requirements indicated below by referencing ANSI/SDI A250.8 for level and model, ANSI/SDI A250.4 for physical performance level, and HMMA 867 for door construction.
   1. Design: Flush panel.
   2. Core Construction: Foamed in place polyurethane and steel stiffened laminated core with no stiffener face welds or thermally enhanced stiffened laminated core with no stiffener face welds, in compliance with HMMA 867 “Laminated Core”.
      a. Provide 22-gauge steel stiffeners at 6 inches on-center internally welded at 5" on-center to integral core assembly, foamed in place polyurethane core chemically bonded to all interior surfaces. No stiffener face welding is permitted.
      b. Thermal properties to rate at a fully operable minimum U-Factor 0.34 and R-Value 2.92, including insulated door, thermal-break frame and threshold.
      c. Kerf Type Frames: Thermal properties to rate at a fully operable minimum U-Factor 0.38 and R-Value 2.6, including insulated door, kerf type frame, and threshold.
   3. Vertical Edges: Vertical edges to be mechanically interlocked with hairline seam. Beveled Lock Edge, 1/8 inch in 2 inches (3 mm in 50 mm).
   4. 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.
5. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
6. 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. 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.
5. 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.
6. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

D. Manufacturers Basis of Design:
1. CECO Door Products (C) Polystyrene Core - Legion Series.
2. CECO Door Products (C) Energy Efficient - Trio-E Series.

E. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.

F. 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.

G. 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. CECO Door Products (C) - SU Series.
   b. CECO Door Products (C) - Mercury 3 Thermal Break TQB Series.

H. 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:
   a. CECO Door Products (C) - DU Series.

b. CECO Door Products (C) - SU Series.

I. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

J. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.4 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.

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.

2.5 LOUVERS

A. Metal Louvers: Unless otherwise indicated provide louvers to meet the following requirements.
1. Blade Type: Vision proof inverted V or inverted Y.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

B. Louvers for Fire Rated Doors: Metal louvers with fusible link and closing device, listed and labeled for use in doors with fire protection rating of 1-1/2 hours and less.
1. Manufacturers: Subject to compliance with requirements, provide louvers to meet rating indicated.
2. Metal and Finish: Galvanized steel, 0.040 inch thick, factory primed for paint finish with baked enamel or powder coated finish. Match pre-finished door paint color where applicable.

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.

E. Glazing: Comply with requirements in Division 08 Section "Glazing" and with the hollow metal door manufacturer's written instructions.
   1. Factory Glazing: Factory install glazing in doors as indicated. Doors with factory installed glass to include all of the required glazing material.

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. Astragals: Provide overlapping astragals as noted in door hardware sets in Division 08 Section "Door Hardware" on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating or where indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted.
   4. 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

SECTION 081416

FLUSH WOOD DOORS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:
   1. Wood doors hung in hollow metal frames at locations indicated on Drawings.

B. Principal Products:
   1. Solid core wood doors.
   2. Glazed light frames.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door.
   1. Core, edge, and face construction.
   2. Glazing trim materials.
   3. Finishing materials and systems.

B. Shop Drawings: Indicate location, size, and hand of each door; elevation of each kind of door; and construction details.
   1. Blocking sizes and locations.
   2. Hardware preparation sizes and locations.
   3. Glazing sizes and locations.
   4. Factory finishes.
   5. Fire-protection ratings.

C. Samples for Initial Selection:
   1. Factory-finished doors.

D. Samples for Verification:
   1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
   2. Door corner sections, approximately 8 by 10 inches, showing door faces, crossbands, core, and edges.
      a. Provide Samples for each species of veneer and solid lumber.

b. Finish veneer-faced door Samples with same materials proposed for factory-finished doors.

3. Glazed light frames, 6 inches long, for each material, type, and finish.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

B. Quality Standard Compliance Certificates: AWI Quality Certification.

1.5 QUALITY ASSURANCE

A. Manufacturer Qualifications:
1. Certified participant in AWI's Quality Certification Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer's written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during remainder of construction period.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.
2. Warranty Period for Solid-Core Interior Doors: Life of installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Eggers Industries.
   2. Masonite Architectural.
   3. TruStile.
   4. VT Industries, Inc.

B. Source Limitations: Obtain flush wood doors from single manufacturer.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard:
   1. WDMA I.S.1-A, "Architectural Wood Flush Doors.
   2. Provide AWI Quality Certification Labels indicating that doors comply with requirements of grades specified.

B. WDMA I.S.1-A Performance Grade: Heavy Duty, minimum.

C. Fire-Rated Wood Doors: Doors 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 or UL 10C.
   1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
   2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.
   3. Pairs: Provide fire-retardant stiles that are listed and labeled for applications indicated without formed-steel edges and astragals. Provide stiles with concealed intumescent seals. Comply with specified requirements for exposed edges.

D. Structural-Composite-Lumber-Core Doors:
   1. Structural Composite Lumber: WDMA I.S.10.
      a. Screw Withdrawal, Face: 700 lbf.
      b. Screw Withdrawal, Edge: 400 lbf.

E. Mineral-Core Doors:
   1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
   2. Blocking: Provide composite blocking with improved screw-holding capability approved for use in doors of fire-protection ratings indicated asneeded to eliminate through-bolting hardware.
   3. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.
      a. Screw-Holding Capability: 550 lbf per WDMA T.M.-10.

2.3 INTERIOR SOLID CORE WOOD DOORS

A. Door Grade:
   1. Premium, with Grade A faces.

B. Veneer Species:
   1. Select hard white maple.

C. Veneer Cut:
   1. Plain sliced (flat sliced).

D. Match between Veneer Leaves:
   1. Book match.

E. Assembly of Veneer Leaves on Door Faces: Balance match.

F. Pair and Set Match: Provide for doors hung in same opening.

G. Exposed Vertical and Top Edges: Same species as faces or a compatible species - edge Type A.

H. Core:
   1. Structural composite lumber.
   2. Mineral core when required for fire resistance rating.

I. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.

2.4 GLAZED LIGHT FRAMES

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer's standard wood beads unless otherwise indicated.
   1. Wood Species: Same species as door faces.
   2. Profile: Flush rectangular beads.

B. Metal Frames for Light Openings in Fire-Rated Doors: Manufacturer's standard frame formed of 0.048-inch- (1.2-mm-) thick, cold-rolled steel sheet; factory primed for paint with baked-enamel- or powder-coated finish; and approved for use in doors of fire-protection rating indicated.

2.5 FABRICATION

A. Factory fit doors to suit frame-opening sizes indicated. Comply with clearance requirements of referenced quality standard for fitting.
   1. Comply with NFPA 80 requirements for fire-rated doors.

B. Factory machine doors for hardware that is not surface applied.
   1. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.
   2. Coordinate with hardware mortises in metal frames to verify dimensions and alignment before factory machining.

C. Openings: Factory cut and trim openings through doors.
   1. Glazed Light Openings: Trim openings with specified moldings.
   2. Glazing: Factory install glazing in doors indicated to be factory finished. Comply with Section 088000 "Glazing."

2.6 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.
   1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors that are indicated to receive transparent finish.

C. Transparent Finish:
   1. Grade: Premium.
   2. Finish: AWI's, AWMAC's, and WI's "Architectural Woodwork Standards" System 11, catalyzed polyurethane.
   3. Staining: None required.
   4. Sheen: Satin.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine doors and installed door frames, with Installer present, before hanging doors.
   1. Verify that installed frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with level heads and plumb jambs.
   2. Reject doors with defects.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Hardware: For installation, see Section 087100 "Door Hardware."

B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
   1. Install fire-rated doors according to NFPA 80.

C. Align in frames for uniform clearance at jamb and head edges.

D. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.

END OF SECTION

SECTION 083100

ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes.
   1. Wall and ceiling access doors and panels.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordinate sizes and locations with controls, valves, traps, dampers, cleanouts, and similar items requiring operation that are located behind finished surfaces.

B. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one month, minimum, before starting Work of this Section.
   2. Additional Attendees: Installer and Prime Contractor.

1.3 ACTION SUBMITTALS

A. Product Data: Sizes, types, finishes, hardware, scheduled locations, fire resistance listings, and details of adjoining Work.
   1. Initial selection color charts.

B. Shop Drawings:
   1. Locations and sizes of wall and ceiling access doors.

C. Samples: 12 by 12 inch unit with required frame, anchors, and finish.
   1. Samples will be returned to Contractor for installation in Project.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations and sizes of access doors and panels.

B. Maintenance data.

1.5 QUALITY ASSURANCE

A. Qualifications:
   1. Fire Rated Door Inspector: NFPA 80, section 5.2.3.1.

B. Field Samples: Install access doors for each type in locations acceptable to Architect.
   1. Approved Samples establish Work results standard.

PART 2 PRODUCTS

2.1 WALL AND CEILING ACCESS DOORS AND PANELS

A. Flush Steel Access DoorsRefer to drawings.: Flush door with exposed frame; non rated.
   1. Manufacturers and Products:
      a. Babcock-Davis BNT.
      b. Karp Associates DSC-214M.
      c. Milcor M.
      d. Nystrom NT.
      e. Williams Brothers Corporation of America WB Basic 300 Series.
   2. Material: Steel sheet; ASTM A879.
      a. Door: 0.062 and 0.075 inch thick, nominal.
      b. Frame: 0.062 inch thick, nominal.
      c. Finish: Factory primed.
   3. Hinges: Continuous.
   4. Latches: Screw driver operation.
   5. Accessories:
      a. Gasketing.
      b. Masonry anchors.

B. Gypsum Board Access DoorsRefer to drawings: Flush door with frame flanges concealed by gypsum board joint finishing compound.
   1. Manufacturers and Products:
      a. Babcock-Davis BNW.
      b. Bauco Access Panel Solutions Inc. BAUCO plus II.
      c. Karp Associates KDW.
      d. Milcor DW.
      e. Nystrom NW.
      f. Williams Brothers Corporation of America WB DW 400 Series.
   2. Material: Steel sheet; ASTM A879.
      a. Door: 0.062 inch thick, nominal.
      b. Frame: 0.062 inch thick, nominal.
      c. Finish: Factory primed.
   3. Hinges: Continuous.
   4. Latches: Screw driver operation.
   5. Accessories:
      a. Gasketing.
      b. Masonry anchors.

C. Fire Rated Access DoorsRefer to drawings: Flush doors with concealed flange.
   1. Manufacturers and Products:
      a. Acudor FB-5050-DW.
      b. Babcock Davis BUW.
      c. Nystrom IW.

d. Williams Brothers Corporation of America FR-DW Series.
2. Door Construction: Mineral fiber insulation enclosed in sheet metal.
3. Material: Steel sheet; ASTM A879.
   a. Door: 0.036 inch thick, nominal.
   b. Frame: 0.062 inch thick, nominal.
   c. Finish: Factory primed.
4. Material: Galvannealed steel sheet; ASTM A653.
   a. Door: 0.04 inch thick, nominal.
   b. Frame: 0.064 inch thick, nominal.
   c. Finish: Powder coat primer.
5. Hinges: Concealed continuous type.
6. Latches: Self-closing, self-latching hardware, Screwdriver.
7. Accessories:
   a. Gasketing.
   b. Masonry anchors.

2.2 PERFORMANCE

A. Fire Rated Access Door Construction:
   1. Wall Access Doors: NFPA 252 or UL 10B.
   2. Ceiling Access Doors: ASTM E119 or UL 263.

B. Fire Rated Floor Door: Tested in accordance with NFPA 288.

C. Installed Fire Rated Access Door Assembly: Conform to NFPA 80 for rating shown on Drawings.

D. Attach label from agency approved by authority having jurisdiction to identify each fire rated access door.

2.3 MATERIALS

A. Steel Sheet: ASTM A1008, cold rolled.

2.4 FABRICATION

A. Welded Units: Fabricate units of continuous welded construction; weld, fill, and grind exposed joints flush and smooth.

B. Size Variations: Obtain acceptance of manufacturers standard size units which vary slightly from sizes shown or scheduled.

C. Provide manufacturers recommended anchorage fasteners for Project applications.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify rough openings for access doors and panels are correctly sized and located.

3.2 INSTALLATION

A. Secure frames rigidly in place, plumb and level in opening, with plane of door and panel face parallel to adjacent finished surface.
   1. Set concealed frame type units flush with adjacent finished surfaces.

B. Position units to provide convenient access to concealed Work requiring access.

C. Install fire rated units in accordance with NFPA 80 and requirements for fire listing.

3.3 FIELD QUALITY CONTROL

A. Fire Rated Access Panels: Inspect per NFPA 80, section 5.2.

B. Non Conforming Work: Remove and replace, and retest.

END OF SECTION

SECTION 084113

ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Interior storefront framing.
2. Exterior storefront framing.
3. Exterior and interior manual-swing entrance doors and door-frame units.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

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 aluminum-framed entrances and storefronts. 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 aluminum-framed entrances and storefronts, showing the following:
a. Joinery, including concealed welds.
b. Anchorage.
c. Expansion provisions.
d. Glazing.
e. Flashing and drainage.
3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Fabrication Sample: Of each vertical-to-horizontal intersection of assemblies, made from 12-inch lengths of full-size components and showing details of the following:
   1. Joinery, including concealed welds.
   2. Anchorage.
   3. Expansion provisions.
   4. Glazing.
   5. Flashing and drainage.

E. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams. Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

F. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
   1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

B. Product Test Reports: For aluminum-framed entrances and storefronts, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Source quality-control reports.

D. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

B. 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.
   1. Do not change intended aesthetic effects, as judged solely by Architect, except with

Architect's approval. If changes are proposed, submit comprehensive explanatory data to Architect for review.

1.7 WARRANTY

A. Special Warranty: Manufacturer Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Structural failures including, but not limited to, excessive deflection.
      b. Noise or vibration created by wind and thermal and structural movements.
      c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      d. Water penetration through fixed glazing and framing areas.
      e. Failure of operating components.
   2. Warranty Period: Two 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. 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. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.
   1. Aluminum-framed entrances and storefronts 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.

C. Structural Loads:
1. Wind Loads: As indicated on Drawings.
2. Other Design Loads: As indicated on Drawings.

D. Structural: Test according to ASTM E 330 as follows:
1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

E. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
1. Entrance Doors:
a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

F. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 8 lbf/sq. ft.

G. Energy Performance: Certify and label energy performance according to NFRC as follows:
1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.45 Btu/sq. ft. x h x deg Fas determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.

H. Thermal Movements:
1. Allow for thermal movements resulting from ambient and surface temperature changes:
a. 0°F (-18 C) to 180°F (82 C) maximum change (range) in ambient and surface temperatures.
b. 75°F (24 C) test interior ambient air temperature.
2. Test performance shows no buckling; stress on glass; sealant failure; excess stress on framing, anchors, and fasteners; or reduction of performance when tested according to AAMA 501.5 for a minimum 3 cycles.

2.2 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide product by one of the following:
1. Kawneer North America; VG TriFab 451, VG TriFab 451T, 500T wide stile with 1” IGU as basis of design or comparable product buy one of the following:

2. EFCO Corporation.
3. TRACO.
4. Tubelite.
5. YKK AP America Inc.

B. Source Limitations: Obtain all components of aluminum-framed entrance and storefront system, including framing and accessories, from single manufacturer.

2.3 INTERIOR FRAMING

A. Interior Framing Members; Basis of Design VG TriFab 451: Manufacturer's extruded-or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.
1. Construction: Non-thermally broken.
2. Glazing System: Retained mechanically with gaskets on four sides.
3. Glazing Plane: Center.
4. Finish: 70% PVDF fluoropolymer-based coating Medium Blue 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.

D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.
2. 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.
a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
c. Hot-Rolled Sheet and Strip: ASTM A 011/A 1011M.

2.4 EXTERIOR FRAMING - MULLIONS

A. Exterior Framing Members; Basis of Design VG TriFab 451T: 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: Center.
4. Finish: 70% PVDF fluoropolymer-based coating Medium Blue 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.

D. Materials:
1. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
a. Sheet and Plate: ASTM B 209.
b. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.
c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
d. Structural Profiles: ASTM B 308/B 308M.
2. 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.
a. Structural Shapes, Plates, and Bars: ASTM A 36/A 36M.
b. Cold-Rolled Sheet and Strip: ASTM A 1008/A 1008M.
c. Hot-Rolled Sheet and Strip: ASTM A 011/A 1011M.

2.5 EXTERIOR ENTRANCE DOOR SYSTEMS

A. Entrance Doors; Basis of Design Insulpor 500T Wide Stile Door: Manufacturer's standard glazed entrance doors for manual-swing operation.
1. Door Construction: 2-1/4-inch overall thickness, with minimum 0.125-inch-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 with 10” bottom rail.
3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
a. Provide nonremovable glazing stops on outside of door.
4. Finish: 70% PVDF fluoropolymer-based coating Medium Blue finish.

2.6 INTERIOR ENTRANCE DOOR SYSTEMS

A. Entrance Doors; Basis of Design 500 Wide Stile Door: Manufacturer's standard glazed entrance doors for manual-swing operation.
   1. Door Construction: 1-3/4-inch overall thickness, with minimum 0.125-inch-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.
   2. Door Design: Wide Stile with 10” bottom rail.
   3. Glazing Stops and Gaskets: Square, snap-on, extruded-aluminum stops and preformed gaskets.
      a. Provide nonremovable glazing stops on outside of door.
   4. Finish: 70% PVDF fluoropolymer-based coating Medium Blue finish.

2.7 ENTRANCE DOOR HARDWARE

A. Entrance Door Hardware: Hardware not specified in this Section is specified in Section 087100 "Door Hardware."

B. Weather Stripping: Manufacturer's standard replaceable components.
   1. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

C. Weather Sweeps: Manufacturer's standard exterior-door bottom sweep with concealed fasteners on mounting strip.

2.8 GLAZING

A. Glazing: Comply with Section 088000 "Glazing."

B. Glazing Gaskets: Manufacturer's standard compression types; replaceable, extruded EPDM rubber.

C. Spacers and Setting Blocks: Manufacturer's standard elastomeric type.

2.9 ACCESSORIES

A. 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.

B. 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.

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

D. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.10 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. 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 interior.
   6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

C. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.
   1. At exterior doors, provide compression weather stripping at fixed stops.
   2. At interior doors, provide silencers at stops to prevent metal-to-metal contact. Install three silencers on strike jamb of single-door frames and two silencers on head of frames for pairs of doors.

D. Entrance Doors: Reinforce doors as required for installing entrance door hardware.
   1. At pairs of exterior doors, provide sliding-type weather stripping retained in adjustable strip and mortised into door edge.
   2. At exterior doors, provide weather sweeps applied to door bottoms.

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.

2.11 ALUMINUM FINISHES

A. 70% PVDF, AAMA 2605, Fluoropolymer Coating, Color Medium Blue.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas, 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 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 perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:
   1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
   2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 079200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

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.

3.3 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:
   1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
   2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
   3. Alignment:
      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch wide, limit offset from true alignment to 1/16 inch.
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
      c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.
   4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

END OF SECTION

SECTION 084523

FIBERGLASS-SANDWICH-PANEL ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes the insulated sandwich panel system and accessories as shown and specified. Work includes providing and installing:
   1. Wall assemblies.
   2. Skylight assemblies.

1.2 SUBMITTALS

A. Submit manufacturer's product data. Include construction details, material descriptions, profiles and finishes of components.

B. Submit shop drawings. Include plans, elevations and details.

C. Submit samples representing manufacturer's product:
   1. Submit manufacturer's color charts showing the full range of colors available for factory finished aluminum. When requested, submit samples for each exposed finish, in 5" long sections for the same thickness and material indicated for the work.
   2. When requested, submit manufacturer's sample panels in same thickness and material indicated for the work: Sandwich panels: 14" x 28."

D. Submit Installer Certificate, signed by installer, certifying compliance with project qualification requirements.

E. Submit product reports from a qualified independent 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 reports will be acceptable if for current manufacturer and indicative of products used on this project.
   1. Reports required (if applicable) are:
      a. International Building Code Evaluation Report (AC 177).
      b. Flame Spread and Smoke Developed (UL 723) - Submit UL Card.
      c. Burn Extent (ASTM D 635).
      d. Color Difference (ASTM D 2244).
      e. Impact Strength (UL 972).
      f. Bond Tensile Strength (ASTM C 297 after aging by ASTM D 1037).
      g. Bond Shear Strength (ASTM D 1002).
      h. Beam Bending Strength (ASTM E 72).
      i. Insulation U-Factor (NFRC 100).
      j. NFRC System U-Factor Certification (NFRC 700).

k. NFRC Visible Light Transmittance (NFRC 202).
l. Solar Heat Gain Coefficient (NFRC or Calculations).
m. Condensation Resistance Factor (AAMA 1503) (Insulated Thermally Broken only).
n. Air Leakage (ASTM E 283).
o. Structural Performance (ASTM E 330).
p. Water Penetration (ASTM E 331).
q. 1200°F Fire Resistance (SWRI).
r. ASTM E1886/1996 or TAS 201, 202 and 203 (Optional-Windborne Debris).
s. Performance for Windows (AAMA/WDMA/CSA-101/I.S.2/A440) (Optional).
t. Fall Through Resistance (ASTM E 661) (Optional).
u. Class A Roof Covering Burning Brand (UL 790) (Skylight only).

1.3 CLOSEOUT SUBMITTALS

A. Provide field maintenance manual to include in project maintenance manuals.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications:
1. Material and products shall be manufactured by a company continuously and regularly employed in the manufacture of specified materials for a period of at least ten consecutive years and which can show evidence of those materials being satisfactorily used on at least six projects of similar size, scope and location. At least three of the projects shall have been in successful use for ten years or longer.
2. Panel system must be listed by an ANSI accredited Evaluation Service, which requires quality control inspections and fire, structural and water infiltration testing of sandwich panel systems by an accredited agency.
3. Quality control inspections shall be conducted at least once each year and shall include manufacturing facilities, sandwich panel components and production sandwich panels for conformance with AC177 "Translucent Fiberglass Reinforced Plastic (FRP) Faced Panel Wall, Roof and Skylight Systems" as issued by the ICC-ES.

B. Installer's Qualifications: Installation shall be by an experienced installer, which has been in the business of installing specified panel systems for at least two consecutive years and can show evidence of satisfactory completion of projects of similar size, scope and type.

1.5 PERFORMANCE REQUIREMENTS

A. The manufacturer shall be responsible for the configuration and fabrication of the complete panel system.
1. When requested, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.
2. Standard panel system shall have less than 0.01 cfm/ft² air leakage by ASTM E 283 at 6.24 PSF (50 mph) and no water penetration by ASTM E 331 at 15 PSF; and structural testing by ASTM E 330.
3. Structural Loads (Wall Assemblies). Provide system capable of handling the following loads:

a. Positive Wind Load (PSF): 30 PSF.
b. Negative Wind Load (PSF): 30 PSF.

4. Structural Loads (Skylight Assemblies). Provide system capable of handling the following loads:
   a. Live Load (PSF): 30 PSF.
   b. Snow Load (PSF): 30 PSF.
   c. Drift Load (PSF): 0 PSF.
   d. Wind Load (PSF): 30 PSF.

B. Deflection Limits:
1. Wall Panel Assemblies: Limited to L/120 of clear span for each assembly component.
2. Skylight Panel Assemblies: Limited to L/60 of clear span for each assembly component.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver panel system, components and materials in manufacturer's standard protective packaging.

B. Store panels on the long edge; several inches above the ground, blocked and under cover in accordance with manufacturer's storage and handling instructions.

1.7 WARRANTY

A. Provide manufacturer's and installer's written warranty agreeing to repair or replace panel system work, which fails in materials or workmanship within five years from the date of delivery. Failure of materials or workmanship shall include excessive deflection, deterioration of finish on metal in excess of normal weathering, defects in accessories, insulated translucent sandwich panels and other components of the work.

B. Alternate Aerogel panel: Material or workmanship warranty is within one year from date of delivery.

PART 2 PRODUCTS

2.1 MANUFACTURER

A. The basis for this specification is for products manufactured by Kalwall Corporation. Other manufacturers may bid this project subject to compliance with the performance requirements of this specification and submission of evidence thereof. Listing other manufacturers' names in this specification does not constitute approval of their products or relieve them of compliance with all the performance requirements contained herein.

B. Kalwall Corporation, Tel: (800) 258-9777 - Fax: (603) 627-7905 - Email: info@kalwall.com.

2.2 PANEL COMPONENTS

A. Face Sheets:
   1. Translucent faces: Manufactured from glass fiber reinforced thermoset resins, formulated specifically for architectural use.
      a. Thermoplastic (e.g. polycarbonate, acrylic) faces are not acceptable.
      b. Face sheets shall not deform, deflect or drip when subjected to fire or flame.
   2. Interior face sheets:
      a. Flame spread: Underwriters Laboratories (UL) listed, which requires periodic unannounced retesting, with flame spread rating no greater than 50 and smoke developed no greater than 250 when tested in accordance with UL 723.
      b. Burn extent by ASTM D 635 shall be no greater than 1".
   3. Exterior face sheets:
      a. Color stability: Full thickness of the exterior face sheet shall not change color more than 3 CIE Units DELTA E by ASTM D 2244 after 5 years outdoor South Florida weathering at 5° facing south, determined by the average of at least three white samples with and without a protective film or coating to ensure long-term color stability. Color stability shall be unaffected by abrasion or scratching.
      b. Strength: Exterior face sheet shall be uniform in strength, impenetrable by hand held pencil and repel an impact minimum of 70 ft. lbs. without fracture or tear when impacted by a 3-1/4" diameter, 5 lb. free-falling ball per UL 972.
      c. Strength: Exterior face sheet shall be uniform in strength, with panel meeting ASTM E1996 and ASTM E1886 or TAS 201, 202 and 203.
      d. Erosion Protection: Integral, embedded-glass erosion barrier.
   4. Appearance:
      a. Exterior face sheet: Smooth, 0.070" thick and Crystal in color.
      b. Interior face sheet: Smooth, 0.045" thick and White in color.
      c. Face sheets shall not vary more than ± 10% in thickness and be uniform in color.

B. Grid Core:
   1. Thermally Broken Composite I-beam grid core shall be of 6063-T6 or 6005-T5 alloy and temper with provisions for mechanical interlocking of muntin-mullion and perimeter. Width of I-beam shall be no less than 7/16".
   2. Thermally Broken Composite I-beam Thermal break: Minimum 1", thermoset fiberglass composite. Pour and debridge thermal break is not acceptable.

C. Laminate Adhesive:
   1. Heat and pressure resin type adhesive engineered for structural sandwich panel use, with minimum 25-years field use. Adhesive shall pass testing requirements specified by the International Code Council "Acceptance Criteria for Sandwich Panel Adhesives".
   2. Minimum tensile strength of 750 PSI when the panel assembly is tested by ASTM C 297 after two exposures to six cycles each of the aging conditions prescribed by ASTM D 1037.
   3. Minimum shear strength of the panel adhesive by ASTM D 1002 after exposure to four separate conditions:
      a. 50% Relative Humidity at 68° F: 540 PSI.
      b. 182° F: 100 PSI.
      c. Accelerated Aging by ASTM D 1037 at room temperature: 800 PSI.
      d. Accelerated Aging by ASTM D 1037 at 182° F: 250 PSI.

2.3 PANEL CONSTRUCTION

A. Provide sandwich panels of flat fiberglass reinforced translucent face sheets laminated to a grid core of mechanically interlocking I-beams. The adhesive bonding line shall be straight, cover the entire width of the I-beam and have a neat, sharp edge.
   1. Thickness: 2-3/4 inches.
   2. Visible Light Transmittance (VLT): Visible LT (NFRC 202 - Center of Glazing Panel) by NFRC certified laboratory: 13%.
   3. Solar heat gain coefficient: 0.18.
   4. Panel U-factor by NFRC certified laboratory: 2-3/4" thermally broken grid: 0.14.
   5. Complete insulated panel system for walls shall have NFRC certified U-factor of:.19.
   6. Complete insulated panel system for skylights shall have NFRC certified U-factor of:.21.
   7. Grid pattern as viewed:
      a. Walls: Nominal size: 8" x 20"; pattern: Shoji.
      b. Skylights: Nominal size: 12" x 24"; pattern: Shoji.

B. Standard panels shall deflect no more than 1.9" at 30 PSF in 10'-0" span without a supporting frame by ASTM E 72.

C. Standard panels shall withstand 1200° F fire for minimum one hour without collapse or exterior flaming.

D. Thermally broken panels with translucent insulation: Minimum Condensation Resistance Factor (CRF) of 80 by AAMA 1503 measured on the bond line. System CRF varies based on application.

E. Skylight System shall pass Class A Roof Burning Brand Test by UL 790.

F. Skylight System shall meet the fall through requirements of OSHA 1910.23 as demonstrated by testing in accordance with ASTM E 661, thereby not requiring supplemental screens or railings.

2.4 BATTENS AND PERIMETER CLOSURE SYSTEM

A. Closure system (Skylight):
   1. Extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system.
   2. Skylight perimeter closures at curbs shall be factory sealed to panels.

B. Closure system (Wall):
   1. Standard Thermally Broken extruded aluminum 6063-T6 and 6063-T5 alloy and temper clamp-tite screw type closure system. Thermal Barrier shall consist of Pour and debridge structural polyurethane.

C. Sealing tape: Manufacturer's standard, pre-applied to closure system at the factory under controlled conditions.

D. Fasteners: 300 series stainless steel screws for aluminum closures, excluding final fasteners to the building.

E. Finish:
   1. Manufacturer's factory applied finish, which meets the performance requirements of AAMA 2604. Color to be selected from manufacturer's standards.

PART 3 EXECUTION

3.1 EXAMINATION

A. Installer shall examine substrates, supporting structure and installation conditions.

B. Do not proceed with panel installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. 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 recommended by manufacturer for this purpose.
   2. Where aluminum will contact concrete, masonry or pressure treated wood, protect against corrosion by painting contact surfaces with bituminous paint or method recommended by manufacturer.

3.3 INSTALLATION

A. Install the panel system in accordance with the manufacturer's suggested installation instructions and approved shop drawings.
   1. Anchor component parts securely in place by permanent mechanical attachment system.
   2. Accommodate thermal and mechanical movements.
   3. Set perimeter framing in a full bed of sealant compound, or with joint fillers or gaskets to provide weather-tight construction.

B. Install joint sealants at perimeter joints and within the panel system in accordance with manufacturer's suggested installation instructions and approved shop drawings.

3.4 FIELD QUALITY CONTROL (SKYLIGHT)

A. Water Test: Installer to test skylights according to procedures in AAMA 501.2.

B. Repair or replace work that does not pass testing or that is damaged by testing and retest work.

3.5 CLEANING

A. Clean the panel system interior and exterior, immediately after installation.

B. Refer to manufacturer's written recommendations.

END OF SECTION

SECTION 085680

INTERIOR TRANSACTION WINDOW

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Interior transaction window.

1.2 REFERENCE

A. Underwriters Laboratory UL 752-Standard for Bullet Resisting Equipment & ASTM E119-98-Standard Test Methods for Fire Tests of Building Construction and Materials, NIJ Standard 0108.01-(National Institute of Justice) Standard for Ballistic Resistant Protective Materials, ASTM B 209/B 209M- Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate, ASTM A 666-Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate and Flat Bar.

1.3 ACTION SUBMITTALS

A. Submit for approval prior to fabrication: samples, product data (including preparation, storage and installation methods), cuts & anchor spacing, reinforcement & location, product specifications, shop drawings, test reports (current UL Listing Verification & UL 752 Test Results as provided by Underwriters Laboratories), and printed data in sufficient detail to indicate compliance with the contract documents.

B. Manufacturer’s Instructions for installation and cleaning Transaction Window Assemblies. All required submittals shall be approved prior to installation.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For transaction window assemblies to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Manufacturer shall be a Company that specializes in manufacturing products of the specified type with a minimum of five years experience. Installer shall be a Company that specializes in

product type specified and Certified for the installation by the manufacturer.

1.6 DELIVERY, STORAGE & HANDLING

A. Handle the materials with care to prevent damage. Store materials inside and under cover, stack flat and off floor. Project conditions (temperature, humidity, and ventilation) shall be within the maximum limit recommendations set by manufacturer. Do not install products that are under conditions outside these limits.

1.7 WARRANTY

A. All materials shall be warranted against defects for a period of 1 year for the date of receipt at the project site. Certificates of manufacturer’s standard limited warranty shall be provided at project completion.

PART 2 PRODUCTS

2.1 DESIGN PERFORMANCE

A. Through the design, manufacturing techniques and material application the Interior Transaction Window with Package Exchanger: shall be of the “non-ricochet” type. This design is intended to permit the encapture and retention of an attacking projectile lessening the potential of a random injury or lateral penetration. This design shall employ a voice port for sound transmission. Each transaction position shall have a stainless-steel cash tray as shown on the drawings. Components must be manufactured in strict accordance with the specifications, design and details. All vision panels shall be cut to size with all exposed edges polished. Necessary holes shall be pre-drilled and tapped where required. Stainless Steel assembly screws and acrylic spacers shall be provided. Frame and channel shall be provided. Anchor screws shall be provided by the installer.

B. No field alterations to the construction of the units fabricated under the acceptable standards shall be allowed unless approved by the manufacturer and the architect. Standard manufacturing tolerances shall be +/- 1/16".

C. Materials shall meet or exceed UL 752 requirements.

2.2 ACCEPTABLE MANUFACTURERS

A. Basis of Design: Total Security Solutions, Inc, 170 National Park Drive, Fowlerville, MI 48836, 800-513-1468. Attn: Sales Department, info@tssbulletproof.com. Web: www.tssbulletproof.com.
   1. Acceptable Manufacturer: Chicago Bullet Proof Systems, Inc, 2595 Bond Street, University Park, IL 60484 US, 708-534-9102, www.chicagobulletproof.com, Beni@chicagobulletproof.com.

B. Products that meet material and performance requirements with specified and validated third party testing, are acceptable. “Equal products” shall be required to be pre-submitted and approved.

2.3 BULLET RESISTANT INTERIOR TRANSACTION WINDOW WITH PACKAGE EXCHANGER

A. Basis of Design: TSS Interior Transaction Window with Package Exchanger: The window system consists of custom prefabricated bullet resistant panels with secure air passage as required for voice transmission. Includes frame with a recessed cash tray. All accessories for installation are to be included.

B. Glazing Options:
   1. Bullet-Resisting Glazing Material Options:
      a. Bullet Resistant Level 3 - 1 1/4" LP 1250 Laminated.

C. Cash tray: Brushed Stainless Steel Counter Mounted.
   1. Cash tray to be 18 ga. stainless steel, # 4 finish 16" x 10" from the outside edge of flanges with a clear opening.
   2. Tray to be integrated into casework counter. See the drawings for the shelf materials and design in which the tray is installed.

D. Frame Finish: Aluminum - Black anodized.
   1. Aluminum sections to be manufactured in accordance with ASTM B209, Extruded aluminum alloy 6063 T5 Anodized or powder coated finish to match the existing décor and be free of sharp edges or burrs when in place. Glazing Channel: U-Channel specifically designed for securing transparencies tightly in place. Angles and stops are only acceptable for top attachment.
   2. Frame to be black anodized aluminum. The bottom of the glazing to be capped with corresponding material on the frame.

2.4 BULLET RESISTANT ACRYLIC PACKAGE PASSER

A. Basis of Design: TSS PE Acrylic Package Passer (interlocking). The PE package passer consists of a rectangular box built from transparent bullet resistant glazing material, with doors on the customer and employee sides. A mechanical interlocking mechanism hinged door control, prevents the opening of both doors simultaneously, allowing small packages to be passed through a barrier without a breach of security.
   1. Base Finish - Provide stainless steel 18 ga. #4 finish.

B. Option is available for applications requiring the passage of large to very large packages or equipment.

C. Product size shall be: TSS PE Acrylic Package Passer.
   1. Size shall be Standard size: OD 14”W x 14” H x 16” D.
   2. Security Level shall be: Bullet Resistant Level 3 - 1 1/4" LP 1250 Laminated.

PART 3 EXECUTION

3.1 PREPERATION

A. Prior to installing the bullet resistant material, the contractor shall verify that all supports have been installed as required by the contract documents and architectural drawings, and approved shop/CAD drawings, if required. Installer shall notify architect of any unsatisfactory preparation that's the responsibility of another installer.

B. Clean and prepare all surfaces per manufacturer's recommendations for achieving the best results for the substrate under the project conditions.

3.2 INSTALLATION

A. Do not begin installation until openings have been verified and surfaces properly prepared in accordance with Drawings. Install in accordance with manufacturer's instructions and UL 752. Set all equipment plumb. All products shall be installed per instructions provided by Total Security Solutions, if warranty is to be issued.

B. Interior Transaction Window with PE: shall arrive on site as a completed unit. Unit shall be installed in provided opening (wall/door), secured to structure (anchors by others).

3.3 POST APPLICATION

A. Interior Transaction Window with PE: shall be installed in accordance with manufacturer's printed recommendations, including adhering to anchoring and finishing details.

B. Inspection and Cleaning: Verify installation is complete and complies with manufacturer's requirements. Clean product and accessories, removing excess sealant, labels and protective covers.

C. Touch-up, repair or replace damaged products before Substantial Completion.

D. Product Warranty: Applicable warranty shall be issued to owner upon final release of completed project.

END OF SECTION

SECTION 087100

DOOR HARDWARE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes commercial door hardware for the following:
   1. Swinging doors.
   2. Other doors to the extent indicated.

D. Door hardware includes, but is not necessarily limited to, the following:
   1. Mechanical door hardware.
   2. Electromechanical door hardware.

E. Related Sections:
   1. Division 01 Section "General Conditions”.
   2. Division 06 Section “Rough Carpentry”.
   3. Division 06 Section “Finish Carpentry”.
   4. Division 08 Section “Operations and Maintenance”.
   5. Division 08 Section “Hollow Metal Doors and Frames”.
   6. Division 08 Section “Flush Wood Doors”.
   7. Division 08 Section “Aluminum-Framed Entrances and Storefronts”.
   8. Division 26 Section "Electrical”.

F. 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.

G. 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.

1.3 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 owner 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. Owner 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.

1.4 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.

1.5 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 Owner 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.

1.6 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".

1.7 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 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.

1.8 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.

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 Owner. 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. McKinney (MK) - TA/T4A Series, 5-knuckle.

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. Pemko (PE).

2.4 POWER TRANSFER DEVICES

A. 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. Securitron (SU) - EL-CEPT Series.

B. 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. McKinney (MK) - QC-C Series.

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. Rockwood (RO).

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. 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.
   3. Pulls shall be provided with a 10” clearance from the finished floor on the push side to accommodate wheelchair accessibility.
   4. 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.
   5. Manufacturers:
      a. Rockwood (RO).

2.6 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have minimum (10) years experience designing secured master key systems and have on record a published security keying system policy.
   1. Manufacturers:
      a. Sargent Manufacturing (SA).
      b. Match Existing, Field Verify.
      c. No Substitution.

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 conduct 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 Owner.
   3. Existing System: Field verify and key cylinders to match Owner's existing system.

E. Key Quantity: Provide the following minimum number of keys:
   1. Change Keys per Cylinder: Two (2).
   2. Master Keys (per Master Key Level/Group): Five (5).
   3. Construction Keys (where required): Ten (10).

F. Construction Keying: Provide construction master keyed cylinders.

G. Key Registration List (Bitting List):
   1. Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
   2. Provide transcript list in writing or electronic file as directed by the Owner.

2.7 KEY CONTROL

A. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
   1. Manufacturers:
      a. Lund Equipment (LU).
      b. MMF Industries (MM).
      c. Telkee (TK).

B. Electronic Key Management System: Provide an electronic key control system with Stand-alone Plug and Play features including advanced RFID technology. Touchscreen interface with PIN access for keys individually locked in place. Minimum 1,000 system users and 21 iFobs for locking receptors. System shall have a minimum 250,000 audit events screen displayed or ability to be exported via USB port.
   1. Manufacturers:
      a. Medeco (MC).

2.8 CYLINDRICAL LOCKS AND LATCHING DEVICES

A. Cylindrical Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.2, Series 4000, Operational Grade 1 Certified Products Directory (CPD) listed cylindrical locksets. Listed manufacturers shall meet all functions and features as specified herein.
   1. Provide locksets with functions and features as follows:
      a. Meets ANSI/BHMA A156.41 for single motion egress.
      b. Where required by code, provide knurling or abrasive coating on all levers leading to hazardous areas.
      c. Meets UL and CUL Standard 10C Positive Pressure, Fire Test of Door Assemblies with levers that meet A117.1 Accessibility Code.
      d. Exceeds ANSI/BHMA A156.2 requirements by 2.6 times for 3,100 in-lb. abusive locked lever torque with no entry while maintaining egress.
      e. Exceeds ANSI/BHMA A156.2 requirements by 8 times for 1,600 lbs. offset lever pull with no entry for protection against attacks.
      f. Exceeds ANSI/BHMA A156.3 requirements by 2 times for latch retraction with 100 lb. preload while maintaining operation in warped doors.
      g. Exceeds ANSI/BHMA A156.3 requirements by 20 times for no access with minimum 100 vertical impacts for protection against vandalism attempts.
      h. Independent return springs allow lock to exceed ANSI/BHMA A156.2 Grade 1 cycle requirements without lever sag.
      i. Status indicators inside, outside, or on both sides of doors as specified with high visibility red/green or red/white icons to display locked or unlocked state in the rose.
      j. Ten-year limited warranty for mechanical functions.
   2. Manufacturers:
      a. Sargent Manufacturing (SA) - 10X Line.
      b. No Substitution.

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 ELECTROMAGNETIC LOCKING DEVICES

A. Surface Electromagnetic Locks (Commercial Duty): Electromagnetic locks to be surface mounted type conforming to ANSI A156.23, Grade 3 with minimum holding force strength of 600 pounds. Locks to autosense either 12 or 24 voltage and be UL listed for use on fire rated door assemblies. Locks are to have an integrated door position switch and lock bond sensor. Locks are to have optional integrated motion sensor and/or security camera as indicated in the hardware sets. Provide mounting accessories as needed to suit opening conditions. Power supply to be by the same manufacturer as the lock with combined products having a lifetime replacement warranty.
   1. Manufacturers:
      a. Securitron (SU) - M380E Series.

2.11 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. Electromechanical exit devices shall have the following functions and features:
      a. Universal Molex plug-in connectors that have standardized color-coded wiring and are field configurable in fail safe or fail secure and operate from 12vdc to 24vdc regulated.
      b. EcoFlex or equivalent technology that reduces energy consumption up to 92% as certified by GreenCircle.
      c. Options to be available for request-to-exit or enter signaling, latchbolt and touchbar monitoring.
      d. Field configurable electrified trim to fail-safe or fail-secure that operates from 12-24VDC.
      e. Five-year limited warranty for electromechanical features.
   2. Manufacturers:
      a. Sargent Manufacturing (SA) - 80 Series.
      b. No Substitution.

2.12 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. Sargent Manufacturing (SA) - 351 Series.
      b. No Substitution.

2.13 SURFACE MOUNTED CLOSER HOLDERS

A. Electromagnetic Door Holders: ANSI A156.15, Grade 1 electromagnetic door holder/releases with a minimum 25 to 40 pounds holding power and fail-safe operation; power failure releases door to close.
   1. Manufacturers:
      a. Norton Rixson (NO) - 900 Series.

2.14 ARCHITECTURAL TRIM AND ACCESSORIES

A. Door, Frame and Wall Protective Trim: ANSI/BHMA A156.6, protective products as specified in the hardware sets. Door protection plates shall be not more than 2" less than door width on stop side and 1” less door width on the pull side or on stop side of pairs of doors. Listed manufacturers shall meet all functions and features as specified herein.
   1. Provide protective trim with functions and features as follows:
      a. Meets ADA requirements for smooth bottom door surfaces.
      b. UL Classified options for use on fire-rated doors up to 3 hours.
      c. Fabricated from stainless steel, brass, bronze, aluminum, or high-impact plastic.
      d. Available in a variety of sizes, finishes, and profiles to suit aesthetic and functional requirements.
      e. Designed to protect doors, frames, and adjacent walls from damage due to impact, abrasion, or traffic.
      f. Fasteners included; adhesive-backed options available for select models.
      g. Ten-year limited warranty.
   2. Manufacturers:
      a. Rockwood (RO).

2.15 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. Rockwood (RO).

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).

2.16 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. Pemko (PE).

2.17 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. Securitron (SU) - DPS Series.

B. Linear Power Supplies: Filtered and regulated power for electrified hardware. Listed manufacturers shall meet all functions and features as specified herein.
   1. Provide power supplies with functions and features as follows:
      a. 120VAC input with selectable output at 12VDC (6 amp) or 24VDC (3 amp).
      b. Internal back-up battery (batteries not included) charging circuit.
      c. Regulated and filtered, fuse protected outputs.
      d. Each output can be individually turned on and off via a jumper.
      e. Power status of each output is shown by an LED.
      f. Fire alarm interface; dry contacts NO/NC, 9-33VDC, 3-15mA.
   2. Manufacturers:
      a. Sargent (SA) - LSP Series.

2.18 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.

2.19 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 owner occupancy.

3.7 DEMONSTRATION

A. Instruct Owner's 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 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. Refer to Section 080671, Door Hardware Sets, for hardware sets.

END OF SECTION

SECTION 088000

GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:
   1. Glass and glazing for the following:
      a. Windows.
      b. Doors.
      c. Storefront framing.
   2. Glazing sealants and accessories.

B. Principal Products:
   1. Float glass.
   2. Fully tempered float glass.
   3. Insulating glass.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

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. 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.

1.5 INFORMATIONAL SUBMITTALS

A. Qualifications: Installer NACC Certificate or written quality management system.

B. Product Test Reports: For insulating glass and glazing sealants, for tests performed by a qualified testing agency.
   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

C. Preconstruction adhesion and compatibility test report.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications for Insulating-Glass Units with Sputter-Coated, Low-E Coatings: A qualified insulating-glass manufacturer who is approved and certified by coated-glass manufacturer.

B. Installer Qualifications: NACC Certified or entity with written quality management system, approved by business owner, documenting home office, shop, and field procedures and operations to ensure compliance with Contract requirements.

C. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

D. Sealant Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated.

E. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
   1. Install glazing in mockups specified to match glazing systems required for Project, including glazing methods.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 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 C 1087 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 the use of specially formulated primers.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to 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.

1.9 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.

1.10 WARRANTY

A. Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Guardian Glass, LLC; SunGuard Advanced Architectural Glass or comparable product by one of the following:
   1. Pilkington North America Inc.
   2. Viracon, Inc.
   3. Vitro Architectural Glass (formerly PPG).

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.
   1. Obtain tinted glass from single source from single manufacturer.
   2. Obtain reflective-coated glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

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 the following:
   1. Defective manufacture, fabrication, or installation.
   2. Failure of sealants or gaskets to remain watertight and airtight.
   3. Deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design glazing.

C. Structural Performance: Provide glazing capable of withstanding design loads within limits and under conditions indicated.
   1. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
      a. Wind Design Data: As indicated on Drawings.
   2. 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.

D. Windborne-Debris-Impact Resistance: Exterior glazing shall comply with basic-protection testing requirements in ASTM E 1996 for Wind Zone 1 when tested according to ASTM E 1886. Test specimens shall be no smaller in width and length than glazing indicated for use on Project and shall be installed in same manner as glazing indicated for use on Project.
   1. Large-Missile Test: For glazing located within 30 feet of grade.
   2. Small-Missile Test: For glazing located more than 30 feet above grade.

E. Air Blast Resistance: Resist 6 psi for 41 milliseconds when tested in accordance with ASTM F1642 and meeting GSA/ISC Condition 3a High Protection Level.
   1. Glass cracks. Glass fragments land of floor 3.3 feet maximum distance from opening.

F. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201, Category II.

G. 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 laminated-glass lites, properties are based on products of construction indicated.
   3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
   4. U-Factors: Center-of-glazing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
   5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glazing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
   6. Visible Reflectance: Center-of-glazing values, according to 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. GANA 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 ofthe SGCC or another certification agency acceptable to authorities having jurisdiction or manufacturer. 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 IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass that complies with performance requirements and is not less than the thickness indicated.
   1. Minimum Glass Thickness for Exterior Lites: 6 mm.

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. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Fully Tempered Float Glass: ASTM C 1048, 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 parallel to bottom edge of glass as installed unless otherwise indicated.

C. Heat-Strengthened Float Glass: ASTM C 1048, 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 parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
   2. Spacer: Manufacturer's standard spacer material and construction.
   3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.6 GLAZING SEALANTS

A. General:
   1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

2.7 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.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces.

2.8 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of 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: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

2.9 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.

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.

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 according to 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 by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant where indicated on Drawings.

G. Center glass lites in openings on setting blocks, and press firmly against tape 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.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 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 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 by gasket manufacturer.

E. Install gaskets so they protrude past face of glazing stops.

3.6 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.

3.7 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 come into 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.

3.8 MONOLITHIC GLASS SCHEDULE

A. Glass Type GLS-2: Laminated security glazing; refer to 088853 Security Glazing.

B. Glass Type GLS-4: Clear fully tempered float glass.
   1. Minimum Thickness: 6 mm.
   2. Safety glazing required.

C. Glass Type GLS-5: Fire resistant glazing; refer to 088813 Fire-Resistant Glazing.

3.9 INSULATING GLASS SCHEDULE

A. Glass Type GLS-1: Low-E Coated security glass, Clear Insulating Vision Glass.
   1. Basis-of-Design Product: Guardian Glass, LLC; SunGuard SNX 70+ on Clear.
   2. Overall Unit Thickness: 1-1/8 inch.
   3. Minimum Thickness of Each Glass Lite: 6 mm.
   4. Outboard Lite: Guardian Clear float glass.
      a. Low-E Coating on No.2 Surface: SNX 70+ sputtered on second surface.
      b. Heat Treatment: Fully tempered.
   5. Interspace: Argon filled, 1/2 inch (12 mm) wide, hermetically sealed.
   6. Inboard Lite: Guardian Clear float glass laminated with SchoolGuard SG4.
      a. Heat Treatment: Fully tempered.
   7. Glass Unit Performance Characteristics:
      a. Visible Light Transmittance: 66 percent minimum.
      b. SGHC: 0.27 maximum.
      c. Winter Nighttime U-Factor: 0.24 maximum.
      d. Summer Daytime U-Factor: 0.21 maximum.
   8. Safety glazing where required.

B. Glass Type GLS-3: Low-E Coated, Clear Insulating Vision Glass.
   1. Basis-of-Design Product: Guardian Glass, LLC; SunGuard SNX 70+ on Clear.
   2. Overall Unit Thickness: 1 inch (25 mm).
   3. Minimum Thickness of Each Glass Lite: 6 mm.
   4. Outboard Lite: Guardian Clear float glass.
      a. Low-E Coating on No.2 Surface: SNX 70+ sputtered on second surface.
      b. Heat Treatment: Fully tempered.
   5. Interspace: Argon filled, 1/2 inch (12 mm) wide, hermetically sealed.
   6. Inboard Lite: Guardian Clear float glass.
      a. Heat Treatment: Fully tempered.
   7. Glass Unit Performance Characteristics:
      a. Visible Light Transmittance: 66 percent minimum.
      b. SGHC: 0.27 maximum.
      c. Winter Nighttime U-Factor: 0.24 maximum.
      d. Summer Daytime U-Factor: 0.21 maximum.
   8. Safety glazing where required.

END OF SECTION

SECTION 088813

FIRE-RESISTANT GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Fire-resistance-rated glazing.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of glass product; 12 inches square.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For glass testing agency.

B. Product Certificates: For each type of glass and glazing product, from manufacturer.

C. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions. Prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install fire-resistant glazing until spaces are enclosed and weathertight and temporary HVAC system is operating and maintaining ambient temperature conditions at occupancy levels during the remainder of the construction period.

1.8 WARRANTY

A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   1. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

B. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General: Installed glazing systems shall withstand normal thermal movement and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, or installation; deterioration of glazing materials; or other defects in construction.

B. Laminated glass with intumescent interlayers: 120-minute fire-resistance-rated glazing with 450 deg F (250 deg C) temperature-rise limitation.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organization below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

B. Safety Glazing Labeling: Permanently mark glazing with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, glass thickness, and safety glazing standard with which glass complies.

2.4 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Ultraclear Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear), with visible light transmission not less than 91 percent.

C. Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class I (clear) unless otherwise indicated, Quality-Q3.
   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

D. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.
   1. Construction: Laminate glass with polyvinyl butyral interlayer unless fire-protection or fire-resistance rating is based on another product.
   2. Interlayer Thickness: Provide thickness as needed to comply with requirements.
   3. Interlayer Color: Clear unless otherwise indicated.

2.5 FIRE-RESISTANCE-RATED GLAZING

A. Fire-Resistance-Rated Glazing: Listed and labeled by a testing agency acceptable to authorities having jurisdiction, for fire-resistance ratings indicated, based on testing according to ASTM E 119 or UL 263.

B. Fire-Resistance-Rated Glazing Labeling: Permanently mark fire-resistance-rated glazing with certification label of a testing agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, test standard, that the glazing is approved for use in walls, and the fire-resistance rating in minutes.

C. Laminated Glass with Intumescent Interlayers: Laminated glass made from multiple plies of uncoated, ultraclear float glass; with intumescent interlayers; and complying with 16 CFR 1201, Category II.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Technical Glass Products; Pyrostop or comparable product by one of the following:

a. GGI; Pyrobel.
b. Vetrotech Saint-Gobain; SGG Contraflam.

2.6 GLAZING ACCESSORIES

A. Provide glazing gaskets, glazing sealants, glazing tapes, setting blocks, spacers, edge blocks, and other glazing accessories that are compatible with glazing products and each other and are approved by testing agencies that listed and labeled fire-resistant glazing products with which products are used for applications and fire-protection ratings indicated.

B. Glazing Sealants for Fire-Rated Glazing Products: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT. Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Dow Corning Corporation; 795.
      b. GE Advanced Materials - Silicones; SilGlaze II SCS2800.
      c. Tremco Incorporated; Spectrem 2.
   2. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

C. 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;

D. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.

C. Perimeter Insulation for Fire-Resistive Glazing: Product that is approved by testing agency that listed and labeled fire-resistant glazing product with which it is used for application and fire-protection rating indicated.

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.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine framing, glazing channels, and stops, with Installer present, for compliance with manufacturing and installation tolerances, including those for size, squareness, and offsets at corners, and for compliance with minimum required face and edge clearances.

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 fire side and protected side. Label or mark units as needed so that fire side and protected side are readily identifiable. Do not use materials that leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Use methods approved by testing agencies that listed and labeled fire-resistant glazing products.

B. 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.

C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

E. 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.

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. 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.

H. 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 according to requirements in referenced glazing publications.

I. Set glass lites with proper orientation so that coatings face fire side or protected side 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 by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first and then to jambs. Cover horizontal framing joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Apply heel bead of elastomeric sealant where indicated.

G. Center glass lites in openings on setting blocks and press firmly against tape 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.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.5 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.

D. Install gaskets so they protrude past face of glazing stops.

3.6 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. 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 washaway from glass.

3.7 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 come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. Remove and replace glass that is damaged during construction period.

D. Wash glass on both exposed surfaces in each area of Project 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.

END OF SECTION

SECTION 088853

SECURITY GLAZING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes laminated glass for the following applications:
   1. Doors.
   2. Storefront framing.

1.2 COORDINATION

A. Coordinate glazing channel dimensions to provide necessary bite on security glazing, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review and finalize construction schedule, and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review temporary protection requirements for security glazing during and after installation.

1.4 SUBMITTALS

A. Product Data: For each type of product.

B. Security Glazing Samples: For each type of security glazing; 12 inches square.

C. Security Glazing Schedule: List security glazing types and thicknesses for each size opening and location. Use same designations indicated on Drawings. Indicate coordinated dimensions of security glazing and construction that receives security glazing, including clearances and glazing channel dimensions.

D. Qualification Data: For installers.

E. Product Certificates: For each type of product indicated, from manufacturer.

F. Product Test Reports: For each type of security glazing, for tests performed by manufacturer and witnessed by a qualified testing agency.

G. Product Test Reports: For each type of glazing sealant, for tests performed by a qualified testing agency.
   1. Provide test reports based on testing current sealant formulations within previous 36-month period.

H. Preconstruction adhesion and compatibility test reports.

I. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glazing installers for this Project who are certified under the National Glass Association Glazier Certification Program.

B. Sealant Testing Agency Qualifications: Qualified according to ASTM C 1021 for testing indicated.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Adhesion and Compatibility Testing: Test each security glazing type, tape sealant, gasket, glazing accessory, and glazing-framing member for adhesion to and compatibility with elastomeric glazing sealants.
   1. Testing will not be required if data based on previous testing of current sealant products and glazing materials match those submitted.
   2. Use ASTM C 1087 to determine whether priming and other specific joint-preparation techniques are required to obtain rapid, optimum adhesion of glazing sealants to security glazing, 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 sufficient 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 the use of specially formulated primers.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect security glazing and glazing materials according to manufacturer's written instructions. Prevent damage from condensation, temperature changes, direct exposure to sun, or other causes.

1.8 PROJECT 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 condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or below 40 deg F.

1.9 WARRANTY

A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer agrees to replace laminated glass that deteriorates within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Security Glazing: Obtain security glazing from single source from single manufacturer using the same types of lites, plies, interlayers, and spacers for each security glazing type indicated.

B. Source Limitations for Glazing Sealants: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

A. General:
   1. Installed security glazing shall withstand security-related loads and forces without damage to the glazing beyond that allowed by referenced standards.

B. Structural Performance: Glazing shall withstand the following:
   1. Design Wind Pressures: As indicated on Drawings.
   2. UL 972 Rating: 5-aa1 rated for 6 minutes.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glazing framing members and glazing components.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

D. Safety Glazing: Where safety glazing is indicated, provide glazing that complies with 16 CFR 1201.

2.3 SECURITY GLAZING, GENERAL

A. Glazing Publications: Comply with published recommendations of security glazing and glazing material manufacturers and organizations below unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.
   1. GANA Publications: "Laminated Glazing Reference Manual" and "Glazing Manual."

B. Safety Glazing Labeling: Where safety glazing is indicated, permanently mark glazing with certification label of the Safety Glazing Certification Council or another certification agency acceptable to authorities having jurisdiction or manufacturer. Label shall indicate manufacturer's name, type of glazing, glass thickness, and safety glazing standard with which glazing complies.

2.4 LAMINATED GLASS

A. Laminated Glass: Two outer layers of glass with custom security strengthened substrate core.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide LTI Smart Glass, Inc.; SchoolGuard SG4 or comparable product by the following:
      a. Global Security Glazing: CHILDGARD security glazing.
   2. Color: Clear.
   3. Nominal Thickness: Manufacturer's standard.
   4. Provide safety glazing labeling.

2.5 INSULATING SECURITY GLAZING

A. Insulating Security Glazing: Factory-assembled units, consisting of sealed lites of glazing material indicated separated by a dehydrated interspace.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide LTI Smart Glass, Inc.; SchoolGuard SG4 IGU.
      a. Global Security Glazing: CHILDGARD security glazing.
   2. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
   3. Spacer: Manufacturer's standard spacer material and construction Aluminum with mill or clear anodic finish Aluminum with black, color anodic finish Aluminum with bronze, color anodic finish Aluminum with powdered metal paint finish in color selected by Architect Galvanized steel Stainless steel Polypropylene-covered stainless steel in color selected by Architect Thermally broken aluminum Nonmetallic laminate Nonmetallic tube Insert material.
   4. Desiccant: Molecular sieve or silica gel, or blend of both.
   5. Refer to Section 088000 for IGU requirements.

2.6 GLAZING SEALANTS

A. General:
   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they contact, including security glazing, seals of insulating security glazing and air-gap security glazing, and glazing channel substrates, under conditions of

service and application, as demonstrated by sealant manufacturer based on testing and field experience.

2. Suitability: Comply with sealant and security glazing manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

2.7 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of security glazing 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: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by security glazing manufacturer to maintain security glazing lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit security glazing lateral movement (side walking).

F. Cylindrical Glazing Sealant Backing: ASTM C 1330, 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 SECURITY GLAZING

A. Fabricate security glazing 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.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine framing for security glazing, with Installer present, for compliance with the following:
   1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
   2. Minimum required face or edge clearances.
   3. Minimum required bite.
   4. Effective sealing between joints of 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 security glazing 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 will leave visible marks in the completed work.

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of security glazing, sealants, gaskets, and other glazing materials unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect edges of security glazing from damage during handling and installation. Remove damaged security glazing from Project site and legally dispose of off Project site. Damaged security glazing includes units with edge or face damage or other imperfections that, when installed, could weaken security glazing and impair performance and 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 glazing unit manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by security glazing manufacturers for installing lites.

F. Provide spacers for security glazing lites where the length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of security glazing. 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 performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glazing lites 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 security glazing from moving sideways in glazing channel, as recommended in writing by security glazing manufacturer and according to requirements in referenced glazing publications.

H. Set security glazing in each series with uniform pattern, draw, bow, and similar characteristics.

I. 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.

J. 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 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 securely in place between glazing unit 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 security glazing 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 security glazing. Seal gasket joints with sealant recommended by gasket manufacturer.

D. Installation with Pressure-Glazing Stops: Center security glazing 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 security glazing. Seal gasket joints with sealant recommended 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 security glazing and glazing stops to maintain face clearances and to prevent sealant from extruding into glazing channel and blocking weep systems. 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 security glazing and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial washaway from security glazing.

3.6 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.

B. Protect security glazing from contact with contaminating substances resulting from construction operations, including weld splatter. Examine glass surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, or stains.
   1. If, despite such protection, contaminating substances do come into contact with security glazing, remove substances immediately as recommended in writing by security glazing manufacturer. Remove and replace security glazing that cannot be cleaned without damage.

C. Wash security glazing on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash security glazing as recommended in writing by security glazing manufacturer.

END OF SECTION

SECTION 090511

CONCRETE FLOOR PREPARATION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Mechanical cleaning of new and existing concrete floor surfaces for application of the following finishes:
      a. Sealers.
      b. Coatings.
      c. Polymer overlays.
      d. Resilient Flooring.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."
   1. Review conditions affecting substrate preparation.
   2. Review procedures that will be used for substrate preparation.
   3. Require attendance by finish flooring installers to review preparation requirements of floor finish product and flooring adhesive manufacturers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of mechanical cleaning equipment used on the project.

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.
   1. Submit report of observations.
   2. Certify installation is complete in accordance with manufacturer’s instructions.
   3. Indicate supplementary instructions provided for Project specific conditions.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained in the use of the equipment and techniques required to produce the specified results.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify new concrete floors have cured minimum 28 days.

B. Examine substrates, with Installer present, for compliance with requirements for surface contamination, damage, and other conditions affecting performance of the Work.

C. Examine substrate to determine repairs required to restore substrate surface to be within tolerances required for floor finishes specified in other sections, prior to completing Work of this section.

D. Examine substrate to verify surfaces prepared in accordance with this section will be suitable for application of finishes specified in other sections.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance with recommendations for methods and materials required to correct conditions before proceeding with work of this section.

F. Proceed with surface preparation only after unsatisfactory conditions have been corrected.
   1. Proceeding with surface preparations indicates acceptance and of surfaces and conditions of substrate.

3.2 SURFACE PREPARATION EQUIPMENT

A. Mechanical Cleaning Equipment: Automatic, dry shot blast type, self contained capable of recycling blast materials and collecting surface abrasions.

3.3 SURFACE PREPARATION

A. Mechanically clean concrete substrate and create surface profile in existing concrete substrate in accordance with ASTM D 4259.
   1. Mechanically clean concrete substrate to remove surface and penetrating contaminates to produce a surface profile of ICRI CSP 3 in accordance with ICRI Technical Guideline No. 310.2.
   2. Acceptable substrate surfaces will be free of laitance, oil, grease, flooring adhesive, paint, and other surface contaminates capable of affecting bond of specified floor finishes to concrete substrate.

B. Repair surface irregularities after cleaning.
   1. Fill bugholes, spalls, cracks, deteriorated joints and other surface damage exposed or created as a result of substrate cleaning operations flush with adjacent surfaces to provide sound substrate for specified floor finish.

C. Dry broom or vacuum clean concrete substrates immediately before application of specified floor finishes in accordance with ASTM D 4258 to remove loose materials on substrate surface.

D. When field quality control report indicates portions are unsatisfactory, repeat process until field quality control report indicates there are no unsatisfactory portions remaining.

E. At Resilient Flooring.
   1. After the concrete has cured and is dry, clean construction joints, saw cuts, score marks and cracks, and fill with an underlayment. Use a high quality Portland Cement, calcium aluminates, or gypsum-based products. The floor fill, topping or underlayment must also have a minimum compressive strength of 3500 psi. When using these products, be sure to follow the manufacturer's recommendations regarding application, drying time, and moisture testing. S-194 Patch, Underlayment & Embossing Leveler, S-463 Level Strong and S-466 Patch Strong meet or exceed this requirement as underlayments.
   2. Repaired areas must be finished flush with the surface of the concrete and allowed to fully dry before the installation of the floor covering.
   3. Dusty concrete slabs may be primed with one coat of S-185 Latex Primer. Sweep or vacuum the concrete and apply the S-185 with a 3/8” nap paint roller. You may also prime concrete subfloors with the recommended flooring adhesive for the material about to be installed. When using adhesive as a primer, allow the adhesive to dry completely.
   4. After sweeping/vacuuming, apply the adhesive using a smooth-edge trowel.
   5. A rough concrete floor can be ground smooth with a commercial diamond or carbide-equipped grinding machine. If the concrete subfloor is extremely rough or uneven, it may be too great a job to smooth this way. In this case, apply a cementitious underlayment such as S-194, S-463, or S-466. A smooth, flat, uniform surface is necessary as a good base for resilient flooring.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:
   1. Visual inspection of completed substrate preparation to verify contamination is removed.
   2. Visual inspection of completed substrate preparation to verify surface profile matches ICRI CSP 3, using ICRI standard rubber mold for visual comparison.
   3. Prepare field quality control report. Clearly indicate the locations, extents, and conditions of areas where surface preparation does not conform to specified profile and cleanliness. Document observed conditions with digital photographs.
   4. Repeat inspections when additional surface preparation for unsatisfactory conditions indicated in the previous field quality control report.

3.5 PROTECTION

A. Protect prepared concrete substrates from contamination. Reclean substrates that are contaminated by construction operations prior to installation of specified floor finishes.

END OF SECTION

SECTION 090512

CONCRETE FLOOR MOISTURE CONTENT AND PH TESTING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Concrete moisture content testing using water vapor emission method.
2. Concrete moisture content testing using relative humidity method.
3. Concrete pH testing.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01 Section "Project Management and Coordination."

B. Scheduling: Schedule work to permit concrete moisture testing to be completed minimum one week and maximum 3 weeks before floor coverings are installed.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Submit model and manufacturer for calcium chloride test kits.
2. Submit data indicating model, manufacturer, and calibration record for relative humidity measuring equipment.
3. Submit data for floor slab treatment products.

B. Shop Drawings:
1. Indicate test locations shown on building floor plan,

1.4 INFORMATIONAL SUBMITTALS

A. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

B. Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for concrete moisture acceptable limits.

C. Test Reports: Report test results in chart form.
1. Calcium Chloride Test Method: Indicate test dates, start/stop time, start/stop weight, weight gain in grams, water vapor emission rate, and pH levels.

2. Relative Humidity Test Method: Indicate test dates, time, depth of test well, in-situ temperature, relative humidity and pH levels.
3. Submit record of ambient air temperature, ambient relative humidity, and floor slab surface temperature when test sites are prepared, start of test, and end of test.
4. Indicate condition of building enclosure including position of operable windows and exterior doors when test sites are prepared, start of test, and end of test.
5. Submit transcript of datalogger.
6. Indicate operational status of HVAC systems maintaining environmental condition of spaces where tests are conducted when test sites are prepared, start of test, and end of test.

1.5 QUALITY ASSURANCE

A. Testing Agency: A qualified, independent testing agency employing ICRI Tier 2 Concrete Slab Moisture Testing Technician to perform tests.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver calcium chloride test kits to Project site in manufacturer’s original, sealed packaging.

B. Accept test kits on site. Inspect test kits for damage. Replace damaged test kits.

1.7 FIELD CONDITIONS

A. Ambient Conditions:
1. Do not perform concrete moisture testing until building is enclosed and HVAC system is operational.
2. Maintain building test areas at design operating conditions for minimum 48 hours before, during, and continuously after conducting testing.
3. When HVAC system is not operational at start of tests, maintain ambient conditions within test areas at 65 to 85 degrees F and 40 to 60 percent relative humidity for minimum 48 hours before, during, and continuously after conducting testing until building HVAC system is capable of maintaining design operating conditions.

PART 2 PRODUCTS

2.1 CALCIUM CHLORIDE TEST KITS

A. Calcium Chloride Test Kit: Comply with ASTM F1869.

2.2 RELATIVE HUMIDITY TEST EQUIPMENT

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Vaisala www.vaisala.com.

B. Humidity and Temperature Probe and Meter: Comply with ASTM F2170.

2.3 PH TEST MATERIALS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Micro Essential Laboratory www.microessentiallab.com.

B. pH Test Paper: Capable of indicating minimum 7.0 to 13 pH range.

C. pH Color Gage: Furnish pH test paper manufacturer's visual color gage to identify measured pH.

D. Water: Distilled or deionized.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify new concrete floors have cured minimum 28 days.

3.2 PREPARATION

A. When a building HVAC system is not operational and maintaining test areas at design operational conditions, install recording hygrometer or data logger in each separate test area to record ambient temperature and relative humidity beginning 48 hours before start of tests until completion of tests within each area.

B. Identify three moisture test sites for first 1,000 sf and one moisture test site for each additional 1,000 sf of floor area receiving floor covering on each separate floor slab.
   1. Layout test site locations uniformly distributed throughout each test area.

C. Mechanically clean each test site to remove oils, laitance, curing compounds, adhesives, and other contaminates affecting water vapor emissions.
   1. Remove cleaning residue.
   2. Do not apply water or other liquid to floor slabs and test sites.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform concrete moisture tests and inspections and prepare test reports.

B. Acceptance Criteria:
   1. Concrete floor slabs will be considered acceptable for installation of floor finishes when:
      a. Calcium Chloride Test Result: 3 lb of water/1000 sf in 24 hours maximum moisture vapor transmission rate.

b. Relative Humidity Test Result: 75 percent maximum relative humidity.
c. pH Test Result: Within alkalinity range of 7.0 to 9.0.

2. When concrete floors do not meet acceptance criteria, obtain recommendations from floor finish manufacturers for remediation measures necessary to permit successful floor finish installation.

C. Concrete Moisture Testing - General.
1. Conduct calcium chloride test and relative humidity test at each test site.
2. Conduct one pH test at each test site.

D. Calcium Chloride Testing:
1. Perform tests in accordance with ASTM F1869.

E. Relative Humidity Testing:
1. Perform tests in accordance with ASTM F2170.
2. Conduct relative humidity testing at the following depths:
a. Slabs-On-Grade: Measure temperature and relative humidity at 40 percent of slab thickness measured from top surface.
b. Elevated Slabs: Measure temperature and relative humidity at 20 percent of slab thickness measured from top surface.
3. Drill test hole at each test site to accommodate test sleeve.
a. Hole Diameter: In accordance with test equipment manufacturer's instructions.
b. Drilling Fluids: Not permitted.
4. Vacuum dust and debris from test hole.
5. Insert sleeve, to the full depth of test hole. Cap or plug sleeve to prevent test hole contamination.
6. Permit the test site to acclimate for minimum 72 hours before measuring relative humidity.
7. Remove sleeve plug and insert probe to bottom of test hole. Allow test probe to reach temperature equilibration with concrete slab.
8. Measure and record temperature and relative humidity at the test site.

F. pH Testing:
1. Place several drops of water onto the concrete surface to form a puddle approximately 1 inch in diameter.
2. Allow the water to set for approximately 60 seconds.
3. After 60 seconds, dip the pH paper into the water and remove immediately, compare color to chart provided by paper supplier to determine pH reading.
4. Record and report results.

END OF SECTION

SECTION 090561

COMMON WORK RESULTS FOR FLOORING PREPARATION

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:
   1. Test concrete floor slabs for moisture and alkalinity.
   2. Prepare existing and new concrete slabs for the following flooring types:
      a. Resilient tile and sheet.
      b. Broadloom or tile carpet.
      c. Epoxy resin.
   3. Remediate concrete floor slabs due to unsatisfactory moisture or alkalinity conditions.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordinate work results of this section with manufacturer recommendations for specified finish flooring types.

B. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one month, minimum, before starting Work of this Section.
   2. Additional Attendees: GC, flooring installer.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Floor Covering and Adhesive Manufacturer Product Literature: For each specific combination of substrate, floor covering, and adhesive to be used; showing:
      a. Moisture and alkalinity limits and test methods.
      b. Manufacturer required bond/compatibility test procedure.
   2. Remedial Materials:
      a. Test reports indicating compliance with specified performance requirements, performed by nationally recognized independent testing agency.

1.4 INFORMATIONAL SUBMITTALS

A. Visual Observation Report: For existing floor coverings to be removed.

B. Testing Agency Report:
   1. Description of areas tested; include floor plans and photographs if helpful.
   2. Summary of conditions encountered.
   3. Moisture and alkalinity test reports.
   4. Copies of specified test methods.
   5. Recommendations for remediation of unsatisfactory surfaces.
   6. Include certification of accuracy by authorized official of testing agency.
   7. Submit report to Architect two Business Days, maximum after conclusion of testing.

C. Adhesive Bond and Compatibility Test Report.

D. Specimen Warranty: Issued by remedial material manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Warranty Documentation: For remedial floor coatings.

1.6 QUALITY ASSURANCE

A. Testing Agency: Employ and pay for an independent testing agency to perform moisture and alkalinity testing.
   1. Qualifications: Experienced in specified testing methods.
   2. Contractor Responsibility Relating to Independent Agency Testing:
      a. Provide access for and cooperate with testing agency.
      b. Confirm date of start of testing at least 10 days before actual start.
      c. Allow at least 4 Business Days on site for testing agency activities.
      d. Achieve and maintain specified ambient conditions.
      e. Notify Owner when specified ambient conditions have been achieved and when testing will start.

B. Mockup: Construct and test mockup per ASTM F3010.

C. Remedial Coating Installer Qualifications: Flooring preparation specialist company, trained or employed by coating manufacturer.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store materials in manufacturer packaging; include installation instructions.

B. Keep materials from freezing.

1.8 FIELD CONDITIONS

A. Maintain ambient temperature in spaces where concrete testing is being performed, and for at least 48 hours before testing, at not less than 65 degrees F or more than 85 degrees F.

B. Maintain relative humidity in spaces where concrete testing is being performed, and for at least 48 hours before testing, at not less than 40 percent and not more than 60 percent.

PART 2 PRODUCTS

2.1 FLOORING PREPARATION MATERIALS

A. Patching and Self-Leveling Compound:
   1. Cementitious moisture, mildew, and alkali resistant compound, compatible with floor, floor covering, and floor covering adhesive, capable of being installed to thicknesses shown, and feathered to nothing at edges.
   2. Compressive Strength: 4000 psi, minimum after 28 days per ASTM C109/C109M or ASTM C472, whichever is appropriate.

B. Flooring Adhesive: Floor covering or adhesive manufacturer recommended product, suitable for the moisture and pH conditions present.
   1. VOC Content: 50 g/L, maximum.

C. Remedial Floor Coating: Single or multilayer coating or coating/overlay combination.
   1. Manufacturers and Products: Testing agency recommended or one of the following:
      a. ARDEX Engineered Cements ARDEX MC RAPID with ARDEX V 1000.
      b. LATICRETE International, Inc. Vapor Ban Primer ER with NXT Level.
      c. MAPEI Planiseal VS with Novoplan Easy Plus.
   2. Primer: Manufacturer recommended for selected assembly.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Follow ASTM F3010.

3.2 CONCRETE SLAB PREPARATION - LIGHTWEIGHT CONCRETE

A. Testing: Relative humidity and pH testing is not required.

B. Remediation: Apply remedial floor coating system over entire floor area.

3.3 CONCRETE SLAB PREPARATION - NORMAL WEIGHT CONCRETE

A. Follow recommendations of testing agency and ASTM F3010.

B. Perform following operations in this order:
   1. Existing on-grade and elevated concrete slabs with existing floor coverings:
      a. Observe existing floor covering for adhesion, water damage, alkaline deposits, and other defects.
      b. Remove existing floor covering.
   2. Existing concrete slabs with coatings or penetrating sealers/hardeners/dustproofers:
      a. Do not attempt to remove coating or penetrating material.
      b. Do not abrade surface.
   3. Perform preliminary cleaning.
   4. Internal Relative Humidity Testing: Three tests in the first 1000 square feet and one test in each additional 1000 square feet, or flooring manufacturer recommended frequency.
   5. Alkalinity Tests: Relative humidity test locations.
   6. Specified remediation, if required due to relative humidity test result.
   7. Patching, smoothing, and leveling.
   8. Other preparation specified in finish flooring sections.
   9. Adhesive bond and compatibility test.
   10. Apply protection.

C. Remediations:
   1. Active Water Leaks or Continuing Moisture Migration to Surface of Slab: Correct before doing any other remediation; retest after correction.
   2. Excessive Relative Humidity: If an adhesive that is resistant to the level of moisture present is available and acceptable to flooring manufacturer, use that adhesive for installation of the flooring; if not, apply remedial floor coating over entire suspect floor area.
   3. Excessive Alkalinity:
      a. If remedial floor coating is necessary to address excessive moisture, no additional remediation is required for pH.
      b. If an adhesive that is resistant to the pH level present is available and acceptable to the flooring manufacturer, use that adhesive for installation of the flooring; otherwise, apply a skim coat of specified patching compound over entire suspect floor area.

3.4 EXISTING FLOOR COVERINGS REMOVAL

A. Follow local, State, and federal regulations and RFCI Recommended Work Practices for Removal of Resilient Floor Coverings, applicable to floor covering being removed.

3.5 PRELIMINARY CLEANING

A. Clean floors, remove adhesion inhibiting substances.

B. Do not use solvents for cleaning.

3.6 INTERNAL RELATIVE HUMIDITY TESTING

A. Where the floor covering manufacturer requirements conflict with either the referenced test method or this Specification, follow the manufacturer requirements.

B. Testing: ASTM F2170 Procedure A. Calcium Chloride and electrical impedance or resistance testing may not be substituted.

C. If test values exceed floor covering manufacturer limits, perform remediation. In the absence of manufacturer limits, perform remediation if any test value exceeds 75 percent relative humidity.

D. Report the information required by the test method.

3.7 ALKALINITY TESTING

A. Where the floor covering manufacturer requirements conflict with either the referenced test method or this Specification, follow the manufacturer requirements.

B. Use a wide range alkalinity test paper, its associated chart, and distilled or deionized water.

C. Place several drops of water on a clean surface of concrete, forming a puddle approximately 1 inch in diameter. Allow the puddle to set for approximately 60 seconds, then dip the alkalinity test paper into the water, remove it, and compare immediately to chart to determine alkalinity reading.

D. In the event that test values exceed floor covering manufacturer limits, perform remediation. In the absence of manufacturer limits, perform remediation if alkalinity test value exceeds 10.

3.8 PREPARATION

A. See individual floor covering sections for additional requirements.

B. Follow testing agency recommendations.

C. Fill and smooth surface cracks, grooves, depressions, control joints and other nonmoving joints, and other irregularities with patching compound.

D. Do not fill expansion joints, isolation joints, or other moving joints.

3.9 ADHESIVE BOND AND COMPATIBILITY TESTING

A. Follow requirements and recommendations of floor covering manufacturer.

3.10 APPLICATION OF REMEDIAL FLOOR COATING

A. Mix and apply remedial floor coating.
   1. Prohibit traffic during application.
   2. Honor substrate control, isolation and expansion joints.
   3. Prime substrate, and apply floor coating in layers as recommended by manufacturer.
   4. Allow coating to cure before applying finish flooring.

3.11 PROTECTION

A. Cover prepared floors with building paper or other durable covering until finish flooring is installed.

END OF SECTION

SECTION 090561.13

MOISTURE VAPOR EMISSION CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section includes fluid-applied, resin-based, membrane-forming systems that control the moisture-vapor-emission rate of high-moisture, interior concrete to prepare it for floor covering installation.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each MVE-control system, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Manufacturer Qualifications: Employs factory-trained personnel who are available for consultation and Project-site inspection.

B. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages and containers, with seals unbroken, bearing manufacturer's labels indicating directions for storage and mixing with other components.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Comply with MVE-control system manufacturer's written instructions for substrate and ambient temperatures, humidity, ventilation, and other conditions affecting system installation.
   1. Store system components in a temperature-controlled environment and protected from

weather and at ambient temperature of not less than 65 deg F and not more than 85 deg F at least 48 hours before use.

2. Maintain ambient temperature and relative humidity in installation areas within range recommended in writing by MVE-control system manufacturer, but not less than 65 deg F or more than 85 deg F and not less than 40 or more than 60 percent relative humidity, for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.
3. Install MVE-control systems where concrete surface temperatures will remain a minimum of 5 deg F higher than the dew point for ambient temperature and relative humidity conditions in installation areas for 48 hours before installation, during installation, and for 48 hours after installation unless longer period is recommended in writing by manufacturer.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. MVE-Control System Capabilities: Capable of suppressing MVE without failure where installed on concrete that exhibits the following conditions:
   1. MVER: Maximum 15 lb of water/1000 sq. ft. when tested according to ASTM F1869.
   2. Relative Humidity: Maximum 100 percent when tested according to ASTM F2170 using in situ probes.

B. Water-Vapor Transmission: Through MVE-control system, maximum 0.10 perm when tested according to ASTM E96/E96M.

C. Tensile Bond Strength: For MVE-control system, greater than 200 psi with failure in the concrete according to ASTM D7234.

2.2 MVE-CONTROL SYSTEM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Advanced Moisture Control, Inc.
   2. ARDEX Americas.
   3. BASF Corporation.
   4. Dependable, LLC.
   5. H.B. Fuller Construction Products Inc. / TEC.
   6. LATICRETE SUPERCAP, LLC.
   7. MAPEI Corporation.
   8. USG Corporation.

B. MVE-Control System: ASTM F3010-qualified, fluid-applied, two-component, epoxy-resin, membrane-forming system; formulated for application on concrete substrates to reduce MVER to level required for installation of floor coverings indicated and acceptable to manufacturers of floor covering products indicated, including adhesives.
   1. Substrate Primer: Provide MVE-control system manufacturer's concrete-substrate primer if required for system indicated by substrate conditions.
   2. Cementitious Underlayment Primer: If required for subsequent installation of cementitious underlayment products, provide MVE-control system manufacturer's primer to ensure adhesion of products to MVE-control system.

2.3 ACCESSORIES

A. Patching and Leveling Material: Moisture-, mildew-, and alkali-resistant product recommended in writing by MVE-control system manufacturer and with minimum of 3000-psi compressive strength after 28 days when tested according to ASTM C109/C109M.

B. Crack-Filling Material: Resin-based material recommended in writing by MVE-control system manufacturer for sealing concrete substrate crack repair.

C. Cementitious Underlayment: If required to maintain manufacturer's warranty, provide MVE-control system manufacturer's gypsum cement-based underlayment.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for maximum moisture content, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
   1. Installation of system indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Preinstallation Testing:
   1. Testing Agency: Owner will engage a qualified testing agency to perform tests.
   2. Alkalinity Testing: Perform pH testing according to ASTM F710. Install MVE-control system in areas where pH readings are less than 7.0 and in areas where pH readings are greater than 8.5.
   3. 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. Install MVE-control system in locations where concrete substrate MVER exceeds 3 lb of water/1000 sq. ft. in 24 hours.

b. Internal Relative Humidity Test: Using in situ probes, ASTM F2170. Install MVE-control system in locations where concrete substrates exhibit relative humidity level greater than 75 percent.

4. Tensile-Bond-Strength Testing: For typical locations indicated to receive installation of MVE-control system, install minimum 100-sq. ft. area of MVE-control system to prepared concrete substrate and test according to ASTM D7234.
   a. Proceed with installation only where tensile bond strength is greater than 200 psi with failure in the concrete.

B. Concrete Substrates: Prepare and clean substrates according to MVE-control system manufacturer's written instructions to ensure adhesion of system to concrete.
1. Remove coatings and other substances that are incompatible with MVE-control system and that contain soap, wax, oil, or silicone, using mechanical methods recommended in writing by MVE-control system manufacturer. Do not use solvents.
2. Provide concrete surface profile complying with ICRI 310.2R CSP 3 by shot blasting using apparatus that abrades the concrete surface with shot, contains the dispensed shot within the apparatus, and recirculates the shot by vacuum pickup.
3. After shot blasting, repair damaged and deteriorated concrete according to MVE-control system manufacturer's written instructions.
4. Protect substrate voids and joints to prevent resins from flowing into or leaking through them.
5. Fill surface depressions and irregularities with patching and leveling material.
6. Fill surface cracks, grooves, control joints, and other nonmoving joints with crack-filling material.
7. Allow concrete to dry, undisturbed, for period recommended in writing by MVE-control system manufacturer after surface preparation, but not less than 24 hours.
8. Before installing MVE-control systems, broom sweep and vacuum prepared concrete.

C. Protect walls, floor openings, electrical openings, door frames, and other obstructions during installation.

3.3 INSTALLATION

A. General: Install MVE-control system according to ASTM F3010 and manufacturer's written instructions to produce a uniform, monolithic surface free of surface deficiencies such as pin holes, fish eyes, and voids.
1. Install primers as required to comply with manufacturer's written instructions.

B. Do not apply MVE-control system across substrate expansion, isolation, and other moving joints.

C. Apply system, including component coats if any, in thickness recommended in writing by MVE-control system manufacturer for MVER indicated by preinstallation testing.

D. Cure MVE-control system components according to manufacturer's written instructions. Prevent contamination or other damage during installation and curing processes.

E. After curing, examine MVE-control system for surface deficiencies. Repair surface deficiencies according to manufacturer's written instructions.

F. Install cementitious underlayment over cured membrane if required to maintain manufacturer's warranty and in thickness required to maintain the warranty.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform installation inspections.

B. Installation Inspections: Inspect substrate preparation and installation of system components to ensure compliance with manufacturer's written instructions and to ensure that a complete MVE-control system is installed without deficiencies.
   1. Verify that surface preparation meets requirements.
   2. Verify that component coats and complete MVE-control-system film thicknesses comply with manufacturer's written instructions.
   3. Verify that MVE-control-system components and installation areas that evidence deficiencies are repaired according to manufacturer's written instructions.

C. MVE-control system will be considered defective if it does not pass inspections.

3.5 PROTECTION

A. Protect MVE-control system from damage, wear, dirt, dust, and other contaminants before floor covering installation. Use protective methods and materials, including temporary coverings, recommended in writing by MVE-control system manufacturer.

B. Do not allow subsequent preinstallation examination and testing for floor covering installation to damage, puncture, or otherwise compromise the MVE-control system membrane.

END OF SECTION

SECTION 092116.23

GYPSUM BOARD SHAFT WALL ASSEMBLIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: Gypsum board shaft wall assemblies.

1.2 ACTION SUBMITTALS

A. Product Data: For each component of gypsum board shaft wall assembly.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For shaft wall assemblies and firestop tracks, from ICC-ES.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or with gypsum board manufacturer's written recommendations, whichever are more stringent.

B. Do not install interior products until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, moisture damaged, or mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: Provide materials and construction identical to those of assemblies tested according to ASTM E 90 and classified according to ASTM E 413 by a testing and inspecting agency.

C. Deflection Limits: Limit deflection of shaft wall assemblies that have the following room-side finishes:
   1. Exposed Gypsum Board: L/240.

2.2 GYPSUM BOARD SHAFT WALL ASSEMBLIES

A. Fire-Resistance Rating: As indicated.

B. STC Rating: As indicated.

C. Studs: Manufacturer's standard profile for repetitive members, corner and end members, and fire-resistance-rated assembly indicated.
   1. Depth: As indicated.
   2. Minimum Base-Metal Thickness: 0.018 inch.

D. Runner Tracks: Manufacturer's standard J-profile track with manufacturer's standard long-leg length, but at least 2 inches long and matching studs in depth.
   1. Minimum Base-Metal Thickness: Matching steel studs.

E. Firestop Tracks: Provide firestop track at head of shaft wall on each floor level.

F. Room-Side Finish: Gypsum board.

G. Shaft-Side Finish: Gypsum shaftliner board, Type X, Gypsum shaftliner board, moisture- and mold-resistant Type X.

H. Insulation: Sound attenuation blankets.

2.3 PANEL PRODUCTS

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

B. Gypsum Shaftliner Board, Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with paper faces.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; ProRoc Shaftliner.
      b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; ToughRock Fireguard Shaftliner.
      c. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner.
      d. USG Corporation; Sheetrock Brand Gypsum Liner Panel.
   2. Thickness: 1 inch.
   3. Long Edges: Double bevel.

C. Gypsum Shaftliner Board, Moisture- and Mold-Resistant Type X: ASTM C 1396/C 1396M; manufacturer's proprietary fire-resistive liner panels with moisture- and mold-resistant core and surfaces.
   1. Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; ProRoc Moisture and Mold Resistant Shaftliner.
      b. Georgia-Pacific Gypsum LLC, Subsidiary of Georgia Pacific; Dens-Glass Ultra Shaftliner.
      c. Lafarge North America, Inc.; Firecheck Moldcheck Type X Shaftliner.
      d. National Gypsum Company; Gold Bond Brand Fire-Shield Shaftliner XP.
      e. PABCO Gypsum; Pabcore Mold Curb Shaftliner Type X.
      f. USG Corporation; Sheetrock Brand Mold Tough Gypsum Liner Panel.
   2. Thickness: 1 inch.
   3. Long Edges: Double bevel.
   4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

D. Gypsum Board: As specified in Section 092900 "Gypsum Board."

2.4 NON-LOAD-BEARING STEEL FRAMING

A. Steel Framing Members: Comply with ASTM C 645 requirements for metal unless otherwise indicated.
   1. Protective Coating: ASTM A 653/A 653M, G40, hot-dip galvanized unless otherwise indicated.

B. Firestop Tracks: Top runner manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Fire Trak Corp.; Fire Trak System attached to studs with Fire Trak Posi Klip.
      b. Grace Construction Products; FlameSafe FlowTrak System.
      c. Metal-Lite, Inc.; The System.
      d. Steel Network Inc. (The); VertiClip SLD Series.

2.5 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with manufacturer's written

recommendations.

B. Trim Accessories: Cornerbead, edge trim, and control joints of material and shapes as specified in Section 092900 "Gypsum Board" that comply with gypsum board shaft wall assembly manufacturer's written recommendations for application indicated.

C. Steel Drill Screws: ASTM C 1002 unless otherwise indicated.

D. Track Fasteners: Power-driven fasteners of size and material required to withstand loading conditions imposed on shaft wall assemblies without exceeding allowable design stress of track, fasteners, or structural substrates in which anchors are embedded.
   1. Expansion Anchors: Fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 5 times design load, as determined by testing according to ASTM E 488 conducted by a qualified testing agency.
   2. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with capability to sustain, without failure, a load equal to 10 times design load, as determined by testing according to ASTM E 1190 conducted by a qualified testing agency.

E. Sound Attenuation Blankets: As specified in Section 092900 "Gypsum Board."

F. Acoustical Sealant: As specified in Section 092900 "Gypsum Board."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates to which gypsum board shaft wall assemblies attach or abut, with Installer present, including hollow-metal frames, cast-in anchors, and structural framing. Examine for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Sprayed Fire-Resistive Materials: Coordinate with gypsum board shaft wall assemblies so both elements of Work remain complete and undamaged. Patch or replace sprayed fire-resistive materials removed or damaged during installation of shaft wall assemblies to comply with requirements specified in Section 078100 "Applied Fireproofing."

B. After sprayed fire-resistive materials are applied, remove only to extent necessary for installation of gypsum board shaft wall assemblies and without reducing the fire-resistive material thickness below that which is required to obtain fire-resistance rating indicated.

Protect remaining fire-resistive materials from damage.

3.3 INSTALLATION

A. General: Install gypsum board shaft wall assemblies to comply with requirements of fire-resistance-rated assemblies indicated, manufacturer's written installation instructions, and ASTM C 754 other than stud-spacing requirements.

B. Do not bridge building expansion joints with shaft wall assemblies; frame both sides of expansion joints with furring and other support.

C. Install supplementary framing in gypsum board shaft wall assemblies around openings and as required for blocking, bracing, and support of gravity and pullout loads of fixtures, equipment, services, heavy trim, furnishings, wall-mounted door stops, and similar items that cannot be supported directly by shaft wall assembly framing.
   1. Reinforcing: Where handrails directly attach to gypsum board shaft wall assemblies, provide galvanized steel reinforcing strip with 0.033-inch minimum thickness of base metal (uncoated), accurately positioned and secured behind at least one layer of face panel.

D. Penetrations: At penetrations in shaft wall, maintain fire-resistance rating of shaft wall assembly by installing supplementary steel framing around perimeter of penetration and fire protection behind boxes containing wiring devices, elevator call buttons, elevator floor indicators, and similar items.

E. Isolate perimeter of gypsum panels from building structure to prevent cracking of panels, while maintaining continuity of fire-rated construction.

F. Firestop Tracks: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.

G. Control Joints: Install control joints at locations indicated on Drawings while maintaining fire-resistance rating of gypsum board shaft wall assemblies.

H. Sound-Rated Shaft Wall Assemblies: Seal gypsum board shaft walls with acoustical sealant at perimeter of each assembly where it abuts other work and at joints and penetrations within each assembly.

I. 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.

3.4 IDENTIFICATION

A. Identify fire rated walls and partitions and other walls required to have protected openings or penetrations effectively and permanently with signs or stenciling above accessible ceilings, repeated at intervals not exceeding 30 feet measured horizontally along walls and partitions.

B. Include the following information in lettering not less than 3 inches high with 3/8 inch stroke:
   1. "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS."

3.5 PROTECTION

A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

B. Remove and replace panels that are wet, moisture damaged, or mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, and irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 092216

NON-STRUCTURAL METAL FRAMING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Non-load-bearing steel framing systems for interior partitions.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.3 INFORMATIONAL SUBMITTALS

A. Evaluation Reports: For firestop tracks, from ICC-ES.

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.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated, according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

C. Deflection Limits: Limit deflection of non-structural framed wall assemblies that have the following finishes based on horizontal loading of 5 lbf/sq. ft.
   1. Exposed Gypsum Board: L/240.
   2. Tile Finish: L/360.

2.2 FRAMING SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. California Expanded Metal Products Company (CEMCO).
   2. ClarkDietrich Building Systems.

3. Marino\WARE.
4. Phillips Manufacturing Company.
5. Telling Industries, LLC.

B. 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.

C. Studs and Tracks: ASTM C 645.
   1. Steel Studs and Tracks:
      a. Minimum Base-Metal Thickness: As indicated on Drawings.
      b. Depth: As indicated on Drawings.

D. Slip-Type Head Joints: Provide one of the following:
   1. Single Long-Leg Track System: ASTM C 645 top track with 2-inch- deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
   2. Double-Track System: ASTM C 645 top track, inside track with 2-inch- deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction fit inside track.
   3. Deflection Track: Steel sheet top track 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) Dietrich Metal Framing; SLP-TRK Slotted Deflection Track.
         2) MBA Building Supplies; FlatSteel Deflection Track.
         3) Steel Network Inc. (The); VertiClip SLD Series.
         4) Superior Metal Trim; Superior Flex Track System (SFT).
         5) Telling Industries; Vertical Slip Track.

E. Firestop Head of Wall Joints: See Division 07 Section "Joint Firestopping."

F. Firestop Track:
   1. Top track manufactured to allow partition heads to expand and contract with movement of the structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
      a. CEMCO; California Expanded Metal Products Co.; FAS Track.
      b. ClarkDietrich Building Systems; BlazeFrame DL 2.
      c. Fire Trak Corp.; Fire Trak System.
      d. Metal-Lite, Inc.; The System.

G. Acoustical Furring Clip: Molded rubber and galvanized steel mount clip used to attach furring and gypsum wallboard wall or floor/ceiling assemblies.
   1. GenieClip as manufactured by Pliteq Inc.

H. Blocking Material Options:
   1. 6 inch wide, 0.0677 inch thick (14 gage) steel with 1-1/4 inch legs, pre notched 1/2 inch

to fit 16 or 24 inch on center stud.
a. Flush-Mount Flat Reinforced Backing; as manufactured by Perfect Wall, Inc.
2. 6 inch wide by 48 inches long, pre notched fire- retardant treated plywood with flexible connector plate including trimable plates for off-module backing, to fit 16 or 24 inch on center stud.
a. Danback; as manufactured by Dietrich.
3. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
a. Minimum Base-Metal Thickness: As indicated on Drawings.

I. Cold-Rolled Channel Bridging: Steel, 54 mils minimum base-metal thickness, with minimum 1/2-inch- wide flanges.
1. Depth: As indicated on Drawings.
2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

J. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
1. Minimum Base-Metal Thickness: As indicated on Drawings.
2. Depth: As indicated on Drawings.

K. Resilient Furring Channels: 1/2-inch- deep, steel sheet members designed to reduce sound transmission.
1. Configuration: Asymmetrical or hat shaped.

L. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches (32 mm), wall attachment flange of 7/8 inch (22 mm), minimum uncoated-metal thickness of 18 mils (0.45 mm), and depth required to fit insulation thickness indicated.

2.3 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.

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

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 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 and floor decks, 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 track section (for cripple studs) at head and secure to jamb studs.
      a. Install two studs at each jamb unless otherwise indicated.
      b. 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.
      a. Firestop Track: Install where required to maintain continuity of fire-resistance-rated assembly indicated.
   5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

E. Direct Furring:
   1. Screw to wood framing.
   2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

F. Z-Furring Members:
   1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches (610 mm) o.c.
   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.

END OF SECTION

SECTION 092900

GYPSUM BOARD

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Tile backing panels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:
   1. Trim Accessories: Full-size Sample in 12-inch- long length for each trim accessory indicated.

1.3 QUALITY ASSURANCE

A. Mockups: Before beginning gypsum board installation, install mockups of at least 100 sq. ft. in surface area to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Install mockups for the following:
      a. Each level of gypsum board finish indicated for use in exposed locations.
      b. Each texture finish indicated.
   2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
   3. Simulate finished lighting conditions for review of mockups.
   4. ubject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.4 DELIVERY, STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements.

B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.

C. Do not install panels that are wet, those that are moisture damaged, and those that are mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing agency.

B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Gypsum.
   2. CertainTeed Corp.
   3. Continental Building Products.
   4. Georgia-Pacific Gypsum LLC.
   5. National Gypsum Company.
   6. PABCO Gypsum.
   7. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.
   1. Thickness: 5/8 inch.
   2. Long Edges: Tapered.

C. Impact-Resistant Gypsum Board: ASTM C 1629/C 1629M.
   1. Basis of Design Product: Gold Bond XP Hi-Impact Gypsum Board.
   2. Core: 5/8 inch, Type X.
   3. Surface Abrasion: Meets or exceeds Level 3 requirements.

4. Surface Indentation: Meets or exceeds Level 1 requirements.
5. Single-Drop Soft-Body Impact: Meets or exceeds Level 3 requirements.
6. Hard-Body Impact: Meets or exceeds Level 3 requirements according to test in Annex A1.
7. Long Edges: Tapered.
8. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

D. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
1. Basis of Design Product: USG; Fiberock Aqua-Tough.
2. Core: 5/8 inch, Type X.
3. Long Edges: Tapered.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.4 TILE BACKING PANELS

A. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.
1. Products: Subject to compliance with requirements, provide one of the following:
a. C-Cure; C-Cure Board 990.
b. CertainTeed Corp.; FiberCement Underlayment.
c. Custom Building Products; Wonderboard.
d. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
e. James Hardie Building Products, Inc.; Hardiebacker.
f. National Gypsum Company, Permabase Cement Board.
g. USG Corporation; DUROCK Cement Board.
2. Thickness: 5/8 inch.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.5 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
a. Cornerbead.
b. Bullnose bead.
c. L-Bead: L-shaped; exposed long flange receives joint compound.
d. U-Bead: J-shaped; exposed short flange does not receive joint compound.
e. Expansion (control) joint.

2.6 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:
   1. Interior Gypsum Board: Paper.
   2. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: Products compatible with substrate and other coatings applied to surface.
   1. Filling, Tape Embedding and Topping Coats: Products complying with ASTM C475 and recommended by gypsum board manufacturer for finish level specified.
   2. Skim Coat: For final coat of Level 5 finish, use drying-type, topping compound.

D. Joint Compound for Tile Backing Panels:
   1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
   2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.7 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
   1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

E. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.

B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold

damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

A. Comply with ASTM C 840.

B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch- wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

I. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

J. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Type X:As indicated on Drawings.
   2. Impact-Resistant Type: As indicated on Drawings.
   3. Moisture- and Mold-Resistant Type: As indicated on Drawings.

B. Single-Layer Application:
   1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
   2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
      a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
      b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
   3. On Z-furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
   4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

C. Multilayer Application:
   1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, 16 inches minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
   2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
   3. On Z-furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
   4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.4 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Cementitious Backer Units: ANSI A108.11, at locations indicated to receive tile.

C. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints at locations indicated on Drawings.

C. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners unless otherwise indicated.
   2. Bullnose Bead: Use where indicated.
   3. L-Bead: Use where indicated.
   4. U-Bead: Use where indicated.

D. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
      a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
   4. Level 5: Where indicated on Drawings.
      a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."

E. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.7 IDENTIFICATION

A. Identify fire rated walls and partitions and other walls required to have protected openings or penetrations effectively and permanently with signs or stenciling above accessible ceilings, repeated at intervals not exceeding 30 feet measured horizontally along walls and partitions.

B. Include the following information in lettering not less than 3 inches high with 3/8 inch stroke:
   1. "FIRE AND/OR SMOKE BARRIER - PROTECT ALL OPENINGS."

3.8 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.

B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
   1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
   2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION

SECTION 093000

TILING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Ceramic and Porcelain tile for:
      a. Walls.
   2. Metal edge strips.

1.2 PERFORMANCE REQUIREMENTS

A. Dynamic Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ANSI A137.1 by Dynamic Coefficient of Friction (DCOF) AcuTest:
   1. Level Surfaces: Minimum 0.42.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Show locations of each type of tile and tile pattern. Show widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   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 12 inches square, but not fewer than 4 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. Metal edge strips in 6-inch lengths.

1.4 INFORMATIONAL SUBMITTALS

A. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

B. Product Certificates: For each type of product, signed by product manufacturer.

C. Material Test Reports: For each tile-setting and -grouting product.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
   2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type and color or finish from one source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.

B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from one manufacturer and each aggregate from one source or producer.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer for each product:
   1. Joint sealants.
   2. Metal edge strips.

D. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Build mockup of each type of wall tile installation.
   2. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. Preinstallation Conference: Conduct conference at Project site.
   1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.

B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.

C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.

D. Store liquid materials in unopened containers and protected from freezing.

E. Handle tile that has temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.8 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

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.
   1. Provide tile complying with Standard grade requirements unless otherwise indicated.
   2. Provide tile complying with Standard grade requirements unless otherwise 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.
   1. Large Format Tile: Comply with ANSI A 118.5 series for tile installation standards.
      a. Back buttering the tile to obtain 100 percent mortar coverage.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
   1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

E. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by precoating with continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

F. Trim Units: Coordinated with sizes and coursing of adjoining flat tile where applicable and matching characteristics of adjoining flat tile. Provide manufacturer's shapes as selected.

2.2 MANUFACTURERS

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide product as specified or comparable product by one of the following:
   1. Daltile; Division of Dal-Tile International Inc. as basis of design.
   2. American Olean; Division of Dal-Tile International Inc.
   3. Crossville, Inc.

2.3 TILE PRODUCTS, T-1, T-2, T-2B, T3, T-4, T-5, T6, T-7, T-8, T-9

A. Ceramic and Porcelain Tile: ANSI A137.1, in sizes and thickness as indicated on Drawings.
   1. Basis of Design Products: See Finish Schedule on Drawings.

2.4 TILE BACKING PANELS

A. Type as specified in Section 092900 "Gypsum Board."

2.5 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set-Small Format Tile 12 inches or less in any direction): ANSI A118.4.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      a. Custom Building Products; Versa Bond.
      b. Laticrete International, Inc.; 253 Gold Thinset Set Mortar.
      c. MAPEI Corporation; UltraFlex 2 Thin Set.
      d. Merkrete Inc.; 7D10 Latex Thin Set Mortar.
   2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

B. Latex-Portland Cement Mortar (Medium Bed/LHT Thin Set-Large Format Tile Mortar 12 inches or greater in any direction): ANSI A118.4 and ANSI A118.15.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Custom Building Products; ProLite.
      b. Laticrete International, Inc.; 4 XLT.
      c. MAPEI Corporation; UltraFlex LFT.
      d. Merkrete Inc.; 820 Merlite.

C. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following :
      a. Custom Building Products.
      b. Laticrete International, Inc.
      c. MAPEI Corporation.
      d. Merkrete Inc.; Pro Epoxy Grout.
   2. Provide product capable of withstanding continuous and intermittent exposure to

temperatures of up to 140 deg F and 212 deg F, respectively, and certified by manufacturer for intended use.

2.6 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3.
   1. Manufacturers: Subject to compliance with requirements, provide products as indicated on Finish Schedule or comparable product by one of the following :
      a. Custom Building Products.
      b. Laticrete International, Inc.
      c. MAPEI Corporation.
      d. Merkrete Inc.

B. Grout Color: See Finish Schedule.

2.7 ELASTOMERIC SEALANTS

A. As specified in Section 079200 "Joint Sealants."
   1. Colors: Provide colors of exposed sealants to match colors of grout in tile adjoining sealed joints unless otherwise indicated.

2.8 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: Angle or L-shape, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications.
   1. Basis of Design Product: See Finish Schedule.

C. 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.

D. Grout Sealer: Grout manufacturer's standard product for sealing grout joints and that does not change color or appearance of grout or tile.

2.9 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and

other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations 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 as specified in Section 090511 "Concrete Floor Preparation."
   1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Concrete Substrates:
   1. Prepare substrate according Section 090511 "Concrete Floor Preparation."
   2. Concrete Testing: As specified in Section 090512 "Concrete Floor Moisture Content and pH Testing.

B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot toward drains.

C. 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.

3.3 TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
   1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
      a. Tile floors in wet areas.
      b. Tile floors composed of tiles 8 by 8 inches or larger.

B. 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.

C. 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.

D. 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 the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.
   2. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   3. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

E. Joint Widths: Unless otherwise indicated or recommended by manufacturer, install tile with the following joint widths:
   1. Ceramic Tile: 1/16 inch.
   2. Porcelain Tile: 1/16 inch.

F. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

G. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
   2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."

H. Metal Edge Strips: Install at locations indicated.

I. Grout Sealer: Apply grout sealer to cementitious grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.

3.4 TILE BACKING PANEL INSTALLATION

A. Comply with Section 092900 "Gypsum Board."

3.5 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove epoxy grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and

plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Metal Studs or Furring:
   1. Tile Installation W243: Thin-set mortar on gypsum board; TCNA W243.
      a. Thin-Set Mortar: Latex- portland cement mortar.
      b. Grout: High performance cement unsanded grout.
   2. Tile Installation W244C: Thin-set mortar on cementitious backer units; TCNA W244.
      a. Thin-Set Mortar: Latex- portland cement mortar.
      b. Grout: High performance cement unsanded grout.

END OF SECTION

SECTION 095113

ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below.
   1. Acoustical Panel: Set of full-size Samples of each type, color, pattern, and texture.
   2. Exposed Suspension-System Members, Moldings, and Trim: Set of 6-inch- long Samples of each type, finish, and color.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Suspended ceiling components.
   2. Structural members to which suspension systems will be attached.
   3. Size and location of initial access modules for acoustical panels.
   4. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
   5. Perimeter moldings.

B. Product Test Reports: For each acoustical panel ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.

C. Evaluation Reports: For each acoustical panel ceiling suspension system and anchor and

fastener type, from ICC-ES.

D. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For finishes to include in maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
   2. Suspension-System Components: Quantity of each exposed component equal to 2 percent of quantity installed.
   3. Hold-Down Clips: Equal to 2 percent of quantity installed.
   4. Impact Clips: Equal to 2 percent of quantity installed.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver acoustical panels, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.

B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.

C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
   1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
   2. Smoke-Developed Index: 50 or less.

C. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Indicate design designations from UL's "Fire Resistance Directory" or from the listings of another qualified testing agency.

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations:
   1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
   2. Suspension System: Obtain each type from single source from single manufacturer.

B. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

C. Acoustical Panel Standard: Provide manufacturer's standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

D. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

2.3 ACOUSTICAL PANELS, ACT-1, ACT-2, ACT-3

A. Basis-of-Design Product: Subject to compliance with requirements, provide products as indicated in Finish Schedule on Drawings or comparable product by one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corp.
   3. Rockfon.
   4. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Color: See Finish Schedule on Drawings.

C. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus,

mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.
   1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.
   1. Anchors in Concrete: Anchors of type and material indicated below, with holes or loops for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to five times that imposed by ceiling construction, as determined by testing according to ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
      a. Type: Postinstalled expansion or Postinstalled bonded anchors.
      b. 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.
      c. Corrosion Protection: Stainless-steel components complying with ASTM F 593 and ASTM F 594, Group 1 Alloy 304 or 316 for bolts; Alloy 304 or 316 for anchor.
      d. Corrosion Protection: Components fabricated from nickel-copper-alloy rods complying with ASTM B 164 for UNS No. N04400 alloy.
   2. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with capability to sustain, without failure, a load equal to 10 times that imposed by ceiling construction, as determined by testing according to ASTM E 1190, conducted by a qualified testing and inspecting agency.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
   1. Zinc-Coated, Carbon-Steel Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper.
   2. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304, nonmagnetic.
   3. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.106-inch- diameter wire.

D. Hanger Rods or Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch- thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch- diameter bolts.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to

accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

J. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.5 METAL SUSPENSION SYSTEM

A. Basis-of-Design Manufacturer: Subject to compliance with requirements, provide products as indicated on Drawings or comparable product by one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corp.
   3. Rockfon.
   4. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. 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 according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 02/11-inch- wide metal caps on flanges.
   1. Structural Classification: Intermediate-duty system.
   2. End Condition of Cross Runners: butt-edge type.
   3. Face Design: Flat, flush.
   4. Cap Material: Steel or aluminum cold-rolled sheet.
   5. Cap Finish: Painted in color as selected from manufacturer's full range.

C. Drywall Suspension Systems all main beams and cross tees shall be commercial quality hot-dipped galvanized steel.
   1. Structural Classification: Intermediate-duty system.
   2. Main beam: manufactured main beam- 1-1/2" knurled face with ScrewStop™ reverse hem by 1-11/16 inches high. Drywall Main Beams are factory punched with cross tee routs, hanger wire holes, and SuperLock™ main beam clip for a strong secure connection and fast accurate alignment. Drywall Main Beams are Heavy-duty performance per ASTM C635.
      a. HD8906 - 12ft HD Drywall Main Beam 1-1/2 in.
   3. Cross Tees: manufactured cross tee- 1-1/2" knurled face with ScrewStop™ reverse hem by 1-1/2 inches high with factory punched cross tee routs and hanger wire holes and XL stake on clip for a strong secure connection.
      a. XL8945P - 4ft Drywall Cross Tee.
   4. Wall Molding: KAM12 - 12ft Knurled Angle Molding 1-1/4" Face.
   5. Hanger wire: a Class 1 zinc coating, soft temper, pre-stretched, with a yield stress load of at least time three times the design load, but not less than 12-gauge.

6. Fasteners (for Panel attachment).
   a. #6 x 1-5/8” Fine thread drywall screws.
   b. Recommended Adhesives: Loctite PL Premium Polyurethane Construction Adhesive, OSI F38 Drywall Panel Adhesive.
7. Perimeter Systems.
   a. Commercial quality extruded aluminum alloy 6063 trim channel, factory finished in baked polyester paint. Commercial quality galvanized steel unfinished T-bar connection clips; galvanized steel splice plates.
      1) Color: White.
      2) Size: 120 in X 4 in (also available in 6”).
      3) Recycle Content: Post-Consumer - 50% Pre-Consumer - 0%.
      4) Acceptable Product: AXIOM One Piece for Drywall, 4in Straight – AX1PC4STR or Curved AX1PC4CUR as manufactured by Armstrong World Industries.
   b. Axiom Trim Channel:
      1) AX4STR 4in Axiom Classic Straight.
      2) AX1PC4STR 4IN One –Piece Drywall Trim.
   c. Axiom Bottom Trim with taping flange.
      1) AXBTASTR – Bottom Trim for AcoustiBuilt.
   d. Axiom Accessories:
      1) AXSPLICE - Splice Plate.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Armstrong World Industries, Inc.
   2. CertainTeed Corp.
   3. Rockfon.
   4. Fry Reglet Corporation.
   5. Gordon, Inc.
   6. USG Interiors, Inc.; Subsidiary of USG Corporation.

B. Roll-Formed, Sheet-Metal 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. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.
   2. 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.
   3. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

C. Extruded-Aluminum Edge Moldings and Trim: Where indicated, provide manufacturer's extruded-aluminum edge moldings and trim of profile indicated or referenced by manufacturer's designations, including splice plates, corner pieces, and attachment and other clips, complying with seismic design requirements and the following:
   1. Aluminum Alloy: 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 aluminum extrusions complying with ASTM B 221 (ASTM B 221M) for Alloy and Temper 6063-T5.
   2. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
   3. Baked-Enamel or Powder-Coat Finish: Minimum dry film thickness of 1.5 mils (0.04 mm). Comply with ASTM C 635/C 635M and coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
   1. Exposed and Concealed Joints: Nonsag, paintable, nonstaining latex sealant.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
   1. Fire-Rated Assembly: Install fire-rated ceiling systems according to tested fire-rated design.

B. Suspend ceiling hangers from building's structural members and as follows:
   1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
   2. Splay hangers only where required and, if permitted with fire-resistance-rated ceilings, to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
   3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
   4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
   5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
   6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
   7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
   8. Do not attach hangers to steel deck tabs.
   9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
   10. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
   11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. 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. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more

than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.

3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
2. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.
3. Install hold-down or impact clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION

SECTION 096500

RESILIENT FLOORING

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Supply and installation of the indoor resilient multipurpose surfacing.

B. References for the correct construction and preparation of concrete slabs to receive resilient flooring.

1.2 SUBMITTALS

A. Product Data:
   1. Manufacturer's promotional brochures, specifications and installation instructions.

B. Manufacturer Certifications:
   1. Provide certification that accurately identifies the Original Equipment Manufacturer (OEM) of flooring furnished for this project including manufacturer's name, address and factory location.
   2. Suppliers of private label flooring for this project must identify themselves as such and fully disclose the OEM information listed above.
   3. All "manufacturer" requirements in these specifications must be complied with by the OEM, including warranties, certifications, qualifications, product data, test results, environmental requirements, performance data, etc.

C. Samples:
   1. Submit for selection and approval three (3) sets of the indoor resilient multipurpose surfacing, manufacturer's brochures, samples or sample boards of all of the available colors, textures and styles.
   2. Submit color samples of all the available game line paint colors for selection and approval.

D. Closeout Submittals:
   1. Submit three (3) copies of the indoor resilient multipurpose surfacing and manufacturer's maintenance instructions.
   2. Submit three (3) copies of the material and installation warranties as specified.

1.3 QUALITY ASSURANCE

A. Qualifications:
   1. The indoor resilient multipurpose surfacing shall have been actively marketed for a

minimum of ten (10) years.
2. The indoor resilient multipurpose surfacing shall be manufactured in an ISO 9001 certified plant.
3. The indoor resilient multipurpose surfacing shall be manufactured in an ISO 14001 certified plant.
4. The indoor resilient multipurpose surfacing supplier shall be an established firm, experienced in the field, and competent in the techniques required by the manufacturer.
5. The installer of the indoor resilient multipurpose surfacing shall have a minimum of five (5) years of experience in the field installing indoor resilient multipurpose surfacing and have worked on at least five (5) projects of similar size, type and complexity.

B. Certifications:
1. Installer to submit the indoor resilient athletic surfacing manufacturer's or distributor's certification attesting that they are an approved installer of the indoor resilient multipurpose surfacing.
2. The indoor resilient multipurpose surfacing manufacturer to submit official ISO 9001 certification for the facility in which the indoor resilient multipurpose surfacing is manufactured.

C. Testing:

1.4 DELIVERY, STORAGE AND HANDLING

A. Delivery:

B. Storage:
1. Store the material in a secure, clean and dry location.
2. Maintain temperature between 55° and 85° Fahrenheit.
3. Store the indoor resilient athletic surfacing rolls in an upright position on a smooth flat surface immediately upon delivery to jobsite.
4. Rolls shipped in rigid protective cardboard containers can be laid horizontally prior to unpacking and installation.

1.5 PROJECT/SITE CONDITIONS

A. It is the responsibility of the general contractor/construction manager to maintain project/site conditions acceptable for the installation of the indoor resilient multipurpose flooring.

B. The area in which the indoor resilient multipurpose surfacing will be installed shall be dry and weather tight. Permanent heat, light and ventilation shall be installed and operable.

C. All other trades shall have completed their work prior to the installation of the resilient athletic flooring. The general contractor or construction manager shall maintain a secure and clean working environment before, during and after the installation.

D. Maintain a stable room temperature of at least 65°F for a minimum of one (1) week prior to, during and thereafter installation.

E. An effective low-permeance vapor barrier is placed directly beneath the concrete subfloor. For “on” or “below grade” installations, it is recommended to provide a permanent vapor barrier resistant to long term hydrostatic pressure/moisture exposure. Protrusions should be sealed to prevent moisture migration into the slab. Moisture should not be allowed to enter the slab after the completed construction.

F. Concrete subfloor surface pH level within the 7 to 10 range dependent upon installation type.

G. Concrete subfloor should be no greater than 1/8" within a 10 ft diameter. This tolerance can be measured in accordance with ASTM E1155. A specified (FF) of 50 and an (FL) of 30 should reach this degree of floor flatness and floor level. There is no numerical correlation between F numbers and the deviation from the straight.

H. Concrete subfloor must be clean and free of all foreign materials or objects including, but not limited to, curing compounds and sealers.

I. Fill cracks, grooves, voids, depressions, and other minor imperfections. Follow the manufacturer’s directions. Moveable joints must be treated utilizing specific transitioning joint devices depending upon the architect’s recommendations. Follow current ASTM F710 guidelines for the preparation of concrete slabs to receive resilient flooring.

J. Refer to ACI 302.2R “Guidelines for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials” for concrete design and construction.

K. Concrete slab shall be fortified with continual steel reinforcement. Fiber reinforcement alone shall not be considered adequate fortification.

1.6 WARRANTY

A. Special Limited Warranty:
   1. Manufacturer's standard form in which manufacturer agrees to repair or replace sports flooring including labor that fails within specified warranty period.

B. Material warranty must be direct from the product manufacturer.
   1. Material warranties must come from original manufacturer or division thereof. Private label warranties from distributors or brokers are not valid. Supply original point of manufacturing upon request.

C. Failures include, but are not limited to, the following:
   1. Material manufacturing defects.
   2. Surface wear and deterioration to the point of wear-through of wear layer per ASTM F410/ASTM F1303.
   3. Failure due to substrate moisture exposure exceeding 98 percent relative humidity when tested according to ASTM F2170.

D. Warranty Period:
   1. For material defects and surface wear-through: 25 years from date of substantial completion.
   2. For moisture vapor tolerance: 25 years from date of substantial completion.

E. Installer’s Limited Warranty:
   1. Installer's standard form in which installer agrees to repair or replace sports flooring that fails due to poor workmanship or faulty installation within the specified warranty period.
   2. Warranty Period: 2 years from date of substantial completion.

1.7 ADDITIONAL MATERIALS

A. Furnish to the owner additional materials containing a total of at least 1% of each different color or design of the indoor resilient athletic surfacing used on the project.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. The basis of the design for the indoor resilient multipurpose surfacing is Taraflex Sport M Plus as manufactured by Tarkett.

B. All other installation accessories and related components must be either made or approved by the indoor resilient athletic surfacing manufacturer.

C. Other products may be approved as equal if deemed qualified and submitted in accordance with the General Conditions.

D. Test reports confirming compliance from an independent sports laboratory must be provided along with samples, technical data, installation, maintenance, and warranty prior to acceptance as an alternative product.

E. MATERIALS
Physical properties of the indoor resilient athletic surfacing shall conform to the following minimums:

Width	-	6’ 6” (2 m)
Length	-	85’ (25.9m) approx.
Wear Layer	-	2 mm
Total Thickness	-	8.1 mm
Wear Layer	Type 1- Grade 1	ASTM F1303/F410
Vertical Deformation	PASSED	ASTM F2772
Rolling Load	PASSED	0.30 (EN 1569 {11/1999})
Surface Finish Effect	PASSED	ASTM F2772 (80 - 110)
Chemical Resistance	Excellent	ASTM F925
Impact Resistance	PASSED	EN 1717
Abrasion Resistance	PASSED	0.10 (EN ISO 5470-1 {06/1999})
Static Load Limit	PASSED	ASTM F970- Load 175 Lbs
Sound Insulation	Excellent	+/= 19 dB (ISO 717/2)
In-Room Sound Insulation	Excellent	61dB (NF S31-074)
Ball Rebound	PASSED	ASTM F2772 > 90%
Force Reduction	PASSED	ASTM F2772 Class 3
Fire Rating	PASSED	ASTM E648 Class 1
Microbial Assays Test	No Growth	G21 ASTM - Backing
Asthma and Allergy Friendly™	ASP: 05-01/101	Certified Compliant
Phthalate-free technology	-	YES
REACH Compliant	-	YES
Heavy Metals	-	NO
ISO 9001	-	YES
ISO 14001	-	YES

Color: As available from the indoor resilient athletic surfacing manufacturer’s standard range.Hardwood Design Series: A wood look design as available from the indoor resilient athletic surfacing manufacturer’s standard range.Texture: Texture to remain consistent between solid colors and wood design when blending colors.Welding Rod: As supplied by the indoor resilient athletic surfacing manufacturer or supplier.Color to blend with the indoor resilient athletic surfacing color or design.All seams shall be welded to create a monolithic and impermeable surface.Adhesive: As approved by the indoor resilient athletic surfacing manufacturer.Game Line Paint and Primer: As approved by the indoor resilient athletic surfacing manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

A. It is the responsibility of the general contractor/construction manager to ensure that project/site conditions are acceptable for the installation of the indoor resilient athletic flooring.

B. Verify that the area in which the indoor resilient athletic surfacing will be installed is dry and weather tight. Verify that permanent heat, light and ventilation are installed and operable.

C. Verify that all other work that could cause damage, dirt and dust or interrupt the normal pace of the indoor resilient athletic flooring installation is completed or suspended.

D. Verify that there is a stable room temperature of at least 65°F.

E. Verify that there are no foreign materials or objects on the subfloor and that the subfloor is clean and ready for installation.

F. Direct Full Spread Adhering to Concrete Subfloor Multi-Set : moisture content less than 83% RH when tested per ASTM F2170.

G. Follow Fieldturf USA, Inc installation recommendations.

H. Do not average the results of the tests. Report all field test results in writing to the General Contractor, Architect, and End User prior to installation.

I. Verify that the concrete subfloor surface pH level is within the 7 - 10 range.

J. Document the results indicating the slab is within manufacturer’s tolerances for slab deviation.

3.2 PREPARATION OF SURFACES

A. Sand the entire surface of the concrete slab.

B. Sweep the concrete slab so as to remove all dirt and dust. If a sweeping compound is to be used it must be a sweeping compound that does not contain oil or other items that may inhibit the adhesive bond.

C. Slab must be dust free. In the event that dust impairs adhesive bond, priming the slab prior to application of adhesive may be necessary. Follow installation guidelines.

3.3 INSTALLATION

A. The installation area shall be closed to all traffic and activity for a period to be set by the indoor resilient athletic surfacing installer. The indoor resilient athletic surfacing installation shall not begin until the installer is familiar with the existing conditions.

B. All necessary precautions should be taken to minimize noise, smell, dust, the use of hazardous materials and any other items that may inconvenience others.

C. Install the indoor resilient athletic surfacing in strict accordance with the indoor resilient athletic surfacing manufacturer's written instructions.

D. Install the indoor resilient athletic surfacing minimizing cross seams. Provide a seam diagram during the submittal process for approval prior to installation. Vinyl Sheet Flooring Seams: Comply with ASTM F 1516. Rout joints and heat weld to permanently and seamlessly fuse sections together. Apply transitions at doorways as needed.

E. Install appropriate threshold plates or transition strips where necessary.

3.4 CLEANING

A. Remove all unused materials, tools, and equipment and dispose of any debris properly. Clean the indoor resilient athletic surfacing in accordance with the manufacturer's instructions.

3.5 PROTECTION

A. If required, protect the indoor resilient athletic surfacing from damage using coverings approved by the manufacturer until acceptance of work by the customer or their authorized representative.

3.6 RELATED STANDARDS AND GUIDELINES

A. ASTM F2170 "Standard Test Method for Determining Relative Humidity In Concrete Floor Slabs Using In-Situ Probes".

B. ASTM F710 "Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring".

C. ACI 302.2R-06 "Guideline for Concrete Slabs that Receive Moisture-Sensitive Flooring Materials".

D. ASTM F2772-11 "Standard Specification for Athletic Performance Properties of Indoor Sports Floor Systems".

END OF SECTION

SECTION 096513

RESILIENT BASE AND ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:
   1. Resilient base.

B. Principal Products:

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.

C. Product Schedule: For resilient base and accessory products.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

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 time 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 RESILIENT BASE

A. B-1: Basis of Design Manufacturer: Subject to compliance with requirements, provide products as indicated in Finish Schedule on Drawings or comparable by one of the following:
   1. Johnsonite as basis of design.
   2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
   3. Flexco.
   4. Roppe Corporation, USA.

B. B-2: Basis of Design Manufacturer: Subject to compliance with requirements, provide products as indicated in Finish Schedule on Drawings or comparable by one of the following:
   1. Johnsonite as basis of design.
   2. Burke Mercer Flooring Products, Division of Burke Industries Inc.
   3. Flexco.
   4. Roppe Corporation, USA.

2.2 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.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

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 as specified in Division 09 Section "Concrete Floor Preparation."
   1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Concrete Substrates:
   1. Prepare substrate according Section 090511 "Concrete Floor Preparation."
   2. Concrete Testing: As specified in Section 090512 "Concrete Floor Moisture Content and pH Testing.

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 they are the same temperature as the 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.

H. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Miter or cope corners to minimize open joints.

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 exposed surfaces.

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

SECTION 096519

RESILIENT TILE FLOORING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vinyl composition floor tile.

B. Related Sections: Sections related to this section include:
   1. Acoustical Underlayment.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of floor tile. Include floor tile layouts, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.
   1. Show details of special patterns.

C. Samples for Verification: Full-size units of each color and pattern of floor tile required.
   1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.

D. Product Schedule: For floor tile.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of floor tile to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Floor Tile: Furnish one box for every 50 boxes or fraction thereof, of each type, color, and pattern of floor tile installed.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store floor tile 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 floor tiles on flat surfaces.

1.7 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 floor tile during the following time 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 floor tile installation.

D. Close spaces to traffic for 48 hours after floor tile installation.

E. Install floor tile after other finishing operations, including painting, have been completed.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient tile 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 VINYL COMPOSITION FLOOR TILE, RF-1, RF-2, RF-3, RF-4, RF-5.

A. Basis of Design Manufacturer: Subject to compliance with requirements, provide products as indicated in Finish Schedule, or approved equal.

B. Tile Standard: ASTM F 1066 tile.

2.3 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.

C. Floor Polish: Provide protective, liquid floor-polish products recommended by floor tile manufacturer.

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 as specified in Division 09 Section "Concrete Floor Preparation."
   1. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Prepare substrates according to floor tile manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates:
   1. Prepare substrate according to Division 09 Section "Concrete Floor Preparation."

3.3 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.

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 with grain running in one direction.

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 finished floor 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 flooring 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.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting floor tile.

B. Perform the following operations immediately after completing floor tile installation:
   1. Remove adhesive and other blemishes from exposed surfaces.
   2. Sweep and vacuum surfaces thoroughly.
   3. Damp-mop surfaces to remove marks and soil.

C. Protect floor tile from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Floor Polish: Remove soil, adhesive, and blemishes from floor tile surfaces before applying liquid floor polish.
   1. Apply one coat(s).

E. Cover floor tile until Substantial Completion.

END OF SECTION

SECTION 096813

TILE CARPETING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes modular carpet tile.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.
   1. Review methods and procedures related to carpet tile installation including, but not limited to, the following:
      a. Review delivery, storage, and handling procedures.
      b. Review ambient conditions and ventilation procedures.
      c. Review subfloor preparation procedures.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
   2. Include installation recommendations for each type of substrate.

B. Shop Drawings: Show 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 of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
   1. Carpet Tile: Full-size Sample.
   2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- long Samples.

D. Product Schedule: For carpet tile. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For carpet tile, for tests performed by a qualified testing agency.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
   1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
   2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.9 FIELD CONDITIONS

A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 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 does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, dimensional stability, excess static discharge, loss of tuft bind strength, loss of face fiber, and delamination.
   3. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 CARPET TILE

A. Basis of Design Products: See Finish Schedule on Drawings for products, including colors and patterns.

B. Antimicrobial Treatment: Manufacturer's standard material.

C. Performance Characteristics: As follows:
   1. Appearance Retention Rating: Heavy traffic, 3.0 minimum according to ASTM D 7330.
   2. Critical Radiant Flux Classification: Not less than Class 1 0.45 W/sq. cm.

2.2 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 complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

C. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and dimensions as indicated on Drawings.

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 as specified in

Division 09 Section "Concrete Floor Preparation."

3.2 PREPARATION

A. General: Comply with CRI 104 and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Concrete Substrates:
   1. Prepare substrate according Division 09 Section "Concrete Floor Preparation."
   2. Concrete Testing: As specified in Section 090512 "Concrete Floor Moisture Content and pH Testing.

3.3 INSTALLATION

A. General: Comply with 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. 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.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

H. 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.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:
   1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
   2. Remove yarns that protrude from carpet tile surface.
   3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRI 104, Section 11.0, "Post Installation."

C. 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

SECTION 097200

WALL COVERINGS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Vinyl wall covering.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

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. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.

C. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch- long in size.
   1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. 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 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Wall-Covering Materials: For each type, color, texture, and finish, full width by length to equal to 5 percent of amount installed.

1.7 QUALITY ASSURANCE

A. Mockups: Build mockups Of tackable wall surfaces to verify selections made under Sample submittals and to demonstrate aesthetic effects and to set quality standards for installation.
   1. Build mockups for each type of wall covering on each substrate required. Comply with requirements in ASTM F 1141 for appearance shading characteristics.
   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.

1.8 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 temporary 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.

1.9 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 50 or less.

PART 2 PRODUCTS

2.1 VINYL WALL COVERING, WC-1.

A. Manufacturer: Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings.
   1. GRAVITY DIGITAL WALLS: See Finish Schedule on Drawings for style and color.
   2. Textured White Vinyl Wallcovering Protected with ImageLock® Coating.
   3. Backing: None.
   4. Width: 54”.
   5. Weight: 20.00 oz per linear yard.
   6. Hanging information: straight hang, custom graphic.
   7. Fire rating: Class A, per ASTM E84 (adhered).
   8. NFPA 286, meets 2006 IBC Section 803.2.1.
   9. Flame spread: 10.
   10. Smoke development: 50.
   11. Printed with HAP-free inks.

2.2 TACKABLE WALL SURFACE COVERING, EQ-8

A. Manufacturers: Basis of Design Product: Subject to compliance with requirements, provide tackboard panel as manufactured by Forbo (basis of design), Colored Cork Board, Forbo Cork Board with wood frame. See drawings for detail and dimensions. Or comparable product by one of the following:
   1. A-1 Visual Systems.
   2. Marsh Industries, Inc.; Visual Products Group.
   3. PolyVision Corporation; a Steelcase company.

B. MWL style bulletin board constructed of ¼” Forbo Bulletin Board cork laminated to ¼” tempered hardboard with solid red oak frame 1-7/8" face x 1-1/16”. All corners mitered to a hair line joint with clear finish.

C. Adhesive: As recommended by manufacturer for substrate.

D. Linoleum: Comprised from natural materials consisting of linseed oil, cork, rosin binders, and dry pigments mixed and calendared onto a natural jute backing. Unicolor extends throughout the thickness of the product. Material is ¼” thick, material size see drawings. Make each board from a single piece of material (no splicing).

E. Color as selected by architect from the manufacturers standard colors.

F. Red Oak Frame 1-7/8” Face, 1-1/6” Depth from the wall.

2.3 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 099000 "Painting and Coating" and recommended in writing by primer/sealer and wall-covering manufacturers for intended substrate.

C. Seam Tape: As recommended in writing by wall-covering manufacturer.

D. Manufacturer’s standard sealant that matches tackable surface.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 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, mildew, and incompatible primers.

C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
   1. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
   2. Painted Surfaces: Treat areas susceptible to pigment bleeding.

D. Check painted surfaces for pigment bleeding. Sand gloss, semigloss, and eggshell finish with fine sandpaper.

E. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

F. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.

3.3 WALL-COVERING INSTALLATION

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 unless otherwise indicated.

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.

3.4 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

SECTION 097733

FIBERGLASS REINFORCED PLASTIC PANELS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes.
1. Surface preparation and prime painting.
2. Sanitary wall panels.

1.2 SUBMITTALS

A. Shop Drawings: Indicate wall elevations with joint layout.

B. Product Data: Provide data on panels and adhesive.

C. Samples:
1. Submit two samples of panels 3 x 3 inch in size illustrating color, finish, and texture.
2. Submit two samples of each type trim and moldings 12 inches long illustrating color, finish, and texture.

D. Test Reports: Indicate verification of flame and smoke ratings, when tested by UL.

E. Manufacturer's Installation Instructions: Submit special procedures and perimeter conditions requiring special attention.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit data on cleaning, touch-up, and repair of covered surfaces.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with a minimum of three years documented experience.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not apply materials when surface and ambient temperatures are outside the temperature range of 65 - 85 degrees F.

B. Do not apply materials when relative humidity is greater the 80 percent.

C. Maintain these conditions 48 hours before, during and after installation of panels.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Maximum 25/450 flame spread/smoke developed ratings when tested to ASTM E84.

2.2 MATERIALS - FIBERGLASS, FRP-1

A. Subject to requirements, provide products indicated in Finish Schedule on Drawings as Basis of Design.

B. Manufacturers:
1. Nudo Products, Inc.
2. Marlite.
3. Crane Composites Inc.

C. Sanitary Panels: Rigid, impact resistant fiberglass panels, 0.090 inches thick, color and texture as selected, 48 inches wide.

D. Adhesive: Type Silicone as specified in Section 079000 "Joint Sealants".

E. Substrate Filler: Recommended by adhesive and panel manufacturers compatible with substrate.

F. Substrate Primer: As specified in Section 099000.

G. Trim: Manufacturer’s standard single piece, color to match sanitary panels:
1. Panel Joints: Joint strip molding.
2. Corners: Inside and outside corner angles.
3. Termination Trim: J-molding.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that substrate surfaces are flat and prime painted, ready to receive work.

B. Measure moisture content of surfaces using an electronic moisture meter. Do not apply panels unless moisture content of surfaces are below the following maximums:

3.2 PREPARATION

A. Fill cracks and smooth irregularities with filler, sand smooth. Vacuum clean surfaces.

B. Surface Appurtenances: Remove electrical plates, hardware, light fixture trim, escutcheons, and fittings prior to preparing surfaces or finishing.

3.3 INSTALLATION

A. Apply adhesive and panels in accordance with manufacturer's instructions.

B. Apply adhesive and panels smooth. Ensure full bond to substrate surface.

C. Horizontal joints on walls are not acceptable.

D. Joints are not permitted within 12 inches of corners and terminations.

E. Install termination trim.

F. Remove excess adhesive.

G. Seal joints with adjacent materials with sanitary silicone sealant as specified in Section 079000.

3.4 CLEANING

A. Clean panels of excess adhesive, dust, dirt, and other contaminants.

B. Reinstall wall plates and accessories removed prior to work of this section.

END OF SECTION

SECTION 098433

SOUND-ABSORBING WALL UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES

A. Sound-absorbing wall panels, custom-fabricated and fabric-finished.

1.2 REFERENCES

A. ASTM International.
   1. ASTM C423 Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.
   2. ASTM E84 Standard Test Method for Surface Burning Characteristics of Building Materials.
   3. ASTM E795 Standard Practices for Mounting Test Specimens During Sound Absorption Tests.

1.3 SYSTEM DESCRIPTION

A. Performance Requirements:
   1. Surface Burning Characteristics (ASTM E84):
      a. Flamespread: 25 maximum.
      b. Smoke Developed: 450 maximum.
      c. Fire ratings for all fabric covered panels is based on testing of the panel wrapped with the standard in stock fabric, Guilford of Maine, Model FR 701.

1.4 SUBMITTALS

A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.

B. Product Data: Submit product data sheet, for specified products.

C. Shop Drawings: Submit shop drawings showing layout, edge profiles and panel components, including anchorage, accessories, finish colors and textures.

D. Samples: Submit selection and verification samples of finishes, colors and textures.

E. Test Reports: Certified test reports showing compliance with specified performance requirements.
   1. Standard Systems: Submit certified copies of previous test reports substantiating performance of system in lieu of retesting.

1.5 DELIVERY, STORAGE, AND HANDLING

A. General: Comply with Division 1 Product Requirements Section.

B. Delivery: Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.

C. Storage and Protection: Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.6 PROJECT CONDITIONS

A. Environmental Requirements: Do not install panels until wet work, such as concrete and plastering, is complete; the building is enclosed; and the temperature and relative humidity are stabilized at 60 - 80 degrees F (16 - 27 degrees C) and 35% MINIMUM RH and 55% MAXIMUM RH, respectively. All products constructed with wood or wood fiber content must be stored for at least 72 hours in the controlled environment specified herein prior to installation to allow the materials to stabilize.

PART 2 PRODUCTS

2.1 SOUND-ABSORBING WALL PANELS

A. Manufacturer: Kinetics Noise Control, Inc.
   1. Contact: PO Box 655, 6300 Irelan Place, Dublin, OH 43017; Telephone: (614) 889-0480; Fax: (614) 889-0540; E-mail: intsales@kineticsnoise.com; Web site: www.kineticsnoise.com.

B. Substitutions: No substitutions permitted.

2.2 MANUFACTURED UNITS

A. Sportsboard Elite Fabric-Wrapped Copolymer Panels:
   1. Thickness: 2-1/16 inches (52 mm).
   2. Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 120 inches (3048 mm).
   3. Core: 2 inches (51 mm) thick, 6 - 7 pcf (96 - 112 kg/m3) density fiberglass.
   4. Edge Detail: Square hardened with a Class A hardening solution.
   5. Fabric Facing: 100% polyester fabric, FR 701 Style 2100 by Guilford of Maine. Designer selected fabrics must be approved by the panel manufacturer as acceptable quality for

wrapping and covering core materials. Some fabrics are unstable, too stiff, or lack the weight and thread density for producing an acceptable finish.
   a. Color: Refer to Finish Schedule on Drawings.
6. Copolymer Impact Resistant Layer: 1/16 inch (1.6 mm) thick copolymer perforated with 3/32 inch (2.4 mm) holes on 5/32 inch (4 mm) staggered centers.
7. Sound Absorption (ASTM C423, A Mounting): Noise Reduction Coefficient of 1.00, 2 inch thick core minimum.
8. Mounting Accessories: HS impaling clips.

B. Hi-Tack Tackable Panels:
1. Thickness: 3/4 inches (19.1 mm).
2. Size: As indicated on the drawings up to a maximum 48 inches (1219 mm) x 48 inches (1219 mm) panel.
3. Core: 3/4 inch (19.1 mm)] thick mineral fiber board, 24 pcf (384 kg/m3) density Perforated core.
4. Edge Detail: Square.
5. Facing: 100% polyester fabric, FR 701 Style 2100 by Guilford of Maine.
   a. Color: As selected from fabric manufacturer’s full range of colors.
6. Mounting Accessories: DS-90 impaling clips.

2.3 FABRICATION

A. SportsBoard Elite Panels.
1. Wrap panel edges and return facing fabric 1 to 2 inches (25.4 to 51 mm) on back of panel. Secure fabric with adhesive applied to edges and back of panel only.

PART 3 EXECUTION

3.1 MANUFACTURER'S INSTRUCTIONS

A. Compliance: Comply with manufacturer's product data, including product technical bulletins, product catalog installation instructions and product carton instructions for installation.

3.2 EXAMINATION

A. Site Verification of Conditions: Verify that substrate conditions, which have been previously installed under other sections, are acceptable for product installation in accordance with manufacturer's instructions.
1. Verify that stud spacing is 16 inches (406 mm) o.c., maximum, for panels installed over open studs.
2. Do not install panels until unsatisfactory conditions are corrected.

3.3 CLEANING

A. Follow manufacturer's instructions for cleaning panels soiled during installation. Replace panels that cannot be cleaned to as new condition.

B. Keep site free from accumulation of waste and debris.

END OF SECTION

SECTION 098436

SOUND-ABSORBING CEILING UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes shop-fabricated, fabric-wrapped panel units tested for acoustical performance, including:
   1. Sound-absorbing baffle panels.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, mounting, material descriptions, dimensions of individual components and profiles, and finishes for sound-absorbing ceiling units.
   2. Include furnished specialties and accessories.

B. Shop Drawings: For sound-absorbing ceiling units.
   1. Include plans, elevations, sections, and mounting devices and details.
   2. Include details at joints and corners; and details at ceiling intersections and intersections with walls. Indicate panel edge and core materials.
   3. Include reflected ceiling plans showing panel sizes and direction of fabric weave and pattern matching.

C. Samples for Verification: For the following products:
   1. Fabric: Full-width by approximately 36-inch- long Sample, but not smaller than required to show complete pattern repeat, from dye lot to be used for the Work, and with specified treatments applied. Mark top and face of fabric.
   2. Panel Edge: 12-inch- long Sample(s) showing each edge profile, corner, and finish.
   3. Core Material: 12-inch- square Sample at corner.
   4. Mounting Devices: Full-size Samples.
   5. Assembled Panels: Approximately 36 by 36 inches, including joints and mounting methods.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Electrical outlets, switches, and thermostats.
   2. Suspended ceiling components above sound-absorbing ceiling units.
   3. Structural members to which suspension devices will be attached.
   4. Items penetrating or covered by sound-absorbing ceiling units including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Alarms.
      e. Sprinklers.
      f. Access panels.
   5. Show operation of hinged and sliding components covered by or adjacent to sound-absorbing ceiling units.

B. Product Certificates: For each type of sound-absorbing ceiling unit.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For sound-absorbing ceiling units to include in maintenance manuals. Include fabric manufacturer's written cleaning and stain-removal recommendations.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Comply with fabric and sound-absorbing ceiling unit manufacturers' written instructions for minimum and maximum temperature and humidity requirements for shipment, storage, and handling.

B. Deliver materials and units in unopened bundles and store in a temperature-controlled dry place with adequate air circulation.

1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install sound-absorbing ceiling units until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work at and above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Lighting: Do not install sound-absorbing ceiling units until a permanent level of lighting is provided on surfaces to receive the units.

C. Air-Quality Limitations: Protect sound-absorbing ceiling units from exposure to airborne

odors, such as tobacco smoke, and install units under conditions free from odor contamination of ambient air.

D. Field Measurements: Verify locations of sound-absorbing ceiling units and actual dimensions of openings and penetrations by field measurements before fabrication.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of sound-absorbing ceiling units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Acoustical performance.
      b. Fabric sagging, distorting, or releasing from panel edge.
      c. Warping of core.
   2. Warranty Period: Two years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product:
   1. Baffles: Subject to compliance with requirements, provide Armstrong Soundscapes Blades or and approved comparable product.
   2. Suspension System: Subject to compliance with requirements, provide Armstrong Soundscapes Blades or and approved comparable product.

B. Linear Acoustical Panels: Manufacturer's standard panel construction.
   1. Mounting: 360º Painted Direct to Grid Suspension System, XL732036WH, 2' Cross Tee.
   2. Panel Thickness: 2 inches.
   3. Core: Manufacturer's standard.
   4. Core-Face Layer: Manufacturer's standard .
   5. Sizes:
      a. 5 x 46 x 2” Rectangle (item 8250F03RH05).
      b. 5 x 94 x 2” Rectangle (item 8250F03RH06).
   6. Edges: Square.
   7. Fabric: As indicated on Finish Schedule on Drawings.
   8. Acoustical Performance: Sound absorption NRC of 1.80 according to ASTM C 423.

C. Source Limitations: Obtain sound-absorbing ceiling units from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Requirements for Sound-Absorbing Ceiling Units: Provide and sound-absorbing baffle panels that comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic

Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Fire-Test-Response Characteristics: Provide sound-absorbing ceiling units meeting the following requirements as determined by testing identical products by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:
   1. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
      a. Flame-Spread Index: 25 or less.
      b. Smoke-Developed Index: 450 or less.

C. Fire Growth Contribution: Comply with acceptance criteria of local code and authorities having jurisdiction when tested according to NFPA 265.

2.3 FABRICATION

A. General: Use manufacturer's standard construction except as otherwise indicated, with facing material applied to face, edges, and back border of dimensionally stable core and with rigid edges to reinforce panel perimeter against warpage and damage.

B. Core-Face Layer: Evenly stretched over core face and edges and securely attached to core; free from puckers, ripples, wrinkles, or sags.

C. Facing Material: Apply fabric facing fully covering visible surfaces of unit; with material stretched straight, on the grain, tight, square, and free from puckers, ripples, wrinkles, sags, blisters, seams, adhesive, or other visible distortions or foreign matter.
   1. Fabrics with Directional or Repeating Patterns or Directional Weave: Mark fabric top and attach fabric in same direction so pattern or weave matches adjacent units.

D. Dimensional Tolerances of Finished Units: Plus or minus 1/16 inch for the following:

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine fabric, fabricated units, substrates, areas, and conditions for compliance with requirements, installation tolerances, and other conditions affecting performance of sound-absorbing ceiling units.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install sound-absorbing ceiling units in locations indicated with edges in alignment with walls and other units, faces flush, and scribed to fit adjoining work accurately at borders and at penetrations.

B. Comply with sound-absorbing ceiling unit manufacturer's written instructions for installation of units using type of mounting devices indicated. Mount units securely to supporting substrate.

C. Align fabric pattern and grain with adjacent units.

3.3 INSTALLATION TOLERANCES

A. Variation from Alignment with Surfaces: Plus or minus 1/16 inch.

B. Variation from Level or Slope: Plus or minus 1/16 inch.

3.4 CLEANING

A. Clip loose threads; remove pills and extraneous materials.

B. Clean panels on completion of installation to remove dust and other foreign materials according to manufacturer's written instructions.

END OF SECTION

SECTION 099000

PAINTING AND COATING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes.
   1. Interior paint systems.
   2. Exterior paint systems.
   3. High-performance coating systems.

1.2 REFERENCES

A. Definitions:
   1. Sheen Levels: ASTM D523.
      a. Flat: Five gloss units at 60 degrees and 10 gloss units at 85 degrees, maximum.
      b. Eggshell: 10 to 25 gloss units at 60 degrees and 10 to 35 gloss units at 85 degrees.
      c. Satin: 20 to 35 gloss units at 60 degrees and 35 gloss units minimum at 85 degrees.
      d. Semigloss: 35 to 70 gloss units at 60 degrees.
      e. Gloss: 70 gloss units at 60 degrees, minimum.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting:
   1. Conduct meeting one month, minimum, before starting Work of this Section.
   2. Additional Agenda Items:
      a. Review moisture testing requirements and results.
      b. Review substrate preparation requirements and methods.

1.4 ACTION SUBMITTALS

A. Product Data.
   1. Initial selection color chip sheets.

B. Samples:
   1. Draw Down Samples: Each type of paint system and each topcoat color and gloss.
      a. Label each Sample for paint system, location, and substrate.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data:
   1. Cleaning, touch up, and repair instructions for painted and coated surfaces.
   2. Area summary with finish schedule and Samples, designating where each product, color and finish was used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:
   1. Paint from same product run as installed materials.
      a. Quantity: 5 percent, but not less than 1 gallon of each material and color.

1.7 QUALITY ASSURANCE

A. Field Samples: Apply each paint systems to substrates as directed by Architect. Demonstrate color.
   1. Approved Samples establish Work results standard.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Storage and Handling Requirements:
   1. Store paint products in sealed containers until ready for use.

1.9 FIELD CONDITIONS

A. Apply materials only when surface and ambient temperatures are within temperature ranges required by paint product manufacturer.

B. Apply exterior coatings when rain or snow are not occurring or forecasted, and when relative humidity is inside humidity ranges, and moisture content of surfaces is within acceptable levels required by paint product manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:
   1. Benjamin Moore.
   2. Pittsburgh Paints.
   3. PPG Protective and Marine Coatings.
   4. Scuffmaster.
   5. Sherwin-Williams.

B. Products: Scheduled in this Section.

2.2 PAINT, GENERAL

A. Colors: Basis of design manufacturer designations, see Finish Schedule on Drawings.

B. Paint Systems: Primers, intermediate coats and topcoats compatible with substrates and one another.

C. Coatings: Ready mixed or field catalyzed.

D. Preparation:
   1. Mix to soft paste consistency, capable of being readily and uniformly dispersed to homogeneous coating.
   2. Blend tints and catalyzers to uniform consistency and color, capable of drying or curing free of streaks or sags.

2.3 SUSTAINABILITY CHARACTERISTICS

A. Indoor Environmental Quality Requirements:
   1. VOC Content: Follow VOC limits of authorities having jurisdiction.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify substrates are ready to receive Work.

B. Preinstallation Testing: Test moisture content of substrate does not exceed the following:
   1. Concrete: 12 percent.
   2. Masonry: 12 percent.
   3. Wood: 15 percent.
   4. Gypsum Board: 12 percent.

C. Gypsum Board: Verify finishing compound is dried and sanded smooth.

D. Concrete: Verify surface has cured at least 30 days and surface pH is between 6 and 9.

E. Masonry: Verify surface has cured at least 30 days and surface pH is between 6 and 9.

3.2 PREPARATION

A. Surface Preparation: Remove electrical plates, hardware, trim, escutcheons, and fittings. Correct defects in substrates capable of affecting Work.

B. Cleaning: Remove substances that could impair paint bond, including dust, oil, grease, and incompatible coatings.
   1. Impervious Surfaces: Remove mildew by scrubbing with cleaning solution recommended by finish coating manufacturer. Rinse with clean water and allow surface to dry.

2. Aluminum Surfaces: Remove surface contamination by steam or high pressure water. Remove oxidation with acid etch and solvent washing. Apply etching primer immediately following cleaning.
3. Asphalt, Creosote, or Bituminous Surfaces: Remove foreign particles to permit adhesion of finishing materials. Apply compatible sealer or primer.
4. Concrete Floors: Follow manufacturer recommendations and See Section 090561.
5. Gypsum Board Surfaces: Fill minor defects with filler compound. Spot prime defects after repair.
6. Plaster Surfaces: Fill cracks, holes, and other imperfections with latex patching plaster. Blend texture with adjacent surfaces. Clean and allow to dry.
7. Concrete and CMU Surfaces: Remove dirt, loose mortar, scale, efflorescence and chalk. Remove oil and grease by scrubbing with cleaning solution recommended by finish coating manufacturer. Rinse with clean water and allow surface to dry.
8. Non-Passivated Galvanized Surfaces: Smooth and hand or power tool clean per ASTM D6386.
9. Passivated Galvanized Surfaces: Remove soluble and insoluble contaminants and corrosion. Sweep blast per ASTM D6386 to achieve uniform 1.0 to 2.0 mil anchor profile.
10. Uncoated Steel: Remove rust and loose mill scale. Clean per SSPC-SP3 Power Tool Cleaning.
11. Primed Steel: Clean field welds, fasteners, and abraded shop primer.
12. Wood Surfaces:
    a. Wipe off dust and grit. Seal knots, pitch streaks, and sappy sections with sealer. Fill nail holes and cracks after primer has dried.
    b. Backprime concealed surfaces.

3.3 APPLICATION

A. Follow manufacturer instructions for application method, thickness of coatings, and number of coats.
   1. Apply finishes when surfaces are dry. Allow applied coats to dry before next coat is applied.
   2. Apply each coat of paint slightly darker than preceding coat.
   3. Apply coatings to uniform appearance.
   4. Sand wood and metal surfaces lightly between coats.
   5. Leave testing agency, equipment identification, and performance labels unpainted.

B. Appearance:
   1. Apply paints without imperfections.
   2. Edges and Color Breaks: Produce sharp edges.

3.4 PAINTING MECHANICAL EQUIPMENT

A. Paint the following equipment when exposed in equipment rooms, occupied spaces, and exterior areas:
   1. Electrical panelboards and switchgear.
   2. Piping.
   3. Ductwork.

4. Pipe hangers.
5. Conduit.
6. Unfinished tanks.
7. Shop-primed equipment.

B. Paint interior surfaces of air ducts visible through grilles with one coat of flat black paint.

3.5 FIELD QUALITY CONTROL

A. Field Tests and Inspections: Engage inspectors to perform tests and inspections and prepare reports. Allow inspectors access to Work areas.
   1. Failed Test Retest Cost: Contractor responsibility.

B. Testing: Dry film thickness.

C. Non-Conforming Work: Remove and replace or apply additional coats, and retest.

3.6 CLEANING

A. Remove rubbish, empty cans, rags, and other discarded materials.

B. Remove splattered paints. Protect adjacent surfaces from damage.

3.7 PROTECTION

A. Protect painted surfaces from subsequent Work. Touch up and restore damaged painted surfaces.

3.8 INTERIOR PAINTING SCHEDULE

A. Concrete Floors, Light Duty, Foot Traffic:
   1. Primer: Not required.
   2. Acrylic Floor Coating: Satin finish.
      a. Benjamin Moore: Insl-X Hot Trax Epoxy Fortified Acrylic Concrete and Garage Floor Paint HTF-xxx.
      b. Pittsburgh Paints; Aquapon WB EP Epoxy.
      c. Sherwin-Williams: Armorseal 8100 Water Based Epoxy.

B. CMU Substrates, Dry Environments:
   1. Latex Block Filler:
      a. BEHR: Behr Pro Block Filler Primer, PR50.
      b. Benjamin Moore: Ultra Spec Masonry Hi-Build Block Filler 571.
      c. Pittsburgh Paints: SPEEDHIDE Hi-Fill Latex Block Filler 6-15XI.
      d. Sherwin-Williams: PrepRite Latex Block Filler, B25W25.
   2. Acrylic Latex Enamel: Semigloss finish.
      a. BEHR: Behr Pro i300 Interior.

b. Benjamin Moore: Ultra Spec 500 Series.
c. Pittsburgh Paints: SPEEDHIDE Zero Interior Latex.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.

C. Gypsum Board Walls:
1. Latex Primer:
a. BEHR: Drywall Plus Interior Primer & Sealer 73.
b. Benjamin Moore: Ultra Spec 500 Interior Latex Primer N534.
c. Pittsburgh Paints: SPEEDHIDE zero Interior Latex Sealer 6-4900XI.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Primer.
2. Acrylic Latex Enamel: Eggshell finish.
a. BEHR: Behr Pro i300 Interior.
b. Benjamin Moore: Ultra Spec 500 Series.
c. Pittsburgh Paints: SPEEDHIDE Zero Interior Latex.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.

D. Gypsum Board Ceilings:
1. Latex Primer:
a. BEHR: Drywall Plus Interior Primer & Sealer 73.
b. Benjamin Moore: Ultra Spec 500 Interior Latex Primer N534.
c. Pittsburgh Paints: SPEEDHIDE zero Interior Latex Sealer 6-4900XI.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Primer.
2. Acrylic Latex Enamel: Flat finish.
a. BEHR: Behr Pro i300 Interior.
b. Benjamin Moore: Ultra Spec 500 Series.
c. Pittsburgh Paints: SPEEDHIDE Zero Interior Latex.
d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.

E. Steel Doors and Frames:
1. Pre Primed Metal: Touch up with same shop primer product used by manufacturer.
2. Latex Primer:
a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
b. Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04.
c. Pittsburgh Paints: Pitt-Tech Plus DTM 4020PF.
d. Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer B66-1310 Series.
e. Tnemec: Series 115 UniBond DF.
3. Acrylic Latex Enamel: Semigloss finish.
a. BEHR: PREMIUM Interior/Exterior Direct to Metal Paint.
b. Benjamin Moore: Ultra Spec HP D.T.M Acrylic Enamel.
c. Pittsburgh Paints: Pitt-Tech Plus Interior/Exterior DTM Industrial Enamel 4216 SG or 90 Series.
d. Sherwin-Williams: Pro Industrial Acrylic.

F. Galvanized Steel Substrates:
1. Latex Primer:
a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
b. Benjamin Moore: Ultra Spec HP Acrylic Metal Primer HP04.
c. Pittsburgh Paints: Pitt-Tech Plus EP Interior/Exterior DTM Industrial Enamel 90-1912 Series.
d. Sherwin-Williams: Pro Industrial Pro-Cryl Universal Primer B66-1310 Series.

e. Tnemec: Series 115 UniBond DF.

2. Acrylic Latex Enamel: Semigloss finish.
   a. BEHR: PREMIUM Interior/Exterior Direct to Metal Paint.
   b. Benjamin Moore: Ultra Spec HP D.T.M Acrylic Enamel.
   c. Pittsburgh Paints: Pitt-Tech Plus EP Interior/Exterior DTM Industrial Enamel.
   d. Sherwin-Williams: Pro Industrial Acrylic.
   e. Tnemec: Series 115 UniBond DF.

G. Overhead Construction:
   1. Water Based Interior Dry Fog: Semigloss finish.
      a. BEHR: Pro HPC Waterborne Dryfall HP210.
      b. Benjamin Moore: Latex Dry Fall.
      c. Pittsburgh Paints: SPEEDHIDE SuperTech Interior Latex Dry-Fog.
      d. Sherwin-Williams: Pro Industrial Waterborne Acrylic Dryfall.

H. Wood Trim:
   1. Latex Primer:
      a. BEHR: Drywall Plus Interior Primer & Sealer 73.
      b. Benjamin Moore: Advance Waterborne Interior Alkyd Primer 790.
      c. Pittsburgh Paints: Seal-Grip Interior/Exterior Universal Primer/Sealer 17-921XI.
      d. Sherwin-Williams: PrepRite ProBlock Interior/Exterior Latex Primer/Sealer B51-600.
   2. Acrylic Latex Enamel: Semigloss finish.
      a. BEHR: Behr Pro i300 Interior.
      b. Benjamin Moore: Ultra Spec 500 Series.
      c. Pittsburgh Paints: SPEEDHIDE Zero Interior Latex.
      d. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex.

3.9 SPECIALTY INTERIOR PAINTING SCHEDULE

A. Scuff Resistant Coatings:
   1. Latex Primer:
      a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
      b. Benjamin Moore: Ultra Spec 500 Interior Latex Primer N534.
      c. Pittsburgh Paints: Seal Grip Interior/Exterior Universal Primer/Sealer 17-921XI.
      d. Scuffmaster: Scuffmaster Primer/Sealer.
      e. Sherwin-Williams: ProMar 200 Zero VOC Interior Latex Primer.
   2. Scuff Resistant Latex: Eggshell finish.
      a. BEHR: ULTRA SCUFF DEFENSE.
      b. Benjamin Moore: Ultra Spec Scuff-X.
      c. Pittsburgh Paints: UltraLast Interior.
      d. Scuffmaster: Scuffmaster Scrubtough.
      e. Sherwin-Williams: Scuff Tuff Interior Waterbased Enamel.

3.10 EXTERIOR PAINTING SCHEDULE

A. CMU Substrates:
   1. Latex Block Filler:
      a. BEHR: Behr Pro Block Filler Primer, PR50.
      b. Benjamin Moore: Ultra Spec Masonry Hi-Build Block Filler 571.
      c. Pittsburgh Paints; Perma-Crete Concrete Block & Masonry Surfacer/Filler 4-100XI.
      d. Sherwin-Williams: Pro Industrial Heavy Duty Block Filler B42W150.
   2. Exterior Latex Topcoat: Semigloss finish.
      a. BEHR: PRO e600 Exterior Paint.
      b. Benjamin Moore: Ultra Spec Exterior Enamel.
      c. Pittsburgh Paints: SPEEDHIDE Exterior Latex.
      d. Sherwin-Williams: A100 Series Exterior Latex.

B. Unprimed Ferrous Metal:
   1. Rust Inhibitive Alkyd Primer:
      a. BEHR: Interior/Exterior Metal Primer 435.
      b. Benjamin Moore: Super Spec HP Alkyd Metal Primer P06.
      c. Pittsburgh Paints: Multiprime 4360.
      d. Sherwin-Williams: Kem Bond HS, B50 Series.
      e. Tnemec: Series V10 Tnemec Primer.
   2. Latex Topcoat: Semigloss finish.
      a. BEHR: PREMIUM Direct to Metal Semi-Gloss Paint 3200.
      b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
      c. Pittsburgh Paints: Pitt-Tech Plus EP Interior/Exterior DTM Industrial Enamel 90-1610.
      d. Sherwin-Williams: A-100 Series.
      e. Tnemec: Series 1029 Enduratone.

C. Galvanized Steel:
   1. Primer:
      a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
      b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
      c. Pittsburgh Paints: Pitt-Tech Plus EP Interior/Exterior DTM Industrial Primer 90-1912 Series.
      d. Sherwin-Williams: Pro Industrial ProCryl Universal Primer B66-1300 Series.
      e. Tnemec: Series 115 UniBond DF.
   2. Latex Topcoat: Semigloss finish.
      a. BEHR: PREMIUM Direct to Metal Semi-Gloss Paint 3200.
      b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
      c. Pittsburgh Paints: Pitt-Tech Plus EP Interior/Exterior DTM Industrial Enamel 90-1610.
      d. Sherwin-Williams: A-100 Series.
      e. Tnemec: Series 1029 Enduratone.

D. Aluminum:
   1. Primer:
      a. BEHR: Interior/Exterior Bonding Primer 432.
      b. Benjamin Moore: Corotech Waterborne Bonding Primer, V175.
      c. Pittsburgh Paints: Pitt-Tech Plus EP Interior/Exterior DTM Industrial Primer 90-

1912.
d. Sherwin-Williams: Pro Industrial ProCryl Universal Primer B66-1310 Series.
e. Tnemec: Series N69 High Build Epoxoline II.

2. Latex Topcoat: Semigloss finish.
a. BEHR: Interior/Exterior Direct To Metal Semi-Gloss Paint 3200.
b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
c. Pittsburgh Paints: Pitt-Tech Plus EP Interior/Exterior DTM Industrial Enamel 90-1610.
d. Sherwin-Williams: A-100 Series.
e. Tnemec: Series 1028 Enduratone.

E. Stainless Steel:
1. Primer:
a. BEHR: Interior/Exterior Bonding Primer 432.
b. Benjamin Moore: Corotech Waterborne Bonding Primer V175.
c. Pittsburgh Paints: Pitt-Tech Plus EP Interior/Exterior DTM Industrial Primer 90-1912.
d. Sherwin-Williams: DTM Wash Primer, B71Y1.
e. Tnemec: Series N69 High Build Epoxoline II.
2. Latex Topcoat: Semigloss finish.
a. BEHR: Interior/Exterior Direct To Metal Semi-Gloss Paint 3200.
b. Benjamin Moore: Ultra Spec HP D.T.M. Acrylic HP29.
c. Pittsburgh Paints: Pitt-Tech Plus EP Interior/Exterior DTM Industrial Enamel 90-1610.
d. Sherwin-Williams: A-100 Series.
e. Tnemec: Series 1028 Enduratone.

F. Wood Trim:
1. Latex Primer:
a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
b. Benjamin Moore: Fresh Start High Hiding All Purpose Primer 046.
c. Pittsburgh Paints: Seal-Grip Interior/Exterior Universal Primer/Sealer 17-921XI.
d. Sherwin-Williams: Exterior Latex Wood Primer B42W08041.
2. Exterior Acrylic Latex Topcoat: Semigloss finish.
a. BEHR: PRO e600 Exterior Paint.
b. Benjamin Moore: Ultra Spec EXT.
c. Pittsburgh Paints: SPEEDHIDE Exterior Latex.
d. Sherwin-Williams: A-100 Exterior Acrylic Latex.

3.11 HIGH PERFORMANCE EXTERIOR COATING SCHEDULE

A. Concrete: Elastomeric coating system.
1. Primer:
a. BEHR: Multi-Surface Interior/Exterior Primer & Sealer 436.
b. Benjamin Moore: Ultra Spec Interior/Exterior Masonry Sealer 608.
c. Pittsburgh Paints: PERMA-CRETE Interior/Exterior Alkali Resistant Primer 4-603XI.
d. Sherwin-Williams: Loxon Concrete and Masonry Primer/Sealer LX02 Series.
e. Tnemec: Series 151 Elasto-Grip.

2. Elastomeric Topcoat: Flat finish.
    a. BEHR: Premium Elastomeric Masonry, Stucco & Brick Paint.
    b. Benjamin Moore: Super Spec Masonry Elastomeric Coating 056.
    c. Pittsburgh Paints: PERMA-CRETE PITT-FLEX Elastomeric Coating 4-110XI.
    d. Sherwin-Williams: CONFLEX SHERLASTIC Elastomeric Coating CF16 Series.
    e. Tnemec: Series 156 Enviro-Crete.

B. CMU: Elastomeric coating system.
1. Block Filler:
    a. BEHR: Behr Pro Block Filler Primer, PR50.
    b. Benjamin Moore: Ultra Spec Masonry Hi-Build Block Filler 571.
    c. Pittsburgh Paints; Perma-Crete Concrete Block & Masonry Surfacer/Filler 4-110XI.
    d. Sherwin-Williams: Pro Industrial Heavy Duty Block Filler B42W150.
    e. Tnemec: Series 54 Masonry Filler.
2. Elastomeric Topcoat: Flat finish.
    a. BEHR: Premium Elastomeric Masonry, Stucco & Brick Paint.
    b. Benjamin Moore: Super Spec Masonry Elastomeric Coating 056.
    c. Pittsburgh Paints: PERMA-CRETE PITT-FLEX Elastomeric Coating 4-110XI.
    d. Sherwin-Williams: CONFLEX SHERLASTIC Elastomeric Coating CF16 Series.
    e. Tnemec: Series 156 Enviro-Crete.

END OF SECTION

SECTION 101400

SIGNAGE

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Room identification signs.
2. Dimensional letter signage.
3. Monument signage.
4. Plaques.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
1. Coordinate locations of concealed blocking and support framing in walls.

B. Preinstallation Meeting Attendees and Procedures:
1. Conduct meeting one month, minimum, before starting Work of this Section.

C. Sequencing Procedures:
1. Install room signs after doors and wall surfaces are finished.

1.3 ACTION SUBMITTALS

A. Product Data: Material, finishes for each type of sign.
1. Initial Selection: Sign styles, color samples, and character styles and colors.

B. Shop Drawings: Sign styles, lettering fonts, foreground and background colors, overall dimensions of each sign.

C. Schedule: Locations of each sign type, description of graphics, and message text.

D. Samples:
1. Full size, each sign type. Approved Samples may not be incorporated into Work.
2. Finishes: 2 by 3 inches in size.
3. Vinyl Graphics: 3 by 3 feet in size.

1.4 SUSTAINABILITY SUBMITTALS

A. Indoor Air Quality Certificates:

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Manufacturer recommended parts and quantities.

B. Extra Stock Materials:
   1. Blank Signs: Two percent of installed materials, but not less than five.

C. Tools: Manufacturer recommended special tools required to maintain Product.

1.7 QUALITY ASSURANCE

A. Qualifications:
   1. Installers: An entity that employs installers and supervisors who are trained and approved by manufacturer. .

1.8 DELIVERY, STORAGE, AND HANDLING

A. Package signs labeled in name groups.

B. Store adhesive attachment tape at ambient room temperatures.

1.9 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations:
   1. Interior Signs: Building enclosed and environmental systems maintaining design conditions for Owner occupancy.
   2. Outdoor Signs: Temperature: 40 degrees F, minimum , and rising.
   3. Precipitation: None occurring and none predicted within 24 hours.

B. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.10 WARRANTY

A. Manufacturer Warranty:
   1. Signs: Warrant against product failure.
      a. Failure includes loss of adhesion, fading, clouding, yellowing, and delamination.

b. Warranty Period: 3 years for exterior, 5 years for interior.
2. Vinyl Graphics: Warrant against product failure, manufacturing defects, excessive dimensional change and loss of adhesion.
a. Warranty Period: 3 years for exterior, 5 years for interior.

B. Finish Warranty: Repair deteriorated finishes or replace components.
1. Deterioration includes the following:
a. Color Fading: More than 5 Hunter units per ASTM D2244.
b. Chalking: More than No. 8 rating per ASTM D4214.
c. Paint cracking, peeling or checking.
2. Warranty Period: 5 years.

PART 2 PRODUCTS

2.1 ROOM IDENTIFICATION SIGNS

A. Room Identification Signs Refer to drawings: Raised character acrylic signs.
1. Manufacturers and Products: See Signage Schedule on Drawings.
2. Manufacturers and Products:
a. APCO Graphics.
b. ASI Sign Systems.
c. Best Signs.
d. Mohawk Sign Systems.
3. Substitutions: Not permitted.
4. Total Thickness: 1/4 inch.
5. Sizes, Shapes: See Drawings.
6. Corners: Radius.
7. Character Style: Architect selected ADA compliant characters.
8. Braille: 1/32 inch, minimum, integral raised characters.
9. Colors: Architect selected and Match existing.
10. Mounting: Double side foam-core adhesive tape and Manufacturer's standard method for substrates indicated with adhesive.

2.2 DIMENSIONAL LETTER SIGNAGE

A. Dimensional Letter Signage Refer to drawings: Aluminum, cast characters.
1. Manufacturers and Products: See Detail on Drawings.
2. Manufacturers and Products:
a. Ace Sign Systems.
b. APCO Graphics.
c. ASI Sign Systems.
d. Best Signs.
3. Sizes: See Drawings.
4. Character Style: See drawings.
5. Colors: See Drawings and Architect selected.
6. Mounting: Pin mounted metal fasteners, anchored to wall.
a. Mounting Height: See Drawings.

2.3 MONUMENT SIGNAGE

A. Monument Signage: Acrylic panel signs, single-sided.
   1. Manufacturers and Products: See Detail on Drawings.
   2. Manufacturers and Products:
      a. Ace Sign Systems.
      b. APCO Graphics.
      c. ASI Sign Systems.
      d. Best Signs.
   3. Sizes: See Drawings.
   4. Aluminum Finishes: Powder coated.
   5. Colors: Architect selected and Match existing.
   6. Support: Two steel posts in concrete foundation.

2.4 PLAQUES

A. Plaques: Etched aluminum.
   1. Manufacturers and Products: See Detail on Drawings.
   2. Manufacturers and Products:
      a. Ace Sign Systems.
      b. ARK Ramos Signage Systems.
      c. ASI Sign Systems.
      d. Gemini.
   3. Sizes: See Drawings.
   4. Aluminum Finishes: As selected by Architect.

2.5 PERFORMANCE

A. Delegated Design:
   1. Delegate exterior signage design to licensed Professional Engineer.
   2. Structural Design Criteria: See Structural Drawings.
   3. Structural Loads: Applicable code compliant.

B. Surface Burning: ASTM E84 Class A.
   1. Flame Spread Index: 25, maximum.
   2. Smoke Developed Index: 50, maximum.

C. Accessibility Requirements: Applicable provisions in ICC/ANSI A117.1.

D. Environmental Performance:
   1. Expansion and Contraction: Withstand 120 degree F ambient and 180 degree F surface thermal cycling without failure.

2.6 MATERIALS

A. Acrylic Sheet: ASTM D4802, manufacturer standard, UV filtering.

B. Concrete: See Section 033000.

C. Aluminum Sheet: ASTM B209, Alloy 6063, Temper T6.
   1. Welding Materials: AWS D1.2, types as required for materials being welded.

D. Bronze Castings: Composition bronze castings, ASTM B62, Alloy UNS C83600 or sand castings, ASTM B584, Alloy UNS C86500.

E. Steel Sheet: ASTM A653, Grade 33 Structural Quality, G40 galvanizing.

F. Steel Hollow Structural Sections: ASTM A500, Grade B.

G. Steel Welding Materials: AWS D1.1, types as required for materials being welded.

H. Adhesives: Recommended by signage manufacturer, VOC compliant.

I. Adhesive Tape: Double-sided, zero VOC.

J. Fasteners: Type, size, and material to suit each application.
   1. Exterior: Stainless steel.

2.7 FABRICATION

A. Factory assemble panel signs.

2.8 FINISHES

A. Anodizing: AAMA 611 Class I or AAMA 612 with electro-deposition organic seal.
   1. Color: See Drawings and Architect selected.

B. Color Coating: Two coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color coat; AAMA 2605.
   1. Color and Gloss: See Drawings and Architect selected.

C. Copper Alloys: Clear acrylic lacquer products specifically manufactured for coating copper alloys.

D. Copper Alloy Finishing: BHMA A156.18 finish, Architect selected.

E. Powder Coating: Two coat fluoropolymer finish; AAMA 2604.

F. Metallic Coated Steel Sheet Coil-Coatings: ASTM A755; Two coat fluoropolymer finish with minimum 70 percent PVDF resin by weight in color coat.
   1. Pencil Hardness, ASTM D3363: HB - H.
   2. Salt Spray Resistance, ASTM G85: 1,000 hours, minimum.
   3. Humidity Resistance, ASTM D2247: 1,000 hours, minimum.
   4. Color and Gloss: See Drawings and Architect selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify substrates are ready to receive Work.

B. Verify mounting structure is ready for signage and can support the equipment weight.

3.2 PREPARATION

A. Clean substrates for adhesive mounting per manufacturer recommendations.

3.3 INSTALLATION

A. Follow accessibility requirements.

B. Sign Locations: See Drawings.
   1. Locate room identification signs on wall surfaces adjacent to strike side of door, 5 feet above finished floor to center line of sign and 3 inches from door jamb trim.
   2. Locate informational signs on wall surfaces, 5 feet above finished floor to center line of sign at scheduled locations.

C. Install signs plumb and level.

D. Install signs to lay flat against wall.

E. Adhere signs to substrate with adhesive tape.

F. Mount dimensional letters to wall with stainless steel bolts.

G. Place concrete footing for sign posts per Drawings. Fasten sign to post with stainless steel bolts.

3.4 CLEANING

A. Clean signage of excess adhesive, dust, and other contaminants.

B. Touch-up, repair or replace damaged products before Substantial Completion.

END OF SECTION

SECTION 102113

TOILET COMPARTMENTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes.
   1. Solid plastic toilet compartments.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordination: Coordinate locations of concealed blocking and support framing in walls and ceilings.

B. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one month, minimum, before starting Work of this Section.
   2. Additional Attendees: Architect, GC, and Installer.
   3. Additional Agenda Items:
      a. Installation schedule.
      b. Partition layout.
      c. Installation procedures.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Standard construction details.
   2. Initial selection color charts.

B. Shop Drawings.
   1. Plans, elevations, sections, and attachment details.
   2. Show toilet accessory cutouts and blocking.
   3. Show floor drain locations.

C. Samples:
   1. Hardware and Accessories: Full sized Samples of each type and color. Approved Samples may not be incorporated into Work.
   2. Panel Material: 6 by 6 inch Samples of same thickness and material as finished Work in each required color.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For toilet compartments.

1.5 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 SOLID PLASTIC TOILET COMPARTMENTS

A. Plastic Toilet Compartments, TP-1: Solid, homogeneous high density polyethylene.
   1. Manufacturers and Products:
      a. Basis of Design: Scranton Products.
      b. ASI Accurate Partitions.
      c. Bradley; Mills Partitions.
   2. Toilet Enclosure Configuration:
      a. Floor mounted, overhead braced.
   3. Panel Colors: See Drawings and Architect selected.

B. Doors, Panels, and Pilasters:
   1. Doors, Panels and Pilasters: 1 inch thick; edges radiused, seamless, with homogenous color and pattern throughout thickness of material, and finished smooth.
   2. Hinge Type: Integral.
   3. Heat Sink Strips: Manufacturer standard; continuous extruded aluminum strip fastened to exposed bottom edges of panels.
   4. Pilaster Shoes: Manufacturer standard design; polymer.
      a. Polymer Colors: See Drawings and Architect selected.

2.2 HARDWARE AND INSTALLATION ACCESSORIES

A. Hardware: Panel manufacturer heavy duty operating hardware and accessories.
   1. Material: Clear anodized aluminum.
   2. Hinges: See compartments articles.
   3. Latches and Keepers: Surface-mounted latch unit with combination rubber faced door strikes and keepers, occupancy indicating.
   4. Coat Hooks: Combination hook and rubber tipped bumpers.
   5. Door Bumpers: Manufacturer heavy duty rubber tipped bumper at outswinging doors and entrance screen doors. Mount with through bolts.
   6. Door Pulls: Manufacturer heavy duty cast stainless steel pull unit at outswinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

B. Mounting Brackets:
   1. Continuous Brackets: Manufacturer standard design; aluminum.

C. Overhead Bracing: Extruded aluminum rail with antigrip profile; manufacturer standard finish.

D. Anchorages and Fasteners: Stainless steel, finished to match the items they are securing, with tamper resistant heads.
   1. Through Bolts: Sex head type.
   2. Concealed Anchors: Stainless steel, hot dip galvanized steel, or other rust resistant, protective coated steel compatible with related materials.

2.3 PERFORMANCE

A. Surface Burning Performance: ASTM E84 Class A.
   1. Flame Spread Index: 25, maximum.
   2. Smoke Developed Index: 450, maximum.

B. Accessibility Requirements: Applicable provisions in ICC/ANSI A117.1.

2.4 MATERIALS

A. Steel Sheet:
   1. Electrolytically Zinc Coated: ASTM A879/A879M, 01Z (03G).
   2. Hot-Dip Galvanized: ASTM A653/A653M, either hot dip galvanized or galvannealed.

B. Brass Castings: ASTM B584.

C. Brass Extrusions: ASTM B455.

D. Stainless Steel Sheet: ASTM A666, Type 304.

E. Stainless Steel Castings: ASTM A743/A743M.

F. Aluminum Extrusions: ASTM B221/B221M.

G. Aluminum Castings: ASTM B26/B26M.

H. Zamac: ASTM B86, commercial zinc alloy die castings, chrome plated.

I. Adhesive: Manufacturer standard product.

2.5 FABRICATION

A. General: Fabricate compartments to sizes shown on approved Shop Drawings.

B. Door Sizes and Swings:
   1. Inswinging Doors: 24 inches wide.
   2. Outswinging Doors: 36 inches wide and with a minimum 32 inch wide clear opening for

compartments designated as accessible.

2.6 FINISHES

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

3.2 INSTALLATION

A. Install units plumb, level, straight, and with tops of panels aligned.

B. Install components with following maximum clearances:
   1. Pilasters and Panels: 1/2 inch.
   2. Panels and Walls: 1 inch.

C. Brackets: Secure panels to walls and pilasters with full height continuous brackets.
   1. Locate stirrup wall brackets or full height continuous bracket fasteners so holes occur at masonry or tile joints.
   2. Secure panels to walls and pilasters with brackets.

D. Overhead Braced and Floor Anchored Units: Secure pilasters with anchors penetrating the manufacturer recommended depth into floor. Secure continuous head rail to each pilaster. Hang doors to align with tops of adjoining panels and parallel to overhead braces when closed.

E. Erection Tolerances:
   1. Correct Position Variation: 1/4 inch, maximum.
   2. Plumb Variation: 1/8 inch, maximum.

3.3 ADJUSTING

A. Adjust and lubricate hardware for smooth, accurate operation.

B. Set hinges on inswinging doors to hold doors open 30 degrees from closed position while unlatched. For outswinging doors, set hinges to return doors to fully closed position.

C. Touch up minor scratches and abrasions to match factory finish.

END OF SECTION

SECTION 102600

WALL AND DOOR PROTECTION

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes.
   1. Corner guards.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordinate installation of wall mounted products with concealed blocking and anchors.

B. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Show physical dimensions, features, anchorage details, and rough-in measurements.

B. Shop Drawings:
   1. Show locations, extent, details, and attachments to other Work.

C. Samples:
   1. Linear Corner Guards: Full sized sections, 12 inches long.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates:
   1. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wall and door protection, describing cleaning and repair procedures.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Materials:
   1. Corner Guard Covers: Full length plastic covers, 2 percent of installed materials; 2 units minimum.

1.7 QUALITY ASSURANCE

A. Qualifications:
   1. Installers: Trained and approved by manufacturer.

B. Field Samples: Install corner guards, 96 inches minimum length. Demonstrate texture, color, or pattern.

1.8 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations.
   1. Building enclosed and environmental systems maintaining design conditions for Owner occupancy.
   2. Temperature: Maintain 70 degrees F for 72 hours, minimum, before installation.

B. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.9 WARRANTY

A. Manufacturer Warranty:
   1. Impact Resistant Wall Units: Warrant against product failure.
      a. Failure includes structural failures, deterioration of plastic and other material under normal use.
      b. Warranty Period: Lifetime.

PART 2 PRODUCTS

2.1 CORNER GUARDS

A. Surface Mounted Stainless Steel Corner Guards, CG-1:
   1. Manufacturers and Products:
      a. Construction Specialties, Inc.
      b. InPro Corporation.
      c. Korogard.
   2. Configuration: See Drawings and Architect selected.
   3. Configuration:
      a. Leg Length: 4 inches.
      b. Installation: Adhesive and Mechanical fasteners.

4. Stainless Steel Finish:#4.
   a. Color: See Drawings and Architect selected.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: Applicable provisions in ICC/ANSI A117.1.

2.3 MATERIALS

A. Adhesives: Manufacturer recommended products.
   1. VOC Content: 50 g/L, maximum.

B. Stainless Steel Sheet: ASTM A240/A240M.

C. Fasteners: Type, size, and material to suit each application.

2.4 FABRICATION

A. General: Factory assemble components to greatest extent possible to minimize field assembly.

B. Fabricate components with tight joints, corners and seams.

2.5 FINISHES

A. Protect metal finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

B. Stainless Steel: 4.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verification of Conditions: Verify wall conditions follow manufacturer recommendations.

3.2 INSTALLATION

A. Install wall and door protection plumb and level.

B. Mounting Height from Finished Floor:
   1. Corner Guards: See Drawings and Top of base to ceiling.

3.3 CLEANING

A. Clean Work after installation. Remove excess adhesive.

END OF SECTION

SECTION 102800

TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes.
1. Public use toilet room accessories.
2. Custodial accessories.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
1. Coordinate size and location of wall backing and toilet partition reinforcement for support of accessories.

B. Preinstallation Meeting Attendees and Procedures:
1. Conduct meeting one month, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data: Each accessory type.
1. Powered Accessories: Submit electrical characteristics.
2. Initial selection color charts.

B. Schedules: List product types, quantities, sizes, and installation locations. Use room numbers and accessory numbers in schedule.

C. Samples:
1. Toilet Accessories: Full sized Samples. Approved Samples may be incorporated into Work.
2. Finishes: 2 by 3 inches in size.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric powered accessories.

B. Warranty Documentation: For toilet accessories and hand dryers.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Manufacturer recommended parts and quantities.

1.6 QUALITY ASSURANCE

1.7 FIELD CONDITIONS

A. Existing Conditions: Verify field measurements before fabrication. Show field measurements on Shop Drawings.

1.8 WARRANTY

A. Manufacturer Warranty:
   1. Toilet Accessories: Warrant against product failure.
      a. Warranty Period: Five years.

PART 2 PRODUCTS

2.1 ACCESSORIES - GENERAL

A. Manufacturers and Products: See Toilet Accessory Schedule on Drawings.

B. Keys: Provide two, minimum for locked accessories.

2.2 PUBLIC USE TOILET ROOM ACCESSORIES

A. Accessories, General: Provide accessories of each type from single manufacturer.
   1. Accessories with Locking Panels: Tumbler cam locks; all accessories keyed alike.
      a. Keys: Provide two, minimum.

B. Soap Dispensers TA-6: Wall mounted, operation.
   1. Manufacturers and Products:
      a. Bobrick, as basis of design.
      b. Bradley Corp.
      c. ASI, American Specialties, Inc.

C. Toilet Tissue Dispenser TA-04: Jumbo roll type.
   1. Manufacturers and Products:
      a. Bobrick, as basis of design.
      b. Bradley Corp.
      c. ASI, American Specialties, Inc.
   2. Mounting: Surface.
   3. Material and Finish:#4 Stainless steel.

D. Paper Towel Dispensers TA-10: Manual roll type.
   1. Manufacturers and Products:
      a. Bobrick, as basis of design.
      b. Bradley Corp.
      c. ASI, American Specialties, Inc.
   2. Operation: Automatic feeding..
   3. Mounting: Surface.
   4. Material and Finish:Gray Plastic.

E. Sanitary Napkin Disposal TA-07:
   1. Manufacturers and Products:
      a. Bobrick, as basis of design.
      b. Bradley Corp.
      c. ASI, American Specialties, Inc.
   2. Mounting: Surface.
   3. Material and Finish: 4 Stainless steel.

F. Toilet Seat Cover Dispenser TA-09:
   1. Manufacturers and Products:
      a. Bobrick, as basis of design.
      b. Bradley Corp.
      c. ASI, American Specialties, Inc.
   2. Mounting: Surface.
   3. Capacity: 250 covers, minimum.
   4. Material and Finish:#4 Stainless steel.

G. Sanitary Napkin Dispenser TA-12:
   1. Manufacturers and Products:
      a. Bobrick, as basis of design.
      b. Bradley Corp.
      c. ASI, American Specialties, Inc.
   2. Mounting: Surface.
   3. Operation: Architect selected.
   4. Locking: Same key for stocking cabinet and coin box.
   5. Material and Finish: 4 Stainless steel.

H. Grab Bars TA-01:
   1. Manufacturers and Products:
      a. Bobrick, as basis of design.
      b. Bradley Corp.
      c. ASI, American Specialties, Inc.
   2. Mounting: Flanges with concealed fasteners.
   3. Material and Finish: 4 Stainless steel, slip-resistant texture.
   4. Configuration and Length: See Drawings.
   5. Diameter: 1-1/2 inches.

I. Framed Mirrors TA-02: Non tilt type.
   1. Manufacturers and Products:
      a. Bobrick, as basis of design.
      b. Bradley Corp.

c. ASI, American Specialties, Inc.
2. Frame: Stainless steel, 1/2 inch wide.
3. Size: See Drawings.

J. Air Dryers TA-05:.
1. Manufacturers and Products:
a. Bobrick, as basis of design.
b. Bradley Corp.
c. ASI, American Specialties, Inc.
2. Mounting: Surface.
3. Material and Finish:#4 Stainless steel.
4. Operation: Electronic sensor.
5. Electrical Characteristics: 115V, 15A, 1725W.

K. Under Lavatory Guard At all lavatories: Insulated pipe and trap covers.
1. Insulation Thickness: 1-1/4 inch.
2. Color: White.

2.3 CUSTODIAL ACCESSORIES

A. Mop and Broom Holders TA-11: Units with hooks, mop clips, and shelf.
1. Manufacturers and Products:
a. Bobrick, as basis of design.
b. Bradley Corp.
c. ASI, American Specialties, Inc.
2. Length: 34 inches.
3. Mop and Broom Holders: Three, spring loaded, rubber hat, cam type.
4. Material and Finish: No. 4 Stainless steel.

2.4 PERFORMANCE

A. Accessibility Requirements: Applicable provisions in ICC/ANSI A117.1 2009.

B. Electrical Components:
1. UL Listed and labeled.

2.5 MATERIALS

A. Stainless Steel Sheet: ASTM A480, Type 304, 0.031 inch minimum nominal thickness.

B. Steel Sheet: ASTM A1008, CS; cold rolled, commercial steel, 0.036 inch minimum nominal thickness.

C. Galvanized Steel Sheet: ASTM A653, G60 hot dip zinc coating.

D. Galvanized Steel Mounting Devices: ASTM A153, hot dip galvanized after fabrication.

E. Fasteners: Screws, bolts, and other devices, same material as accessory.
   1. Exposed Fasteners: Tamper resistant.

F. ABS Plastic: Acrylonitrile-butadiene-styrene resin formulation.

2.6 FABRICATION

A. Accessories, General: Shop assembled, free of dents and scratches and packaged complete with anchors and fittings, steel anchor plates, adapters, and anchor components for installation.
   1. Grind welded joints smooth.
   2. Fabricate sheet metal of seamless sheets with flat surfaces.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify backing supports are in place and adequate.

B. Powered Accessories: Verify electrical power is correctly located and is of proper characteristics.

3.2 INSTALLATION

A. Install accessories level, plumb, and firmly anchored.

B. Install using fasteners appropriate to substrate.

C. Grab Bars: Install to withstand 250 lbf minimum load, when tested per ASTM F446.

D. Powered Accessories: See Division 26 for wiring requirements.

E. Battery Powered Accessories: Install fresh batteries before Substantial Completion.

3.3 CLEANING AND PROTECTION

A. Clean exposed surfaces of compartments, hardware, and fittings using methods acceptable to the manufacturer.

B. Touchup, repair or replace damaged products until Substantial Completion.

END OF SECTION

SECTION 104400

FIRE PROTECTION SPECIALTIES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Fire extinguishers.
2. Fire extinguisher cabinets.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Preinstallation Meeting:
1. Conduct meeting one week, minimum, before starting Work of this Section.

1.3 ACTION SUBMITTALS

A. Product Data:
1. Extinguisher operational features.
2. Initial selection color Samples.

B. Shop Drawings.
1. Show cabinet dimensions, details, fire ratings, and wall bracket mounting.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire extinguishers.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Delivery and Acceptance Requirements:
1. Deliver fire protection specialties in manufacturers undamaged packaging.
2. Obtain bill of lading. Verify delivery is complete and products are undamaged.

1.6 WARRANTY

A. Manufacturer Warranty:
1. Fire Extinguishers: Warrant against product failure.
a. Failure includes material and workmanship.
b. Warranty Period: Five years.

PART 2 PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Fire Extinguishers, General:
   1. Fire Extinguisher Fabrication and Labeling: NFPA 10.
   2. FM Global approved.

B. Multipurpose Dry Chemical, Type FE:
   1. Manufacturers and Products:
      a. Amerex Model B424.
      b. Babcock-Davis: EX-3005.
      c. J.L. Industries Cosmic 5E.
      d. Larsen's Manufacturing Company MP5.
      e. Nystrom: EX-3005.
      f. Potter Roemer 3005.
   2. UL Rating: 3A:40-B:C.
   3. Nominal Capacity: 5 pounds.
   4. Container: Enameled steel container with chrome plated brass valve.

2.2 FIRE EXTINGUISHER CABINETS

A. Cabinet Construction:
   1. Nonrated.

B. Flush Framed Door Fire Extinguisher Cabinets, FEC-x:
   1. Manufacturers and Products:
      a. Babcock-Davis Series BFC-70.
      b. Larsen's Manufacturing Company 2409 Series Architectural.
      c. J.L. Industries Academy.
      d. Nystrom Series FC-70.
      e. Potter-Roemer Alta 7000 Series.
      f. Safety One Industries Murano Series.
      g. Or approved equal.
   2. Substitutions: Not permitted.
   3. Cabinet: Cold rolled steel, sized for extinguisher; semirecessed and surface mounted types.
      a. Interior Finish: White baked enamel.
   4. Door: Steel, powder coated, 0.048 inch thick.
   5. Frames: Hollow metal, 1/2 inch thick.
   6. Glazing: Vertical duo.
   7. Glass Type: Tempered.
      a. Glass Color: Clear.
   8. Hardware: Piano hinge and Door pull.
   9. Trim: Material to match door, rolled edge, depth to suit mounting conditions.

2.3 PERFORMANCE

A. Fire Resistance:
   1. Fire Rated Extinguisher Cabinets: ASTM E814; match rating of walls where installed.

2.4 MATERIALS

A. Steel Sheet: Cold rolled steel, ASTM A1008.

B. Aluminum Extrusions: ASTM B221.

C. Aluminum Sheet: ASTM B221, Alloy 6063-T5 minimum strength and durability.

D. Stainless Steel: ASTM A666, Type 304.

2.5 FABRICATION

A. Shop Fabrication: Provide cabinets with trim, frame, door, and hardware.

2.6 FINISHES

A. Shop Finishing Methods: Follow NAAMM AMP 500.

2.7 ACCESSORIES

A. Mounting Brackets: Steel, red enamel finish, sized for specified fire extinguishers.

B. Cabinet Signs: Cabinet face applied.
   1. Lettering: Architect selected.
      a. Legend: "FIRE EXTINGUISHER."
   2. Arrangement: Architect selected.
   3. Color: Architect selected.

C. Cabinet Signs: Wall mounted above cabinets.
   1. Sign Type and Design: As selected by architect.
      a. Legend: "FIRE EXTINGUISHER."
   2. Colors: Architect selected.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify rough openings and blocking for cabinets are correctly sized and located.

3.2 INSTALLATION - GENERAL

A. General: NFPA 10.

B. Secure cabinets in place.

C. Place extinguishers in cabinets and on wall brackets.

D. Apply signage.

3.3 ADJUSTING

A. Adjust fire protection cabinet doors for smooth operation.

3.4 CLEANING

A. Clean interior and exterior surfaces.

END OF SECTION

SECTION 107516

GROUND-SET FLAGPOLES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes ground-set flagpoles made from aluminum.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, operating characteristics, fittings, accessories, and finishes for flagpoles.

B. Delegated Design Submittals: For flagpoles.

1.3 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For flagpoles to include in operation and maintenance manuals.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain flagpoles as complete units, including fittings, accessories, bases, and anchorage devices, from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design flagpole assemblies.

B. Structural Performance: Flagpole assemblies, including anchorages and supports, to withstand design loads indicated within limits and under conditions indicated.
   1. Wind Loads: Determine according to NAAMM FP 1001. Basic wind speed for Project location is 110 MPH.

2.3 ALUMINUM FLAGPOLES

A. Aluminum Flagpoles: Cone-tapered flagpoles fabricated from seamless extruded tubing complying with ASTM B241/B241M, Alloy 6063, with a minimum wall thickness of 3/16 inch (4.8 mm).
   1. Basis of Design Product: Acme Lingo, Moedel #E25056 External Halyard.

B. Exposed Height: 25 feet.

C. Metal Foundation Tube: Manufacturer's standard corrugated-steel foundation tube, 0.060-inch (1.52-mm) wall thickness with 3/16-inch (4.8-mm) steel bottom plate and support plate; 3/4-inch- (19-mm-) diameter, steel ground spike; and steel centering wedges welded together. Galvanize foundation tube after assembly. Furnish loose hardwood wedges at top of foundation tube for plumbing pole.

D. Sleeve for Aluminum Flagpole: Fiberglass or PVC pipe foundation sleeve, made to fit flagpole, for casting into concrete foundation.

2.4 FITTINGS

A. Finial Ball: Flush-seam ball, sized as indicated or, if not indicated, to match flagpole-butt diameter.
   1. 0.063-inch (1.6-mm) spun aluminum with gold anodic finish.

B. External Halyard System: braided polypropylene halyard; double sheave revolving truck assembly with plastic-coated counterweight and sling. Finish truck assembly to match flagpole.

2.5 MISCELLANEOUS MATERIALS

A. Drainage Material: Crushed stone, or crushed or uncrushed gravel; coarse aggregate.

B. Sand: ASTM C33/C33M, fine aggregate.

C. Elastomeric Joint Sealant: joint sealant complying with requirements in Section 079200 "Joint Sealants."

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D1187/D1187M.

2.6 ALUMINUM FINISHES

A. Natural Satin Finish: AA-M32, fine, directional, medium satin polish; buff complying with AA-M20; seal aluminum surfaces with clear, hard-coat wax.

PART 3 EXECUTION

3.1 PREPARATION

A. Prepare uncoated metal flagpoles that are set in foundation tubes by painting below-grade portions with a heavy coat of bituminous paint.

B. Foundation Excavation: Excavate to neat clean lines in undisturbed soil. Remove loose soil and foreign matter from excavation and moisten earth before placing concrete. Place and compact drainage material at excavation bottom.

C. Foundation Tube: Place foundation tube, center, and brace to prevent displacement during concreting. Place concrete. Plumb and level foundation tube and allow concrete to cure.

D. Sleeves: Locate and secure sleeves in forms by bracing to reinforcement and forms.

E. Place concrete, as specified in Section 033000 "Cast-in-Place Concrete." Compact concrete in place by using vibrators. Moist-cure exposed concrete for no fewer than seven days or use nonstaining curing compound.

F. Trowel exposed concrete surfaces to a smooth, dense finish, free of trowel marks, and uniform in texture and appearance. Provide positive slope for water runoff to perimeter of concrete base.

3.2 FLAGPOLE INSTALLATION

A. General: Install flagpoles where indicated and according to Shop Drawings and manufacturer's written instructions.

B. Foundation Tube: Place flagpole in tube, seated on bottom plate between steel centering wedges, and install hardwood wedges to secure flagpole in place. Place and compact sand in foundation tube and remove hardwood wedges. Seal top of foundation tube with a 2-inch (50-mm) layer of elastomeric joint sealant and cover with flashing collar.

END OF SECTION

SECTION 113013

RESIDENTIAL APPLIANCES

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes.
   1. Residential appliances.

1.2 ADMINISTRATIVE REQUIREMENTS

A. Coordination Procedures:
   1. Coordinate installation of appliances with other work by all prime contractors as required.

B. Preinstallation Meeting Attendees and Procedures:
   1. Conduct meeting one week, minimum, before starting Work of this Section.
   2. Additional Attendees: GC, CMa, Owner.

1.3 ACTION SUBMITTALS

A. Product Data:
   1. Show profiles, sizes, required clearances, utility rough in sizes and locations.
   2. Show data and power requirements.
   3. Initial selection color charts.

B. Shop Drawings:
   1. Customized Appliances: Show sizes, finishes, and installation details.

C. Schedule: Appliance information for each application.

1.4 CLOSEOUT SUBMITTALS

A. Operating and maintenance instructions.

B. Manufacturer warranties.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Spare Parts: Manufacturer recommended parts and quantities.

1.6 QUALITY ASSURANCE

1.7 FIELD CONDITIONS

A. Ambient Conditions: Perform Work within following limitations:
   1. Building enclosed and environmental systems maintaining design conditions for Owner occupancy.

1.8 WARRANTY

A. Manufacturer Warranty:
   1. All appliances: Warrant against product and installation failure.
      a. Warranty Period: 2 years.

PART 2 PRODUCTS

2.1 APPLIANCES

A. Appliances, General:
   1. Conform to applicable code for UL approvals.
   2. Certification Labels:
      a. ENERGY STAR: Appliances follow EPA/DOE ENERGY STAR product labeling program.
   3. Accessibility Requirements: Accessible appliances follow ICC/ANSI A117.1 and state accessibility code.

B. Residential Appliances:
   1. Manufacturers and Products: See Equipment Schedule on Drawings.
   2. Color: Architect selected.

C. Miscellaneous Materials:
   1. Supply fittings and other devices needed for installation.
   2. Supply touch up materials for exposed painted finishes.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that utility services and electrical power match appliance requirements.

3.2 INSTALLATION

A. Remove packing materials before installation.

B. Set and adjust appliances level and plumb, and with faces in alignment with adjacent surfaces.
   1. Tighten leveling nuts and other adjustment devices against loosening.

C. Freestanding Appliances: Place units in final locations after wall and floor finishes have been completed.

D. Built-In Appliances: Securely anchor units to supporting cabinets or countertops with concealed fasteners.

E. Verify loose accessory items are properly installed.

F. Connect appliances to utilities and make units operational.

G. Adjust appliances for smooth operation under loaded conditions.

H. Test each appliance to verify proper operation.

I. Clean exposed surfaces, loose accessories, and interior surfaces of compartments and doors.

END OF SECTION

SECTION 116623

GYMNASIUM EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
1. Basketball equipment.
2. Safety pads.
3. Score board.
4. Volleyball equipment.
5. Ball storage.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.
1. If applicable, include assembly, disassembly, and storage instructions for removable equipment.

B. Shop Drawings: For gymnasium equipment.
1. Include plans, elevations, sections, details, and attachments to other work.
2. Include details of field assembly for removable equipment, connections, installation, mountings, floor inserts, attachments to other work, and operational clearances.
3. Include transport and storage accessories for removable equipment.

C. Coordination Drawings: Court layout plans, drawn to scale, and coordinating floor inserts, game lines, and markers applied to finish flooring. Coordinate the basketball support brackets with the structure, HVAC, lighting, sprinklers, etc.

D. Samples: For the following products:
1. Basketball Net: Full size.
2. Basketball backboard attachment.
3. Volleyball Net: Minimum 12-inch (305-mm) length by full height, including one edge and net accessories.
4. Pad Fabric: Wall padding not less than 3 inches square, and corner and column Samples not less than 3 inches long, with specified treatments applied. Mark face of material.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Court layout plans, reflected ceiling plans, and other details, drawn to scale, and coordinated with ceiling-suspended gymnasium equipment, floor inserts, game lines, and markers applied to finished flooring, and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which overhead-supported gymnasium equipment will be attached.
   2. Suspended ceiling components, if any.
   3. Items supported from building structure above the courts, including the following:
      a. Luminaires.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Smoke detectors.
      f. Acoustical treatments or panels.
      g. Access panels.

B. Setting Drawings: For embedded items and cutouts required in other work.

C. Qualification Data: For Installer.

D. Product Certificates: For each type of gymnasium equipment.

E. Sample Warranty: For special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gymnasium equipment to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products or an entity that employs installers and supervisors who are trained and approved by manufacturer.

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.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not install gymnasium equipment until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Verify position and elevation of floor inserts and layout for gymnasium equipment.

C. Protect all finished surfaces including walls, flooring, lighting, ducts and finishes.

1.7 COORDINATION

A. Coordinate installation of floor inserts with structural floors and finish flooring installation and with court layout and game lines and markers on finish flooring.

B. Coordinate layout and installation of overhead-supported gymnasium equipment and suspension-system components with other construction including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium equipment that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Basketball backboard failures including glass breakage.
   2. Warranty Period: 5 years from date of Substantial Completion.
      a. 25 years warranty for basketball backstop structure.

PART 2 PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain each type of gymnasium equipment from single source from single manufacturer.

B. Products: Subject to compliance with requirements, provide products by one of the following: See drawings for specific models.
   1. Draper, Inc.
   2. Porter Athletic, Inc.
   3. Jaypro Sports Construction Group.

2.2 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Basketball backstops and anchors shall withstand the effects of earthquake motions determined according to ASCE/SEI 7."

2.3 BASKETBALL EQUIPMENT

A. General: Provide equipment complying with requirements in FIBA's "FIBA Basketball Rule Book."

B. Protruding fasteners or exposed bolt heads on front face of backboards are not permitted.

C. Provide manufacturer's recommended connections complying with Section 055000 "Metal Fabrications" of size and type required to transfer loads to building structure.

D. Connections: Manufacturer's standard connections or connections recommended in writing by manufacturer and complying with Section 055000 "Metal Fabrications" of size and type required to transfer loads to building structure.

E. Overhead-Supported Backstops:
   1. Folding Types:
      a. Manufacturer's standard assembly for forward-folding, front-braced backstop, with hardware and fittings to permit folding.
      b. Manufacturer’s standard assembly for stationary, front-braced backstop.
   2. Forward Folding BOD: Draper, Inc. TF-20 Forward Fold Front Braced BackStop.
      a. Type: Ceiling suspended, forward folding, front braced basketball backstop; Model EZ Fold TF-20 as manufactured by Draper, Inc. Backstop to comply with ASTM F3731 – Standard Guide for Ceiling Suspended and Wall Mounted Basketball Backstops. Non-compliant backstops shall not be acceptable substitutes.
      b. Distance from court floor to backstop attachment at roof structure: As indicated on Drawings.
      c. Main frame: Rigid T design of back-to-back right triangles constructed by welding together steel tubing of the following outside diameters and gauges. Parallelogram frames are not acceptable.
         1) Main center stem: [6 inches] [152 mm] diameter, [11 gauge] [3.2 mm thick] of length sufficient to allow backstop height adjustment of plus or minus [6 inches] [152 mm].
         2) Top member of T frame: [4 inches] [102 mm] diameter, [11 gauge] [3.2 mm].
         3) Folding front brace: Jackknife type, fully adjustable, self-locking in down position constructed from [2-1/2 inches] [64 mm] diameter, [13 gauge] [2.4 mm thick] outer tube and [2-1/4 inches] [57 mm] diameter, [14 gauge] [2 mm] inner tube.
         4) Diagonal side braces: [2-1/4 inches] [57 mm] diameter, [14 gauge] [2 mm thick].
      d. Pivot point: [1-1/4 inches] [32 mm] diameter solid steel shaft and [1/2 inch] [13 mm] steel plate hangers.

F. Wall Mounted Folding Backstop.
   1. Type: Wall mounted, side folding basketball backstop; Model EZ Fold DGW as manufactured by Draper, Inc. Backstop to comply with ASTM F3731 – Standard Guide for Ceiling Suspended and Wall Mounted Basketball Backstops. Non-compliant backstops shall not be acceptable substitutes.
   2. Distance from face of backboard to supporting wall: 4 feet.
   3. Support framework: Backstop mounted to wall at four hinged points with two adjustable, rectangular side frames constructed from [2-1/2 inches] [64 mm] diameter, [13 gauge] [2.4 mm thick] outer tube and [2-1/4 inches] [57 mm] diameter, [14 gauge] [2 mm] inner tube.
      a. Extension adjustment: Plus or minus [6 inches] [152 mm].
      b. Hinges: Offset type allowing backstop to be positioned flat against wall. Provide 8 hinges for attachment of frames to wall and to backboard.
      c. Cross braces: [1-1/2 inches] [38 mm] diameter, [11 gauge] [3.2 mm thick] vertical and diagonal steel tubes for bracing rectangular side frames.

d. Telescoping Locking brace: [1-7/8 inch] [4.7625 cm] OD and 1-1/2 inch [3.81 cm] OD steel tubes, running diagonally across the lower extension tubes. Direction of fold may be determined at time of installation by placement of the offset hinge brackets. Brace shall telescope and lock into place by means of a spring-loaded pin.

4. Diagonal support chains: Two [1/4 inch] [6 mm] welded link chains with leveling turnbuckles.
5. Wall pads: Provide [2 by 8 inches] [50 by 203 mm] southern yellow pine pads with chamfered edges and clear lacquer finish for support frame hinge and chain attachment points.

G. Electric Winch.
1. Provide for each folding basketball backstop separate electric winch mechanism.
2. Type: Fully enclosed, direct drive, worm gear, electric winch designed to hold backstop at any position during raising and lowering; Model 503285 Motorized Winch as manufactured by Draper, Inc.
   a. Motor: 3/4 HP, 11.5 AMP, capacitor type, 60 cycle, 115 volt, single phase with automatic thermal overload protection manufactured in compliance with NEMA specifications.
   b. Hoist cable: [1/4 inch] [6 mm] diameter, 7 by 19, galvanized aircraft cable with [7,000 pounds] [3175 kg] ultimate breaking strength.
   c. Roller: Spring-load providing tensioning pressure to ensure cable tracks evenly on grooved drum.
   d. Limit switches: Rotary counting up and down type, pre-wired to motor as integral part of winch.
   e. Winch to comply with ASTM F3731 – Standard Guide for Ceiling Suspended and Wall Mounted Basketball Backstops. Non-compliant backstops shall not be acceptable substitutes.
3. Controls: Provide key lock, 3 position, momentary contact wall control switch to lower, raise, and stop backstop.
   a. Provide two keys.
   b. Provide with stainless steel cover plate.
   c. Refer to Electrical Dwgs for locations.

H. Safety belt and lock.
1. Provide each front and rear folding basketball backstop with safety belt and lock test to withstand [1750 pounds] [794 kg] free fall load.
2. Safety lock: Inertia sensitive to automatically lock backstop in position at any time during storage, raising, or lowering. Sudden increase in either tension or speed shall activate lock.
3. Safety belt: [2 inches] [51 mm] wide nylon belt rated at [6000 pounds] [2721 kg] breaking strength; Safety Belt [503229] [503230] as manufactured by Draper, Inc.
4. Belt shall extend ([36 feet] [10.97 m]-503229) ([46 feet] [14.02 m]-503230) and shall be automatically retracted and stored on reel equipped with constant force spring. Operation and locking action shall be activated by centrifugal force to lock backstop before unit travels [12 feet] [3.7 m] of free fall.
5. Unit shall incorporate automatic reset not requiring poles, ropes, levers, or buttons for resetting.
6. Backstop must include Safety Strap to comply with ASTM F3731.

I. Basketball Backboards:
   1. Rectangular, Glass.
      a. BOD at TF-20: Rectangular, glass, official size backboard to be used with direct attachment goal; Model 503136 as manufactured by Draper, Inc.
         1) Size: [72 inches] [1829 mm] wide by [42 inches] [1067 mm] high.
         2) Construction: [1/2 inch] [13 mm] thick fully tempered glass in extruded aluminum frame with mitered corners. Provide steel gusset type mounting corner brackets with slots for mounting backboard to support structure.
         3) Goal mounting assembly: Steel assembly secured to aluminum frame and equipped with steel sleeves through glass allowing rear structure to be secured to front mounting plate. Provide with holes and studs to secure backboard and goal directly to goal brace. Front plate provided with holes for goal attachment.
         4) Equip frame and goal mounting assembly with neoprene shock absorbing cushions.
         5) Permanently etch official white border and target area on front side of glass.
      b. BOD at DGW: Rectangular, glass, official size backboard with center strut; Model 503138 as manufactured by Draper, Inc.
         1) Size: [72 inches] [1829 mm] wide by [42 inches] [1067 mm] high.
         2) Construction: [1/2 inch] [13 mm] thick fully tempered glass in extruded aluminum frame with mitered corners and vertical aluminum strut in center on back side to alleviate stress on glass. Provide steel gusset type mounting corner brackets with slots for mounting backboard to support structure.
         3) Goal mounting assembly: Steel assembly secured to aluminum frame and equipped with steel sleeves through glass allowing rear structure to be secured to front mounting plate. Provide with holes and studs to secure backboard and goal directly to goal brace. Front plate provided with holes for goal attachment.
         4) Equip frame and goal mounting assembly with neoprene shock absorbing cushions.
         5) Permanently etch official white border and target area on front side of glass.

J. Basketball Goals: Complete with flanges, braces, attachment plate, and evenly spaced loops welded around underside of ring.
   1. BOD: Breakaway goal with standard no-tie net attachment and designed to withstand shock loads from player slam dunking or hanging on rim; Model 503576 as manufactured by Draper, Inc.
   2. Rim shall deflect down when [230 pounds] [104 kg] static load is applied and return to playing position when load is removed. Breakaway point shall be adjustable from [160 to 230 pounds] [73 to 104 kg].
   3. Ring shall have rebound characteristics identical to those of non-moveable ring. Factory set proper flex and rebound requirements. Goal features easy-adjsut system to allow users to adjust the breakaway point form 160 pounds to 230 lbs.
   4. Ring: Fabricated from [5/8 inch] [16 mm] diameter steel rod formed into [18 inches [457 mm] ring. Rigidly brace with die cut steel braces welded to rim.
   5. Mounting plate: Heavy duty steel plate bracket with mounting holes and designed to position inside of ring [6 inches] [152 mm] from backboard.
   6. Rim shall be provided with 12 formed wire “no-tie” net attachment clips on which the net securely hooks.
   7. Finish: Powder coated orange paint.
   8. Anti-whip net: Top half made of durable fibers encased in nylon to prevent net from whipping up on rim. Lower half all nylon. Color white.

9. Mounting hardware: Zinc plated.

K. Safety edge padding.
1. BOD: Foam padding for bottom edge and corners of backboard to provide safety protection to meet NCAA and NFHS requirements; Model 5032XX Safe-Edge Padding as manufactured by Draper, Inc.
2. Construction: Molded foam, [2 inches] [51 mm] wide and wrapping around edges [3/4 inch] [19 mm]. Equip with molded-in steel track and bolt-on attachment system. Padding shall cover bottom edge of backboard and extend [15 inches] [381 mm] up sides.
3. Color: As selected by Architect from manufacturer's full range.
4. Backstop to comply with ASTM F3731 – Standard Guide for Ceiling Suspended and Wall Mounted Basketball Backstops. Non-compliant backstops shall not be acceptable substitutes.

L. Provide backstop with backstop hangers, clamps, brackets, fasteners, and all other hardware required for complete, functional, rigid assembly and installation.

2.4 SAFETY PADS

A. Basis of Design Product: Subject to compliance with requirements, provide product as indicated on Finish Schedule on Drawings comparable product by one of the following:
1. Safety Padding Ink, LLC.
2. Porter Athletic, Inc.
3. Draper, Inc.
4. Jaypro Sports Construction Group.

B. SP-Safety series 18 Wall Pad-Padding Ink Safety Series is an indoor fixed wall padding panel. Designed for direct wall attachment. This style panel is a wood backed pad with 2” high compression polyurethane foam laminated to the face using a two part adhesion process. This combination of foam and wood is wrapped front and sides and securely stapled onto back using 18.5 oz class “A” PVC Vinyl.
1. Backer Board: 7/16” Georgia Pacific Blue Ribbon ® oriented strand board (OSB); Third-Party certified to the sustainable Forestry initiative ® procurement standard, Exposure 1 bond durability. Contains no added urea formaldehyde rains. Georgia-Pacific building products can contribute to LEED® certification points.
2. Fire-Resistive Fill: 2” High Compression polyurethane foam 1.8lb density x 100 ILD.
3. Covering- 18.5 oz coated smooth matte vinyl, BAC Shield; Anti-mildew, anti-fungus, Anti-microbial, Antibacterial treated, UV treated. Passes NFPA-701, CSFM-19, and ASTM E-84 Class A fire retardant compliant.
4. Size: Typical panel to be manufactured at 24” width x height as specified on the drawings.
5. Number of Modular Panel Sections: As indicated on Drawings.
6. Installation Method: Manufacturer's standard.
7. Fabric Covering Color(s): As selected by Architect from manufacturer's standard range.
8. All columns and corners to be pre-fabricated to fit field conditions, ensuring maximum corner protection.
9. 1” nailing margine top and bottom along the width edge attached directly to the wall using appropriate hardware for wall type. Refer to ASTM standard for height above finished floor. 4” AFF to bottom of foam current.

10. No Nail Margin. 1 x3 AC grade fir (or approved substitute) wrapped in matching vinyl along top and sides, mounted directly to wall top, bottom, and middle (as aligned with panel size and mounting height) using appropriate hardware for wall type. Using 15-16 gauge angled finishing nails, panels, are blind nailed into fir along top and bottom, and secured to middle fir. 4” AFF to bottom of panel.
11. No Nail Margine aluminum z-clip mounted to wall top and bottom (as aligned with panel size and mounting height) using appropriate hardware for wall type. Opposing z-clip mounted to panels. Once hardware is securely fastened to wall and panels, panels can be nested into wall side Z-clip. 4” AFF to bottom panel.

C. Cut-out Trim: Provide manufacturer's standard flanged cut-out trim kits for fitting pads around switches, receptacles, and other obstructions.
   1. Color: As selected by Architect.

2.5 SCOREBOARD

A. All American Standard PLK-BK9081 - Scoreboard.
   1. This single-sided LED basketball scoreboard displays period time to 99:59, HOME and GUEST scores to 199, PERIOD to nine and indicates possession and bonus. Scoreboard can also score volleyball and wrestling. When period time is less than one minute, the scoreboard displays time to 1/10 of a second.
   2. Control: MSC9000 (Multi-sport Desktop Console) Extruded Aluminum, high impact low profile microprocessor control console. 5” high x 10.25” wide x 9” deep. Weight: 4.3 lbs. Radio (1600 ft) is standard, simultaneous hardwire option included. Internal rechargeable battery. Switch between multiple sports by removing and replacing the slip sheet.
   3. Size: 3' x 8’ x 5."
   4. Color as selected by architect from standard colors.
   5. Follow the manufactures instructions for operation, wall mounting, etc.

2.6 SHOT CLOCK

A. All American Standard PLK-BK9029V2 - Shot clock.
   1. Black Powder Coated Extruded Aluminum cabinet with black vinyl decorated polycabonate protective face.
   2. Control: MSC9000 (Multi-sport Desktop Console) Extruded Aluminum, high impact low profile microprocessor control console. 5” high x 10.25” wide x 9” deep. Weight: 4.3 lbs. Radio (1600 ft) is standard, simultaneous hardwire option included. Internal rechargeable battery. Switch between multiple sports by removing and replacing the slip sheet.
   3. Size: 1’11” High x 2’ Wide x 5” Depth.
   4. Follow the manufactures instructions for operation, wall mounting, etc.

2.7 VOLLEYBALL EQUIPMENT

A. Source Limitations: Obtain from single source from single manufacturer.

B. Standard Rules: Provide equipment according to the requirements of FIVB's "Official Volleyball Rules."

C. Draper, Steel Volleyball System (SVS) - 500021 & Accessories.

2.8 BALL STORAGE

A. BOD: Porter 93815-BALL CART; HEAVY DUTY; 15 BALLS.
   1. Quantity: Minimum 2, coordinate final amount with owner prior to ordering.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for play court layout, alignment of mounting substrates, installation tolerances, operational clearances, accurate locations of connections to building electrical system, and other conditions affecting performance of the Work.
   1. Verify critical dimensions.
   2. Examine supporting structure, subgrades, subfloors, and footings below finished floor.
   3. Examine wall assemblies, where reinforced to receive anchors and fasteners, to verify that locations of concealed reinforcements are clearly marked. Locate reinforcements and mark locations.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Comply with manufacturer's written installation instructions and competition rules indicated for each type of gymnasium equipment. Complete equipment field assembly where required.

B. Unless otherwise indicated, install gymnasium equipment after other finishing operations, including painting, are completed.

C. Permanently Placed Gymnasium Equipment and Components: Install rigid, level, plumb, square, and true; anchored securely to supporting structure; positioned at locations and elevations indicated; in proper relation to adjacent construction; and aligned with court layout.
   1. Operating Gymnasium Equipment: Verify clearances for movable components of gymnasium equipment throughout entire range of operation and for access to operating components.

D. Safety Pads: Mount with bottom edge at dimension indicated on Drawings above finished floor.

E. Cut-out Trim: Limit cuts in face of padding from trim unit's corner-to-corner outside dimensions. Install with ends of cuts concealed behind trim flange.

F. Anchoring to In-Place Construction: Use anchors and fasteners where necessary to secure

built-in and permanently placed gymnasium equipment to structural support and to properly transfer load to in-place construction.

G. Connections: Connect electric operators to building electrical system.

H. Removable Gymnasium Equipment and Components: Assemble in place to verify that equipment and components are complete and in proper working order. Instruct Owner's designated personnel in properly handling, assembling, adjusting, disassembling, transporting, storing, and maintaining units. Disassemble removable gymnasium equipment after assembled configuration is approved by Architect and Owner, and store units in location indicated on Drawings.

3.3 ADJUSTING

A. Adjust movable components of gymnasium equipment to operate safely, smoothly, easily, and quietly, free from binding, warp, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Lubricate hardware and moving parts.

3.4 CLEANING

A. After completing gymnasium equipment installation, inspect components. Remove spots, dirt, and debris and touch up damaged shop-applied finishes according to manufacturer's written instructions.

B. Replace gymnasium equipment and finishes that cannot be cleaned and repaired, in a manner approved by Architect, before time of Substantial Completion.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium equipment.

END OF SECTION

SECTION 116653

GYMNASIUM DIVIDERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Roll-up Gymnasium Divider Curtain.

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. Shop Drawings: For gymnasium dividers.
   1. Include plans showing alignment of curtains in relation to sport-court layout and overhead structural supports.
   2. Include elevations, sections, details, and attachments to other work.
   3. Include system clearances, stacking requirements, and limits for fitting into adjacent construction.
   4. Include point loads and locations for attachment of gymnasium dividers to structure.
   5. Include diagrams for power, signal, and control wiring.

C. Samples: For each exposed product and for each item and color specified.

D. Samples for Initial Selection: For each type of gymnasium divider curtain fabric.

E. Samples for Verification: For divider curtain fabrics, not less than 12 inches (305 mm) square of mesh and of solid fabric.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans with divider-curtain layouts, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members to which divider-curtain systems will be attached.
   2. Suspended ceiling components, if any.
   3. Items supported from building structure, including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Smoke detectors.
      f. Acoustical treatments or panels.
      g. Access panels.

B. Qualification Data: For Installer.

C. Product Certificates: For each type of gymnasium divider.

D. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For gymnasium dividers to include in operation and maintenance manuals.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of gymnasium dividers that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Faulty operation of gymnasium dividers.
      b. Tearing or deterioration of fabric, seams, or other materials beyond normal use.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain each type of gymnasium equipment from single source from single manufacturer.

B. Products: Subject to compliance with requirements, provide products by one of the following: See drawings for specific models.
   1. Draper Inc.
   2. Porter Athletic, Inc.
   3. Jaypro Sports Construction Group.

2.2 ROLL-UP DIVIDER SYSTEMS

A. Divider-Curtain System, electrically operated, roll-up divider curtain, as follows:
   1. BOD: Draper Inc., Mid-Wall Roll-Up Gymnasium Divider Curtain.
      a. Gray mesh (top), 8’ Dark Royal Blue 22oz. vinyl (bottom).
   2. Type: Electrically operated, roll-up gymnasium divider including motor, controls, clamps for attachment to building structure, threaded rod supports, and other components required for complete functional installation; Mid-Roll Gym Divider as manufactured by Draper, Inc.
   3. Operation: Rolling action shall be from the middle of the curtain, and shall be achieved without the use of belts and/or cables. Upper and lower sections of fabric shall be attached via plastic spline to a 3.35 inch diameter rotating drive pipe operated by electrical motor. Curtain to be held at desired height by two 2 inch nylon straps which will terminate in stabilizers to which the center drive pipe is attached. This assembly will never be within reach without the use of ladders or other equipment.
   4. Configuration: Rectangular shape with straight bottom and extending across room as indicated on Drawings.
      a. Maximum dimension of stored divider: 2 feet from bottom of structural support to bottom of rolled curtain.
      b. Minimum required clearance between vertical curtain edges and adjacent fixed objects: 6 inches.
      c. Minimum curtain height to be 20 feet to keep all electrical components out of reach.
      d. Provide 36 inches wide space between curtain ends and walls or fixed objects to allow passage space around divider.
   5. Operating mechanism: Drive tube driven by 880 in.-lbs.[100 Nm], 14RPM, 110-120V AC, 60 cycle, tubular motor featuring internal limit switches. Number of motors provided to be determined by curtain size and weight. A synchronizer is supplied when the curtain has two motors. Motor(s) will be provided with a mechanism to counteract the reactive torque forces from the motor(s) and self-retracting cable reel system to provide power at motors.
   6. Curtain Attachment: Upper section of curtain is suspended from 1.5 inch top batten, which passes through a pocket in the fabric. Both upper and lower sections of fabric are secured to drive tube using a plastic spline material sealed inside a pocket. Drive tube has extruded grooves into which spline material slides providing a continuous and secure attachment.

7. Attachment: Top batten attached to structural support with beam clamps, hanger brackets, and 3/8 inch diameter threaded rods. Attachment clamps designed to be capable of supporting a minimum of 5000 lb. each and provided in sufficient number to provide a combined minimum 45:1 attachment point safety factor. Fittings should be spaced a maximum of 10 feet center-to-center. Suspension method to be designed so that the curtain can be stored in as little as 14 inches if suspended directly from roof truss, roof joist or other roof support beam.
8. Bottom batten: 1.5 inches diameter steel pipe contained inside sealed pocket.

2.3 DIVIDER CURTAINS

A. Bottom 8 feet: Opaque solid vinyl coated polyester fabric:
   1. Weight: 22 ounces per SY.
   2. Resistant to rot, mildew, and ultraviolet light.
   3. Flammability: Rated self-extinguishing in accordance with California State Fire Marshall Title 19.
   4. Color: Dark royal blue.

B. Upper curtain section: Vinyl coated polyester mesh.
   1. Weight: 9 ounces per SY.
   2. Resistant to rot, mildew, and ultraviolet light.
   3. Flammability: Rated self-extinguishing in accordance with California State Fire Marshall Title 19.
   4. Color: Grey.

C. VOC Emission: Divider Curtain Vinyl and Mesh to be low emitting and certified to meet all of the requirements of the GREENGUARD Gold certification program. GREENGUARD Gold requires emissions of total volatile organic compounds ≤ 0.22 mg/m3, formaldehyde ≤ 0.0135 ppm, total aldehydes ≤ 0.043 ppm, individual volatile organic compounds ≤ 1/1000 TLV and ≤ ½ chronic REL and total phthalates ≤ 0.01 mg/m3. Vinyl and Mesh must be evaluated to indoor air quality evaluation (IAQ) using a GREENGUARD product evaluation protocol following the requirements of The GREENGUARD Product Certification Program, ASTM Standard D5116 and the United States Environmental Protection Agency and modeled based on GEI requirements for a standard gymnasium loading and ASHRAE 62.1 – 2004 ventilation conditions. Manufacturer to provide certificate and/or test results upon request.

D. Seams: Horizontal and electronically welded with 1 inch full contact weld.

E. Outer edge hems: Turned with double welds.

F. Upper panel shall be mesh fabric with two pockets. Upper pocket is to allow for suspension from Top Batten; Lower pocket shall be sealed and contain plastic spline material for attachment to center drive tube.

G. Lower panel shall be solid fabric with two sealed pockets. Lower pocket is sealed, and contains 1.5 inch Bottom Batten; Upper pocket to contain plastic spline material for attachment to center drive tube.

2.4 CURTAIN SAFETY DEVICE

A. A. Provide Draper Model 503229 Aut-O-Loc™ 2 safety device. Aut-O-Loc™ 2 to be sensitive to automatically lock divider curtain in position at any time during storage or operation. Aut-O-Loc™ 2 is permanently locked when a load of more than 1000 pounds of force is captured and will not be functional after it has caught a significant load to prevent possible re-use and failure of critical components that are stressed when the unit engages a load.

2.5 CONTROLS

A. Provide key lock, 3-position, momentary contact wall control switch to lower, raise, and stop gymnasium divider. Provide with switch box and plastic cover plate.

PART 3 EXECUTION

3.1 EXAMINATION

A. Coordinate support of gymnasium divider with roof structure to ensure proper distribution of loads and adequacy of attachment points. Ensure that building structure has been designed for loads of specific gymnasium divider to be provided. Provide additional structural framing members as required.

B. Coordinate configuration, size, and installation of gymnasium divider with height, slope, and type of building structure and lighting fixtures, mechanical equipment, ductwork, fire-suppression system, athletic equipment, and other potential obstructions.

C. Field verify dimensions prior to fabrication.

D. Coordinate electrical requirements for motorized operating mechanism to ensure proper power source, conduit, wiring, and boxes for keyed switches. Prior to installation, verify type and location of power supply.

E. For installations made after gymnasium flooring is installed, provide protection and exercise care not to damage flooring.

3.2 INSTALLATION

A. Install in accordance with manufacturer's written instructions and shop drawings.

B. Install even and level with curtain hanging 2 inches above finish floor in down position.

C. Install control switch such that operator has view of complete gymnasium divider during lowering and raising.

D. Adjust limit switches of electric winch to ensure accurate position in both stored and lowered positions.
   1. Verify clearances for movable components of gymnasium dividers throughout entire range of operation and for access to operating components.

3.3 DEMONSTRATION

A. Operate divider curtains to ensure proper lifting and lowering. Adjust as required to ensure smooth operation and accurate positioning.

B. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain gymnasium dividers.

END OF SECTION

SECTION 123600

COUNTERTOPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Solid-surface-material countertops and sills.

1.2 ACTION SUBMITTALS

A. Product Data:
   1. For countertop materials.
   2. For each type of product.

B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, field joints, and cutouts for plumbing fixtures.

C. Samples for Verification: For the following products:
   1. One full-size solid-surface-material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Product Certificates: For the following:
   1. Adhesives.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

B. Testing Agency Qualifications: For testing agency providing classification marking for fire-retardant-treated material, an inspection agency acceptable to authorities having jurisdiction that periodically performs inspections to verify that the material bearing the classification marking is representative of the material tested.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.6 COORDINATION

A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS

A. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with IFSA 2-01.
   1. Manufacturers: Subject to compliance with requirements, provide products as indicated on Finish Schedule on Drawings or comparable product by one of the following:
      a. Corian, basis of design.
      b. Wilsonart.
      c. Avonite Surfaces.
      d. E. I. du Pont de Nemours and Company.
      e. Formica Corporation.
   2. Type: Provide Standard Type unless Special Purpose Type is indicated.
   3. Colors and Patterns: See Finish Schedule on Drawings.

B. Configuration: Provide countertops with the following front and backsplash style:
   1. Front: Straight, slightly eased at top.
   2. Backsplash: Straight, slightly eased at corner.

C. Countertops: 3/4-inch- thick, solid surface material with front edge built up with same material.

D. Backsplashes: 3/4-inch- thick, solid surface material.

E. Fabrication: Fabricate tops in one piece with shop-applied edges unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

2.2 ACCESSORY MATERIALS

A. Provide adhesives as recommended by finish material manufacturer for each application.

2.3 FABRICATION

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 3/4 - inch over base cabinets.

B. Complete fabrication, including assembly and finishing 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.
   1. Notify Architect seven days in advance of the dates and times fabrication will be complete.
   2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings.

PART 3 EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

B. Before installing countertops, examine shop-fabricated work for completion and complete work as required, including removal of packing and back priming.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.
   1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required.

D. Install countertops level to a tolerance of 1/8 inch in 8 feet.

E. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
   1. Install backsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

F. Touch up finishing work specified in this Section after installation of wood countertops. Fill nail holes with matching filler where exposed.
   1. Apply specified finish coats, including stains and paste fillers if any, to exposed surfaces where only sealer/prime coats are applied in shop.

3.3 CLEANING AND PROTECTION

A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Architect.

C. Protect epoxy countertop surfaces during construction with 6-mil plastic or other suitable water-resistant covering. Tape to underside of countertop at a minimum of 48 inches o.c.

END OF SECTION

SECTION 210000

FIRE SUPPRESSION

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

B. The requirements of all other sections of Division 21 apply to this section.

1.3 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a (2) two-year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect.

1.4 DEFINITIONS

A. For a complete list of definitions for this contract refer to the Division 1 specifications.

B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.5 SCOPE OF WORK

A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the fire protection work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect

the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:

B. Contract Requirements are to provide a fully sprinklered new building addition. The Complete Structure is contractually required to be a Fully Sprinkled Building as defined by NFPA-13 2019. Contractor is to study carefully review ALL Separate Disciplines (Architectural, Mechanical, Plumbing, Electrical etc). Contract drawings to determine final head locations and amounts.

C. The following is a Summary of Contract Requirements (NOTE: This list is not all inclusive):
1. Provide new piping, sprinkler heads, supports etc., as needed to have a fully operational sprinkler system upon project completion.
2. Provide all associated control equipment required unless otherwise noted.
3. Providing all necessary permits, approvals, fees, etc.
4. Provide instructions to the owner as outlined in these Specifications.
5. Provide all cutting and patching as required to perform the work of this contract.
6. Provide all necessary rigging as required to perform the work of this contract.
7. Provide manufacturer startup for all systems specified as outlined in these Specifications.
8. Provide removal of trash and general clean-up.
9. Provide as-built drawings.
10. Provide operation and maintenance manuals.
11. Employ the services of the local Underwriters' Inspection Agency and pay for all associated fees.
12. Completion Date: All Fire Protection work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.

D. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.

E. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the electrical work as indicated, required or implied by the drawings and as specified herein.

F. All of the contract specifications and all of the contract drawings are part of the Contract Documents of the Contractor. The Contractor shall review all drawings and specification divisions to determine the full scope of his work.

G. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Electrical Mechanical, Plumbing and Fire Protection) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

H. WARRANTY.
1. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will

commence after the Architect issues his letter of "Substantial Completion.".

2. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment; otherwise final payment will be withheld until the factory reports are submitted.
3. All equipment furnished for this School shall include a warranty on parts and labor. The duration of this warranty shall be as noted in paragraph 1.2.A above. This warranty shall supersede all notations in all the other Division 21 specification sections.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 "FIRE WATCH" SCOPE OF WORK

A. Personnel performing the fire watch shall NOT be performing any other duties that would take their attention away from the areas that are not covered by the fire alarm system.

3.2 "FIRE WATCH" RESPONSIBILITIES AND SPECFIC PROGRAM COMPONENTS

A. Construction Services.
   1. Know how to report a fire or emergency situation.
   2. Be trained in fire safety procedures and the use of fire extinguishing equipment.
   3. Must have quick access to at least a 2A:10ABC fire extinguisher at all times.
   4. Be familiar with the surrounding facilities to sound an alarm in the event of a fire.
   5. Have means of emergency communications to the local fire department.
   6. Perform checks and complete the Fire Watch Log during the specified period.

3.3 "FIRE WATCH" PROGRAM COMPONENTS

A. Entire Building.
   1. In the event that the Fire Alarm System is inoperable, signs must be posted on the doors of rooms where the system is inoperable.
   2. The Contractor is responsible for posting the signs in appropriate locations. The following language should be included on the sign: The Fire alarm System is out of order in the following locations/rooms: In case of emergency, please call 911 or from a cell phone call the number to be provided by the Fire Marshall.

B. Building Automatic Sprinkler System.
   1. In the event the Automatic Sprinkler System is inoperable, signs must be posted in locations where the system is inoperable and also on the doors of each entrance to the building.

3.4 “FIRE WATCH” REPORTING REQUIREMENTS

A. Fire Watch Log.
   1. A Fire Watch log must be maintained and is included as part of this specification.
   2. The completed Fire Watch Log should be delivered to the Owners Representative at the end of each day.

END OF SECTION

SECTION 210517

SLEEVES AND SLEEVE SEALS FOR FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Sleeves.
2. Sleeve-seal systems.
3. Grout.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.1 SLEEVES

A. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

B. Galvanized-Steel-Sheet Sleeves: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

2.2 SLEEVE-SEAL SYSTEMS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Advance Products & Systems, Inc.
2. Metraflex Company (The).
3. Pipeline Seal and Insulator, Inc.
4. Proco Products, Inc.

B. Description: Modular sealing-element unit, designed for field assembly, for filling annular space between piping and sleeve.
   1. Sealing Elements: EPDM-rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   2. Pressure Plates: Carbon steel.
   3. Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.

2.3 GROUT

A. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

B. Characteristics: Nonshrink; recommended for interior and exterior applications.

C. Design Mix: 5000-psi, 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, and walls.

B. For sleeves that will have sleeve-seal system installed, select sleeves of size large enough to provide 1-inch annular clear space between piping and concrete slabs and walls.
   1. Sleeves are not required for core-drilled holes.

C. Install sleeves for pipes passing through interior partitions.
   1. Cut sleeves to length for mounting flush with both surfaces.
   2. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation.
   3. Seal annular space between sleeve and piping or piping insulation; use joint sealants appropriate for size, depth, and location of joint. Comply with requirements for sealants specified in Division 07 Section "Joint Sealants."

D. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Select type, size, and number of sealing elements required for piping material and size and for sleeve ID or hole size. Position piping in center of sleeve. Center piping in penetration, assemble sleeve-seal system components, and install in annular space between piping and

sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make a watertight seal.

3.3 SLEEVE AND SLEEVE-SEAL SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:
   1. Concrete Slabs above Grade:
      a. Piping Smaller Than NPS 6: Galvanized-steel-pipe sleeves.
   2. Interior Partitions:
      a. Piping Smaller Than NPS 4: Galvanized-steel-pipe sleeves.

END OF SECTION

SECTION 210518

ESCUTCHEONS FOR FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Escutcheons.
2. Floor plates.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with chrome-plated finish and spring-clip fasteners.

C. One-Piece, Stamped-Steel Type: With chrome-plated finish and spring-clip fasteners.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished, chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      g. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, stamped-steel type.
      h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished, chrome-plated finish.
      i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type.
      j. Bare Piping in Equipment Rooms: One-piece, cast-brass type with polished, chrome-plated finish.
      k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
   1. New Piping: One-piece, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION

SECTION 210523

GENERAL-DUTY VALVES FOR WATER-BASED FIRE-SUPPRESSION PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Two-piece ball valves with indicators.
2. Bronze butterfly valves with indicators.
3. Iron butterfly valves with indicators.
4. Check valves.
5. Bronze OS&Y gate valves.
6. Iron OS&Y gate valves.
7. NRS gate valves.
8. Trim and drain valves.

1.3 DEFINITIONS

A. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

B. NRS: Nonrising stem.

C. OS&Y: Outside screw and yoke.

D. SBR: Styrene-butadiene rubber.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of valve.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:
   1. Protect internal parts against rust and corrosion.
   2. Protect threads, flange faces, and weld ends.
   3. Set valves open to minimize exposure of functional surfaces.

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 operating handles or stems as lifting or rigging points.

D. Protect flanges and specialties from moisture and dirt.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. UL Listed: Valves shall be listed in UL's "Online Certifications Directory" under the headings listed below and shall bear UL mark:
   1. Main Level: HAMV - Fire Main Equipment.
      a. Level 1: HCBZ - Indicator Posts, Gate Valve.
      b. Level 1: HLOT - Valves.
         1) Level 3: HLUG - Ball Valves, System Control.
         2) Level 3: HLXS - Butterfly Valves.
         3) Level 3: HMER - Check Valves.
         4) Level 3: HMRZ - Gate Valves.
   2. Main Level: VDGT - Sprinkler System & Water Spray System Devices.
      a. Level 1: VQGU - Valves, Trim and Drain.

B. FM Global Approved: Valves shall be listed in its "Approval Guide," under the headings listed below:
   1. Automated Sprinkler Systems:
      a. Indicator posts.
      b. Valves.
         1) Gate valves.
         2) Check valves.
            a) Single check valves.
         3) Miscellaneous valves.

C. Source Limitations for Valves: Obtain valves for each valve type from single manufacturer.

D. ASME Compliance:
   1. ASME B16.1 for flanges on iron valves.
   2. ASME B1.20.1 for threads for threaded-end valves.
   3. ASME B31.9 for building services piping valves.

E. AWWA Compliance: Comply with AWWA C606 for grooved-end connections.

F. NFPA Compliance: Comply with NFPA 24 for valves.

G. Valve Pressure Ratings: Not less than the minimum pressure rating indicated or higher as required by system pressures.

H. Valve Sizes: Same as upstream piping unless otherwise indicated.

I. Valve Actuator Types:
   1. Worm-gear actuator with handwheel for quarter-turn valves, except for trim and drain valves.
   2. Handwheel: For other than quarter-turn trim and drain valves.
   3. Handlever: For quarter-turn trim and drain valves NPS 2 and smaller.

2.2 TWO-PIECE BALL VALVES WITH INDICATORS

A. Description:
   1. UL 1091, except with ball instead of disc and FM Global standard for indicating valves (butterfly or ball type), Class Number 1112.
   2. Minimum Pressure Rating: 175 psig.
   3. Body Design: Two piece.
   4. Body Material: Forged brass or bronze.
   5. Port Size: Full or standard.
   6. Seats: PTFE.
   7. Stem: Bronze or stainless steel.
   8. Ball: Chrome-plated brass.
   9. Actuator: Worm gear or traveling nut.
   10. Supervisory Switch: Internal or external.
   11. End Connections for Valves NPS 1 through NPS 2: Threaded ends.
   12. End Connections for Valves NPS 2-1/2: Grooved ends.

2.3 BRONZE BUTTERFLY VALVES WITH INDICATORS

A. Description:
   1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 1112.
   2. Minimum: Pressure rating: 175 psig.
   3. Body Material: Bronze.
   4. Seat Material: EPDM.
   5. Stem Material: Bronze or stainless steel.

6. Disc: Stainless steel.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Ends Connections for Valves NPS 1 through NPS 2: Threaded ends.
10. Ends Connections for Valves NPS 2-1/2: Grooved ends.

2.4 IRON BUTTERFLY VALVES WITH INDICATORS

A. Description:
1. Standard: UL 1091 and FM Global standard for indicating valves, (butterfly or ball type), Class Number 112.
2. Minimum Pressure Rating: 175 psig.
3. Body Material: Cast or ductile iron with nylon, EPDM, epoxy, or polyamide coating].
4. Seat Material: EPDM.
5. Stem: Stainless steel.
6. Disc: Ductile iron, nickel plated and EPDM or SBR coated.
7. Actuator: Worm gear or traveling nut.
8. Supervisory Switch: Internal or external.
9. Body Design: Lug.

2.5 CHECK VALVES

A. Description:
1. Standard: UL 312 and FM Global standard for swing check valves, Class Number 1210.
2. Minimum Pressure Rating: 175 psig.
3. Type: Single swing check.
4. Body Material: Cast iron, ductile iron, or bronze.
5. Clapper: Bronze, ductile iron, or stainless steel.
6. Clapper Seat: Brass, bronze, or stainless steel.
7. Hinge Shaft: Bronze or stainless steel.
8. Hinge Spring: Stainless steel.
9. End Connections: Flanged, grooved, or threaded.

2.6 BRONZE OS&Y GATE VALVES

A. Description:
1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Bronze or brass.
4. Wedge: One-piece bronze or brass.
5. Wedge Seat: Bronze.
6. Stem: Bronze or brass.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.

9. End Connections: Threaded.

2.7 IRON OS&Y GATE VALVES

A. Description:
1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron, or bronze.
5. Wedge Seat: Cast or ductile iron, or bronze.
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections: Flanged.

2.8 NRS GATE VALVES

A. Description:
1. Standard: UL 262 and FM Global standard for fire-service water control valves (OS&Y- and NRS-type gate valves).
2. Minimum Pressure Rating: 175 psig.
3. Body and Bonnet Material: Cast or ductile iron.
4. Wedge: Cast or ductile iron[with elastomeric coating].
5. Wedge Seat: Cast or ductile iron, or bronze[with elastomeric coating].
6. Stem: Brass or bronze.
7. Packing: Non-asbestos PTFE.
8. Supervisory Switch: External.
9. End Connections:[Flanged], [Grooved], and [Threaded].

2.9 TRIM AND DRAIN VALVES

A. Ball Valves:
1. Description:
a. Pressure Rating: 175 psig.
b. Body Design: Two piece.
c. Body Material: Forged brass or bronze.
d. Port size: Full or standard.
e. Seats: PTFE.
f. Stem: Bronze or stainless steel.
g. Ball: Chrome-plated brass.
h. Actuator: Handlever.
i. End Connections for Valves NPS 1 through NPS 2-1/2: Threaded ends.
j. End Connections for Valves NPS 1-1/4 and NPS 2-1/2: Grooved ends.

B. Angle Valves:
   1. Description:
      a. Pressure Rating: 175 psig.
      b. Body Material: Brass or bronze.
      c. Ends: Threaded.
      d. Stem: Bronze.
      e. Disc: Bronze.
      f. Packing: Asbestos free.
      g. Handwheel: Malleable iron, bronze, or aluminum.

C. Globe Valves:
   1. Description:
      a. Pressure Rating: 175 psig.
      b. Body Material: Bronze with integral seat and screw-in bonnet.
      c. Ends: Threaded.
      d. Stem: Bronze.
      e. Disc Holder and Nut: Bronze.
      f. Disc Seat: Nitrile.
      g. Packing: Asbestos free.
      h. Handwheel: Malleable iron, bronze, or aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE INSTALLATION

A. Comply with requirements in the following Sections for specific valve installation requirements and applications:
   1. Section 211100 "Facility Fire-Suppression Water-Service Piping" for application of

valves in fire-suppression water-service piping outside the building.

2. Section 211200 "Fire-Suppression Standpipes" for application of valves in fire-suppression standpipes.
3. Section 211313 "Wet-Pipe Sprinkler Systems" for application of valves in wet-pipe, fire-suppression sprinkler systems.

B. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Install valves having threaded connections with unions at each piece of equipment arranged to allow easy access, service, maintenance, and equipment removal without system shutdown. Provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above the pipe center.

F. Install valves in position to allow full stem movement.

G. Install valve tags. Comply with requirements in Section 210553 "Identification for Fire-Suppression Piping and Equipment" for valve tags and schedules and signs on surfaces concealing valves; and the NFPA standard applying to the piping system in which valves are installed. Install permanent identification signs indicating the portion of system controlled by each valve.

H. Install listed fire-protection shutoff valves supervised-open, located to control sources of water supply except from fire-department connections.

END OF SECTION

SECTION 210553

IDENTIFICATION FOR FIRE-SUPPRESSION PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Equipment-Label Schedule: Include a listing of all equipment to be labeled and the proposed content for each label.

PART 2 PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
2. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
3. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
4. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
5. Fasteners: Stainless-steel self-tapping screws.
6. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number,

Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to[partially cover] and [cover full] circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1/2 inch for viewing distances up to 72 inches and proportionately larger lettering for greater viewing distances.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of incompatible primers, paints, and encapsulants, as well as dirt, oil, grease, release agents, and other substances that could impair bond of identification devices.

3.2 LABEL INSTALLATION REQUIREMENTS

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be installed.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.

E. Piping: Painting of piping is specified in Section 099123 "Interior Painting."

F. Pipe-Label Locations: Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection excluding short takeoffs. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations and on through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit a view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 5 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

END OF SECTION

SECTION 211100

FACILITY FIRE-SUPPRESSION WATER-SERVICE PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes fire-suppression water-service piping installation for new fire suppression system in new building addition. Service shall be sized for new addition and existing building, though only new building addition will be sprinklered at this time.

D. Related Sections:
1. Division 21 Section "Fire-Suppression Standpipes" for fire-suppression standpipes inside the building.
2. Division 21 Section "Wet-Pipe Sprinkler Systems" for wet-pipe fire-suppression sprinkler systems inside the building.

1.2 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings:

C.
1. Wiring Diagrams: For power, signal, and control wiring.

D. Field quality-control reports.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

B.
1. Comply with standards of authorities having jurisdiction for fire-suppression water-service piping, including materials, hose threads, installation, and testing.

C. Piping materials shall bear label, stamp, or other markings of specified testing agency.

D. 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.

E. Comply with the "Approval Guide," published by FM Global, or UL's "Fire Protection Equipment Directory" for fire-service-main products.

F. NFPA Compliance: Comply with NFPA 24 for materials, installations, tests, flushing, and valve and hydrant supervision for fire-suppression water-service piping.

PART 2 PRODUCTS

2.1 DUCTILE-IRON PIPE AND FITTINGS

A. Grooved-Joint, Ductile-Iron Pipe: AWWA C151, with cut, rounded-grooved ends.

B. Grooved-End, Ductile-Iron Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. Star Pipe Products.
      c. Victaulic Company.
   2. Grooved-End, Ductile-Iron Fittings: ASTM A 47/A 47M, malleable-iron castings or ASTM A 536, ductile-iron castings with dimensions matching pipe.
   3. Grooved-End, Ductile-Iron-Piping Couplings: AWWA C606, for ductile-iron-pipe dimensions. Include ferrous housing sections, gasket suitable for water, and bolts and nuts.

C. Flanges: ASME B16.1, Class 125, cast iron.

2.2 SPECIAL PIPE FITTINGS

A. Ductile-Iron Flexible Expansion Joints:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. EBAA Iron, Inc.
      b. ROMAC Industries Inc.
      c. Star Pipe Products.
   2. Description: Compound, ductile-iron fitting with combination of flanged and mechanical-joint ends complying with AWWA C110 or AWWA C153. Include two gasketed ball-joint sections and one or more gasketed sleeve sections. Assemble components for offset and expansion indicated. Include AWWA C111, ductile-iron glands, rubber gaskets, and steel bolts.
   3. Pressure Rating: 250 psig minimum.

2.3 JOINING MATERIALS

A. Gaskets for Ferrous Piping and Copper-Alloy Tubing: ASME B16.21, asbestos free.

B. Brazing Filler Metals: AWS A5.8/A5.8M, BCuP Series.

2.4 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. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cascade Waterworks Manufacturing.
      b. Dresser, Inc.; Dresser Piping Specialties.
      c. Ford Meter Box Company, Inc. (The); Pipe Products Division.
      d. JCM Industries.
      e. ROMAC Industries Inc.
      f. Smith-Blair, Inc.; a Sensus company.
      g. Viking Johnson.
   2. 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.
   3. Standard: AWWA C219.
   4. Center-Sleeve Material: Manufacturer's standard.
   5. Gasket Material: Natural or synthetic rubber.
   6. Pressure Rating: 150 psig minimum.
   7. Metal Component Finish: Corrosion-resistant coating or material.

2.5 GATE VALVES

A. AWWA Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Cast Iron Pipe Company; American Flow Control Division.
      b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
      c. Crane Co.; Crane Valve Group; Stockham Division.
      d. Kennedy Valve; a division of McWane, Inc.
      e. Mueller Co.; Water Products Division.
      f. NIBCO INC.
      g. Tyler Pipe; a division of McWane, Inc.; Utilities Division.
      h. U.S. Pipe.
   2. Class 125, Bronze, Nonrising-Stem Gate Valves:
      a. Description: Class 125, Type 1; bronze with solid wedge and malleable-iron handwheel.
      b. Standard: MSS SP-80.

c. Pressure Rating: 200 psig (1380 kPa).
d. End Connections: Solder joint or threaded.

B. UL-Listed or FM-Approved Gate Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
2.
a. Crane Co.; Crane Valve Group; Jenkins Valves.
b. Crane Co.; Crane Valve Group; Stockham Division.
c. Hammond Valve.
d. Kennedy Valve; a division of McWane, Inc.
e. Milwaukee Valve Company.
f. Mueller Co.; Water Products Division.
g. NIBCO INC.
h. Tyco Fire & Building Products LP.
i. U.S. Pipe.
j. Watts Water Technologies, Inc.
3. UL-Listed or FM-Approved, OS&Y Bronze, Gate Valves:
a. Manufacturers: Subject to compliance with requirements, provide products by one of the following include:
1) Crane Co.; Crane Valve Group; Crane Valves.
2) Crane Co.; Crane Valve Group; Stockham Division.
3) Milwaukee Valve Company.
4) NIBCO INC.
b. Description: Bronze body and bonnet and bronze stem.
c. Standards: UL 262 and "Approval Guide," published by FM Global, listing.
d. Pressure Rating: 175 psig (1200 kPa) minimum.
e. End Connections: Threaded.

2.6 CHECK VALVES

A. UL-Listed or FM-Approved Check Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Kennedy Valve; a division of McWane, Inc.
b. Mueller Co.; Water Products Division.
c. Victaulic Company.
d. Viking Corporation.
e. Watts Water Technologies, Inc.
2. Description: Swing-check type with pressure rating, rubber-face checks unless otherwise indicated, and ends matching piping.
3. Standards: UL 312 and "Approval Guide," published by FM Global, listing.
4. Pressure Rating: 175 psig.

2.7 DETECTOR CHECK VALVES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Kennedy Valve; a division of McWane, Inc.
   2. Mueller Co.; Hersey Meters Division.
   3. Victaulic Company.
   4. Viking Corporation.
   5. Watts Water Technologies, Inc.

B. Description: Galvanized cast-iron body, bolted cover with air-bleed device for access to internal parts, and flanged ends. Include one-piece bronze disc with bronze bushings, pivot, and replaceable seat. Include threaded bypass taps in inlet and outlet for bypass meter connection. Set valve to allow minimal water flow through bypass meter when major water flow is required.

C. Standards: UL 312 and "Approval Guide," published by FM Global, listing.

D. Pressure Rating: 175 psig.

E. Water Meter: AWWA C700, disc type, at least one-fourth size of detector check valve. Include meter, bypass piping, gate valves, check valve, and connections to detector check valve.

2.8 BACKFLOW PREVENTERS

A. Double-Check, Detector-Assembly Backflow Preventers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Fire & Waterworks; a division of Watts Water Technologies, Inc.
      b. Conbraco Industries, Inc.; Apollo Valves.
      c. Watts Water Technologies, Inc.
      d. Zurn Plumbing Products Group; Wilkins Water Control Products Division.
   2. Standards: ASSE 1048 and UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 5 psig maximum, through middle one-third of flow range.
   5. Size: 6 NPS.
   6. Body Material: Cast iron with interior lining complying with AWWA C550 or that is FDA approved.
   7. End Connections: Flanged.
   8. Configuration: Designed for horizontal, straight through flow.
   9. Accessories:
      a. Valves: UL 262, "Approval Guide," published by FM Global, listing, approved; OS&Y gate type with flanged ends on inlet and outlet.

2.9 ALARM DEVICES

A. General: UL 753 and "Approval Guide," published by FM Global, listing, of types and sizes to mate and match piping and equipment.

B. Water-Flow Indicators: Vane-type water-flow detector, rated for 250-psig working pressure; designed for horizontal or vertical installation; with two single-pole, double-throw circuit switches to provide isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field-adjustable retard element to prevent false signals and tamperproof cover that sends signal when cover is removed.

C. Supervisory Switches: Single pole, double throw; designed to signal valve in other than fully open position.

D. Pressure Switches: Single pole, double throw; designed to signal increase in pressure.

PART 3 EXECUTION

3.1 PIPING INSTALLATION

A. Comply with NFPA 24 for fire-service-main piping materials and installation.

B. Install copper tube and fittings according to CDA's "Copper Tube Handbook."

C. Comply with requirements in Division 21 Sections for fire-suppression-water piping inside the building.

D. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

3.2 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure rating same as or higher than systems pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in tubing NPS 2 and smaller.

C. Install flanges, flange adaptors, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of tubes and remove burrs.

E. Remove scale, slag, dirt, and debris from outside and inside of pipes, tubes, and fittings before assembly.

F. Ductile-Iron Piping, Gasketed Joints for Fire-Service-Main Piping: UL 194.

G. Ductile-Iron Piping, Grooved Joints: Cut-groove pipe. Assemble joints with grooved-end, ductile-iron-piping couplings, gaskets, lubricant, and bolts.

H. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with bolts according to ASME B31.9.

I. Dissimilar Materials Piping Joints: Use adapters compatible with both piping materials, with OD, and with system working pressure.

3.3 ANCHORAGE INSTALLATION

A. Anchorage, General: Install water-distribution piping with restrained joints.

B. Install anchorages for tees, plugs and caps, bends, crosses, valves, and hydrant branches in fire-suppression water-service piping according to NFPA 24 and the following:
   1. Gasketed-Joint, Ductile-Iron, Water-Service Piping: According to AWWA C600.

3.4 VALVE INSTALLATION

A. UL-Listed or FM-Approved 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.

B. MSS Valves: Install as component of connected piping system.

3.5 ALARM DEVICE INSTALLATION

A. General: Comply with NFPA 24 for devices and methods of valve supervision.

B. Supervisory Switches: Supervise valves in open position.
   1. Valves: Grind away portion of exposed valve stem. Bolt switch, with plunger in stem depression, to OS&Y gate-valve yoke.

C. Locking and Sealing: Secure unsupervised valves as follows:
   1. Valves: Install chain and padlock on open OS&Y gate valve.
   2. Post Indicators: Install padlock on wrench on indicator post.

D. Pressure Switches: Drill and thread hole in exposed barrel of fire hydrant. Install switch.

E. Water-Flow Indicators: Install in water-service piping in vault. Select indicator with saddle and vane matching pipe size. Drill hole in pipe, insert vane, and bolt saddle to pipe.

F. Connect alarm devices to building's fire-alarm system.

3.6 CONNECTIONS

A. Connect fire-suppression water-service piping to interior fire-suppression piping.

3.7 FIELD QUALITY CONTROL

A. Use test procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described below.

B. Piping Tests: Conduct piping tests before joints are covered and after concrete thrust blocks have hardened sufficiently. Fill pipeline 24 hours before testing and apply test pressure to stabilize system. Use only potable water.

C. Hydrostatic Tests: Test at not less than one-and-one-half times the working pressure for two hours.
   1. Increase pressure in 50-psig increments and inspect each joint between increments. Hold at test pressure for one hour; decrease to 0 psig. Slowly increase again to test pressure and hold for one more hour. Maximum allowable leakage is 2 quarts per hour per 100 joints. Remake leaking joints with new materials and repeat test until leakage is within allowed limits.

D. Prepare test and inspection reports.

3.8 IDENTIFICATION

A. Permanently attach equipment nameplate or marker indicating plastic fire-suppression water-service piping or fire-suppression water-service piping with electrically insulated fittings, on main electrical meter panel. Comply with requirements for identifying devices in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.9 CLEANING

A. Clean fire-suppression water-service piping as follows:
   1. Purge new piping systems and parts of existing systems that have been altered, extended, or repaired before use.
   2. Use purging procedure prescribed by authorities having jurisdiction or, if method is not prescribed by authorities having jurisdiction, use procedure described in NFPA 24 for flushing of piping. Flush piping system with clean, potable water until dirty water does not appear at points of outlet.

B. Prepare reports of purging activities.

END OF SECTION

SECTION 211313

WET-PIPE SPRINKLER SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Pipes, fittings, and specialties.
2. Fire-protection valves.
3. Fire-department connections.
4. Sprinklers.
5. Alarm devices.
6. Pressure gages.

1.2 SYSTEM DESCRIPTIONS AND REQUIREMENTS

A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water and that is connected to water supply through alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts fusible link or destroys frangible device. Hose connections are included if indicated.

B. All concealed sprinkler heads caps shall be a specific color as chosen by Architect.

1.3 PERFORMANCE REQUIREMENTS

A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Sprinkler system design shall be approved by authorities having jurisdiction.
1. Margin of Safety for Available Water Flow and Pressure: 10 percent, including losses through water-service piping, valves, and backflow preventers.
2. Sprinkler Occupancy Hazard Classifications:
   a. Building Service Areas: Ordinary Hazard, Group 1.
   b. Electrical Equipment Rooms: Ordinary Hazard, Group 1.
   c. General Storage Areas: Ordinary Hazard, Group 1.
   d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
   e. Office and Public Areas: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:

4.
   a. Light-Hazard Occupancy: 0.10 gpm over 1500-sq. ft. area.
   b. Ordinary-Hazard, Group 1 Occupancy: 0.15 gpm over 1500-sq. ft. area.
5. Maximum Protection Area per Sprinkler: Per UL listing.
6. Maximum Protection Area per Sprinkler:
   a. Office Spaces: 225 sq. ft.
   b. Storage Areas: 130 sq. ft.
   c. Mechanical Equipment Rooms: 130 sq. ft.
   d. Electrical Equipment Rooms: 130 sq. ft.
   e. Other Areas: According to NFPA 13 recommendations unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For wet-pipe sprinkler systems. Include plans, elevations, sections, details, and attachments to other work.
   1. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For sprinkler 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.

D. Qualification Data: For qualified Installer and professional engineer.

E. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction, including hydraulic calculations if applicable.

F. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13. Include "Contractor's Material and Test Certificate for Aboveground Piping."

G. Field quality-control reports.

H. Operation and maintenance data.

1.5 QUALITY ASSURANCE

A. Installer Qualifications:
   1. Installer's responsibilities include designing, fabricating, and installing sprinkler systems and providing professional engineering services needed to assume engineering responsibility. Base calculations on results of fire-hydrant flow test.
      a. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer.

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.

C. NFPA Standards: Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:
   1. NFPA 13, "Installation of Sprinkler Systems."

PART 2 PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, and fitting materials, and for joining methods for specific services, service locations, and pipe sizes.

2.2 STEEL PIPE AND FITTINGS

A. Standard Weight, Galvanized-Steel Pipe: ASTM A 53/A 53M, Type E, Grade B. Pipe ends may be factory or field formed to match joining method.

B. Schedule 10, Grooved End Steel Pipe: ASTM A 135 or ASTM A 795/A 795M, Schedule 10 in NPS 5 and smaller; and NFPA 13-specified wall thickness in NPS 6 to NPS 10 with factory or field formed, roll grooved ends.

C. Galvanized-Steel Pipe Nipples: ASTM A 733, made of ASTM A 53/A 53M, standard-weight, seamless steel pipe with threaded ends.

D. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.

E. Grooved-Joint, Steel-Pipe Appurtenances:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. Corcoran Piping System Co.
      c. National Fittings, Inc.
      d. Tyco Fire & Building Products LP.
      e. Victaulic Company.
   2. Pressure Rating: 175 psig minimum.
   3. Galvanized, Grooved-End Fittings for Steel Piping: ASTM A 47/A 47M, malleable-iron casting or ASTM A 536, ductile-iron casting; with dimensions matching steel pipe.
   4. Grooved-End-Pipe Couplings for Steel Piping: AWWA C606 and UL 213, rigid pattern, unless otherwise indicated, for steel-pipe dimensions. Include ferrous housing sections, EPDM-rubber gasket, and bolts and nuts.

F. Steel Pressure-Seal Fittings: UL 213, FM-approved, 175-psig pressure rating with steel housing, rubber O-rings, and pipe stop; for use with fitting manufacturers' pressure-seal tools.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Victaulic Company.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick.
   1. Class 125, Cast-Iron Flat-Face Flanges: Full-face gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

2.4 LISTED FIRE-PROTECTION VALVES

A. General Requirements:
   1. Valves shall be UL listed or FM approved.
   2. Minimum Pressure Rating: 175 psig.

B. Check Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2.
      a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Metraflex, Inc.
      d. NIBCO INC.
      e. Reliable Automatic Sprinkler Co., Inc.
      f. Tyco Fire & Building Products LP.
      g. Victaulic Company.
      h. Viking Corporation.
      i. Watts Water Technologies, Inc.
   3. Standard: UL 312.
   4. Pressure Rating: 250 psig minimum.
   5. Type: Swing check.
   6. Body Material: Cast iron.
   7. End Connections: Flanged or grooved.

C. Iron OS&Y Gate Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Cast Iron Pipe Company; Waterous Company Subsidiary.
      b. American Valve, Inc.
      c. Crane Co.; Crane Valve Group; Crane Valves.
      d. Hammond Valve.
      e. Milwaukee Valve Company.
      f. Mueller Co.; Water Products Division.
      g. NIBCO INC.
      h. Tyco Fire & Building Products LP.
      i. United Brass Works, Inc.
      j. Watts Water Technologies, Inc.
   2. Standard: UL 262.
   3. Pressure Rating: 250 psig minimum.
   4. Body Material: Cast or ductile iron.
   5. End Connections: Flanged or grooved.

D. Indicating-Type Butterfly Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. Global Safety Products, Inc.
      c. Kennedy Valve; a division of McWane, Inc.
      d. Milwaukee Valve Company.
      e. NIBCO INC.
      f. Tyco Fire & Building Products LP.
      g. Victaulic Company.
   2. Standard: UL 1091.
   3. Pressure Rating: 175 psig minimum.
   4. Valves NPS 2 and Smaller:
      a. Valve Type: Ball or butterfly.
      b. Body Material: Bronze.
      c. End Connections: Threaded.
   5. Valves NPS 2-1/2 and Larger:
      a. Valve Type: Butterfly.
      b. Body Material: Cast or ductile iron.
      c. End Connections: Flanged, grooved, or wafer.
   6. Valve Operation: Integral electrical, 115-V ac, prewired, single-circuit, supervisory switch indicating device.

2.5 TRIM AND DRAIN VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   2. Minimum Pressure Rating: 175 psig.

B. Ball Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   2.
      a. Conbraco Industries, Inc.; Apollo Valves.
      b. Kennedy Valve; a division of McWane, Inc.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Potter Roemer.
      f. Tyco Fire & Building Products LP.
      g. Victaulic Company.
      h. Watts Water Technologies, Inc.

2.6 SPECIALTY VALVES

A. General Requirements:
   1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.

2. Minimum Pressure Rating: 175 psig (1200 kPa).
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Alarm Valves:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   b. Globe Fire Sprinkler Corporation.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
   f. Victaulic Company.
   g. Viking Corporation.
2. Standard: UL 193.
3. Design: For horizontal or vertical installation.
4. Include trim sets for bypass, drain, electrical sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
5. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

2.7 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. AFAC Inc.
   b. Elkhart Brass Mfg. Company, Inc.
   c. GMR International Equipment Corporation.
   d. Guardian Fire Equipment, Inc.
   e. Potter Roemer.
2. Standard: UL 405.
3. Type: Flush, for wall mounting. To be approved by the local Fire Company.
4. Pressure Rating: 175 psig minimum.
5. Body Material: Corrosion-resistant metal.
6. Inlets: Brass with threads according to NFPA 1963 and matching local fire-department sizes and threads. Include extension pipe nipples, brass lugged swivel connections, and check devices or clappers.
7. Caps: Brass, lugged type, with gasket and chain.
8. Escutcheon Plate: Rectangular, brass, wall type.
9. Outlet: With pipe threads.
10. Body Style: Horizontal.
11. Number of Inlets: Two.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR & STANDPIPE."
14. Finish: Polished chrome plated.
15. Outlet Size: NPS 4 or as requested by the local Fire Company.

2.8 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Anvil International, Inc.
      b. National Fittings, Inc.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.
   2. Standard: UL 213.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Ductile-iron housing with EPDM seals and bolts and nuts.
   5. Type: Mechanical-T and -cross fittings.
   6. Configurations: Snap-on and strapless, ductile-iron housing with branch outlets.
   7. Size: Of dimension to fit onto sprinkler main and with outlet connections as required to match connected branch piping.
   8. Branch Outlets: Grooved, plain-end pipe, or threaded.

B. Branch Line Testers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Elkhart Brass Mfg. Company, Inc.
      b. Fire-End & Croker Corporation.
      c. Potter Roemer.
   2. Standard: UL 199.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Brass.
   5. Size: Same as connected piping.
   6. Inlet: Threaded.
   7. Drain Outlet: Threaded and capped.
   8. Branch Outlet: Threaded, for sprinkler.

C. Sprinkler Inspector's Test Fittings:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. AGF Manufacturing Inc.
      b. Triple R Specialty.
      c. Tyco Fire & Building Products LP.
      d. Victaulic Company.
      e. Viking Corporation.
   2. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
   3. Pressure Rating: 175 psig minimum.
   4. Body Material: Cast- or ductile-iron housing with sight glass.
   5. Size: Same as connected piping.
   6. Inlet and Outlet: Threaded.

D. Adjustable Drop Nipples:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

a. CECA, LLC.
b. Corcoran Piping System Co.
c. Merit Manufacturing; a division of Anvil International, Inc.

2. Standard: UL 1474.
3. Pressure Rating: 250 psig minimum.
4. Body Material: Steel pipe with EPDM-rubber O-ring seals.
5. Size: Same as connected piping.
6. Length: Adjustable.
7. Inlet and Outlet: Threaded.

E. Flexible, Sprinkler Hose Fittings:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
a. Fivalco Inc.
b. FlexHead Industries, Inc.
c. Gateway Tubing, Inc.
2. Standard: UL 1474.
3. Type: Flexible hose for connection to sprinkler, and with bracket for connection to ceiling grid.
4. Pressure Rating: 175 psig minimum.
5. Size: Same as connected piping, for sprinkler.

2.9 SPRINKLERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. AFAC Inc.
2. Globe Fire Sprinkler Corporation.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Victaulic Company.
6. Viking Corporation.

B. General Requirements:
1. Standard: UL's "Fire Protection Equipment Directory" listing or "Approval Guide," published by FM Global, listing.
2. Pressure Rating for Automatic Sprinklers: 175 psig minimum.

C. Sprinkler Finishes:
1. Chrome plated.
2. Bronze.
3. Painted.

D. Special Coatings:
1. Wax.
2. Lead.
3. Corrosion-resistant paint.

E. Sprinkler Escutcheons: Materials, types, and finishes for the following sprinkler mounting applications. Escutcheons for concealed, flush, and recessed-type sprinklers are specified with sprinklers.
   1. Ceiling Mounting: Plastic, white finish, one piece, flat.
   2. Sidewall Mounting: Plastic, white finish, one piece, flat.

F. Sprinkler Guards:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Reliable Automatic Sprinkler Co., Inc.
      b. Tyco Fire & Building Products LP.
      c. Victaulic Company.
      d. Viking Corporation.
   2. Standard: UL 199.
   3. Type: Wire cage with fastening device for attaching to sprinkler.

PART 3 EXECUTION

3.1 WATER-SUPPLY CONNECTIONS

A. Connect new sprinkler piping to building's sprinkler service array. Reconfigure service as required to accommodate new wet zone(s) system.

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans, schematics, and diagrams indicate general location and arrangement of piping. Install piping as indicated, as far as practical.
   1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

B. Piping Standard: Comply with requirements for installation of sprinkler piping in NFPA 13.

C. Install seismic restraints on piping. Comply with requirements for seismic-restraint device materials and installation in NFPA 13.

D. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller.

F. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

G. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to NFPA 13. Comply with requirements for hanger materials in NFPA 13.

L. Install pressure gages on riser or feed main, at each sprinkler test connection, and at top of each standpipe. Include pressure gages with connection not less than NPS 1/4 and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal, and install where they will not be subject to freezing.

M. Fill sprinkler system piping with water.

N. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

O. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 21 Section "Sleeves and Sleeve Seals for Fire-Suppression Piping."

P. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 21 Section "Escutcheons for Fire-Suppression Piping."

3.3 JOINT CONSTRUCTION

A. Install couplings, flanges, flanged fittings, unions, nipples, and transition and special fittings that have finish and pressure ratings same as or higher than system's pressure rating for aboveground applications unless otherwise indicated.

B. Install unions adjacent to each valve in pipes NPS 2 and smaller.

C. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

D. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

E. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

F. Flanged Joints: Select appropriate gasket material in size, type, and thickness suitable for water service. Join flanges with gasket and bolts according to ASME B31.9.

G. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

H. Twist-Locked Joints: Insert plain end of steel pipe into plain-end-pipe fitting. Rotate retainer lugs one-quarter turn or tighten retainer pin.

I. Steel-Piping, Pressure-Sealed Joints: Join lightwall steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.
   1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

J. Steel-Piping, Cut-Grooved Joints: Cut square-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe joints.

K. Steel-Piping, Roll-Grooved Joints: Roll rounded-edge groove in end of pipe according to AWWA C606. Assemble coupling with housing, gasket, lubricant, and bolts. Join steel pipe and grooved-end fittings according to AWWA C606 for steel-pipe grooved joints.

L. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to NFPA 13 and authorities having jurisdiction.

B. Install listed fire-protection shutoff valves supervised open, located to control sources of water supply except from fire-department connections. Install permanent identification signs indicating portion of system controlled by each valve.

C. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.
   2. Alarm Valves: Include bypass check valve and retarding chamber drain-line connection.

3.5 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

B. Install sprinklers into flexible, sprinkler hose fittings and install hose into bracket on ceiling grid.

3.6 FIRE-DEPARTMENT CONNECTION INSTALLATION

A. Install wall-type, fire-department connections.

B. Install automatic (ball drip) drain valve at each check valve for fire-department connection.

3.7 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Division 26 Section "Identification for Electrical Systems."

3.8 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
1. Leak Test: After installation, charge systems and test for leaks. Repair leaks and retest until no leaks exist.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Flush, test, and inspect sprinkler systems according to NFPA 13, "Systems Acceptance" Chapter.
4. Energize circuits to electrical equipment and devices.
5. Coordinate with fire-alarm tests. Operate as required.
6. Coordinate with fire-pump tests. Operate as required.
7. Verify that equipment hose threads are same as local fire-department equipment.

C. Sprinkler piping system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.9 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.10 PIPING SCHEDULE

A. Sprinkler specialty fittings may be used, downstream of control valves, instead of specified fittings.

B. Wet-pipe sprinkler system, NPS 2 and smaller, shall be one of the following:
   1. Standard-weight schedule 40, black-steel pipe with threaded ends; uncoated, gray-iron threaded fittings; and threaded joints.

C. Standard-pressure, wet-pipe sprinkler system, NPS 2-1/2 to NPS 4, shall be one of the following:

D.
   1. Standard-weight schedule 10, black-steel pipe with cut-or roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.

3.11 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
   1. Rooms without Ceilings: Upright sprinklers.
   2. Rooms with Suspended Ceilings: Concealed sprinklers.
   3. Wall Mounting: Sidewall sprinklers.
   4. Spaces Subject to Freezing: Upright sprinklers.
   5. Special Applications: Extended-coverage, flow-control, and quick-response sprinklers where indicated.

B. Provide sprinkler types in subparagraphs below with finishes indicated.
   1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
   2. Upright Pendent and Sidewall Sprinklers: Chrome plated in finished spaces exposed to view; rough bronze in unfinished spaces not exposed to view; wax coated where exposed to acids, chemicals, or other corrosive fumes.

END OF SECTION

SECTION 220000

PLUMBING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

1.3 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a (1) one year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect.

1.4 DEFINITIONS

A. For a complete list of definitions for this contract refer to the Division 1 specifications.

B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.5 SCOPE OF WORK

A. The following description of work will use the following abbreviations:
   1. General Contractor - GC.
   2. Electrical Contractor - EC.
   3. Mechanical Contractor (HVAC) - MC.
   4. Plumbing Contractor - PC.

B. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the mechanical work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:
   1. For detailed scope of work for each plumbing system, refer to the respective Division 22 specification section.
   2. Demolition and removal of fixtures and equipment as outlined in contract drawings.
   3. Demolition and removal of all domestic hot and cold water and sanitary and vent piping as indicated on contract drawings.
   4. Provide all plumbing fixtures, clean outs, access panels, sanitary waste and vent piping, domestic hot, cold and recirculation piping, hangers, supports, and controls as needed. Reconnect domestic hot and cold piping and sanitary and vent piping to existing piping where indicated.
   5. Coordinate with GC, MC, and EC for the installation of all domestic water, sanitary and vent piping to ensure proper elevations, clearances, installation schedules, excavations & backfill, is performed in an orderly fashion.
   6. Provide insulation of all plumbing equipment and piping.
   7. Connect new sanitary line to new vents up through roof as shown on drawings.
   8. Refer to Architectural Phasing plans and specifications for requirements related to construction phasing and work hours.
   9. Providing all necessary permits, approvals, fees, etc.
   10. Provide instructions to the owner as outlined in these Specifications.
   11. Provide all cutting and patching as required to perform the work of this contract.
   12. Provide all necessary rigging as required to perform the work of this contract.
   13. Provide manufacturer startup for all systems specified as outlined in these Specifications.
   14. Provide removal of trash and general clean-up.
   15. Provide as-built drawings.
   16. Provide operation and maintenance manuals.
   17. Completion Date: All plumbing work shall be completed on the date of substantial completion for the project as set in the Division 1 specifications.

C. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.

D. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the electrical work as indicated, required or implied by the drawings and as specified herein.

E. All of the specifications listed and all of the drawings listed are part of the Contract Documents of the Contractor. The Contractor shall review all drawings and specification divisions to determine the full scope of his work.

F. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Structural, Mechanical, Electrical, Plumbing, and Fire Protection) to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be

considered an indication that all work, in compliance with these specifications and the drawings, has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

G. Coordination between the Plumbing Contractor and Electrical Contractor:
   1. The Electrical Contractor shall:
      a. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
      b. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the Plumbing system and as required by the National Electrical Code, or as shown on the drawings, or as specified.
   2. The Plumbing Contractor will:
      a. Furnish and set all motors for equipment provided as part of the Plumbing contract.
      b. Furnish all motor starters, contactors, pushbuttons and switches for local and remote control of Plumbing equipment that is not provided by the Electrical Contractor and turn over to the Electrical Contractor for installation. Combination starters shall be furnished for individual (not attached to the equipment) and for packaged equipment regardless if specified or not in the respective sections of the specification.
      c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strips.
      d. Provide all-control wiring for all equipment, including all 120 V. controls. Only power supply connection to the equipment will be by the Electrical Contractor.

1.6 WARRANTY

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of “Substantial Completion.”.

B. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this School shall include a warranty on parts and labor. The duration of this warranty shall be as noted in paragraph 1.2.A above. This warranty shall supersede all notations in all the other Division 22 specification sections where warranties are shorter than the duration as noted in paragraph 1.2.A above.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 220500

COMMON WORK RESULTS FOR PLUMBING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Transition fittings.
3. Dielectric fittings.
4. Mechanical sleeve seals.
5. Sleeves.
6. Escutcheons.
7. Grout.
8. Plumbing demolition.
9. Equipment installation requirements common to equipment sections.
10. Painting and finishing.
11. Concrete bases.
12. Supports and anchorages.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by

building occupants. Examples include above ceilings and in chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. ABS: Acrylonitrile-butadiene-styrene plastic.
   2. CPVC: Chlorinated polyvinyl chloride plastic.
   3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for plumbing installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for plumbing items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   1. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 22 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 22 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 TRANSITION FITTINGS

A. AWWA Transition Couplings: Same size as, and with pressure rating at least equal to and with ends compatible with, piping to be joined.

1. Available Manufacturers:
   a. Cascade Waterworks Mfg. Co.
   b. Dresser Industries, Inc.; DMD Div.
   c. Ford Meter Box Company, Incorporated (The); Pipe Products Div.
   d. JCM Industries.
   e. Smith-Blair, Inc.
   f. Viking Johnson.
   g. Or approved equal.
2. Underground Piping NPS 1-1/2 and Smaller: Manufactured fitting or coupling.
3. Underground Piping NPS 2 and Larger: AWWA C219, metal sleeve-type coupling.
4. Aboveground Pressure Piping: Pipe fitting.

2.5 DIELECTRIC FITTINGS

A. Description: Combination of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.

1. Available Manufacturers:
   a. Capitol Manufacturing Co.
   b. Central Plastics Company.
   c. Eclipse, Inc.
   d. Epco Sales, Inc.
   e. Hart Industries, International, Inc.
   f. Watts Industries, Inc.; Water Products Div.
   g. Zurn Industries, Inc.; Wilkins Div.
   h. Or approved equal.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
   1. Available Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Epco Sales, Inc.
      d. Watts Industries, Inc.; Water Products Div.
      e. Or approved equal.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Available Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
      e. Or approved equal.
   2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
   1. Available Manufacturers:
      a. Perfection Corp.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Co., Inc.
      d. Victaulic Co. of America.
      e. Or approved equal.

2.6 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Available Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
      e. Or approved equal.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
   3. Pressure Plates: Carbon steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.7 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.

B. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

D. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.

E. PVC Pipe: ASTM D 1785, Schedule 40.

F. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.8 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Polished chrome-plated.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.9 GROUT

A. Description: ASTM C 1107, Grade B, no shrink and non-metallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive, nongaseous, and recommended for interior and exterior applications.

2. Design Mix: 5000-psi, 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 PLUMBING DEMOLITION

A. Refer to Division 01 Section "Cutting and Patching" and Division 02 Section "Selective Structure Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove plumbing systems, equipment, and components indicated to be removed.
   1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
   2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
   3. Equipment to Be Removed: Disconnect and cap services and remove equipment.
   4. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
   5. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 22 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece or split-casting, cast-brass type with polished chrome-plated finish.
      g. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
      h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
      i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed hinge and set screw or spring clips.
      j. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
      k. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw or spring clips.
      l. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
   2. Existing Piping: Use the following:
      a. Chrome-Plated Piping: Split-casting, cast-brass type with chrome-plated finish.
      b. Insulated Piping: Split-plate, stamped-steel type with concealed hinge and spring clips.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and spring clips.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
      f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
      g. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
      h. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
      i. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.

j. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
k. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
1. Cut sleeves to length for mounting flush with both surfaces.
a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
1) Seal space outside of sleeve fittings with grout.
4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
   4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install plumbing equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. 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 the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement as specified in Division 03 Section "Cast-in-Place Concrete."

3.8 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.9 GROUTING

A. Mix and install grout for plumbing equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

END OF SECTION

SECTION 220523

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Bronze ball valves.
2. Bronze swing check valves.

D. Related Sections:
1. Division 22 plumbing piping Sections for specialty valves applicable to those Sections only.
2. Division 22 Section "Identification for Plumbing Piping and Equipment" for valve tags and schedules.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. NRS: Non-rising stem.

E. RS: Rising stem.

F. SWP: Steam working pressure.

1.4 SUBMITTALS

A. Product Data: For each type of valve indicated.

1.5 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 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 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 ball and plug valves open to minimize exposure of functional surfaces.
4. Set butterfly valves closed or slightly open.

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.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valve Actuator Types:
1. Gear Actuator: For quarter-turn valves NPS 8 and larger.
2. Handwheel: For valves other than quarter-turn types.
3. Handlever: For quarter-turn valves NPS 6 and smaller except plug valves.
4. Wrench: For plug valves with square heads. Furnish Owner with 1 wrench for every plug valves, for each size square plug-valve head.

E. Valves in Insulated Piping: With 2-inch stem extensions and the following features:
   1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
   2. Butterfly Valves: With extended neck.

F. 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.

G. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Stainless-Steel Trim:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.; Apollo Valves.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Milwaukee Valve Company.
      d. NIBCO INC.
      e. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
      f. Or approved equal.
   2. Description:
      a. Standard: MSS SP-110.
      b. SWP Rating: 150 psig.
      c. CWP Rating: 600 psig.
      d. Body Design: Two piece.
      e. Body Material: Bronze.
      f. Ends: Threaded.
      g. Seats: PTFE or TFE.
      h. Stem: Stainless steel.
      i. Ball: Stainless steel, vented.
      j. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 150, Bronze Swing Check Valves with Bronze Disc:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. American Valve, Inc.
      b. Crane Co.; Crane Valve Group; Crane Valves.
      c. Crane Co.; Crane Valve Group; Stockham Division.
      d. Milwaukee Valve Company.
      e. NIBCO INC.

f. Or approved equal.

2. Description:
   a. Standard: MSS SP-80, Type 3.
   b. CWP Rating: 300 psig.
   c. Body Design: Horizontal flow.
   d. Body Material: ASTM B 62, bronze.
   e. Ends: Threaded.
   f. Disc: Bronze.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball valves.
   2. Throttling Service: Ball valves.
   3. Pump-Discharge Check Valves:
      a. Bronze swing check valves with bronze disc.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:
   1. For Copper Tubing: Threaded ends except where solder-joint valve-end option is indicated in valve schedules below.

3.5 DOMESTIC, HOT- AND COLD-WATER VALVE SCHEDULE

A. Bronze Valves: May be provided with solder-joint ends instead of threaded ends.

B. Ball Valves: Two-piece, full port, bronze with stainless-steel ball and trim.

C. Check Valves: Bronze swing type with bronze disk.

END OF SECTION

SECTION 220529

HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following hangers and supports for plumbing system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Thermal-hanger shield inserts.
   4. Fastener systems.
   5. Equipment supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.
   4. Pipe positioning systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze pipe hangers. Include Product Data for components.
   2. Metal framing systems. Include Product Data for components.
   3. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code--Reinforcing Steel."

B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   2. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   3. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.1 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 of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Available Manufacturers:
   1. AAA Technology & Specialties Co., Inc.
   2. B-Line Systems, Inc.; a division of Cooper Industries.
   3. ERICO/Michigan Hanger Co.
   4. Grinnell Corp.

5. GS Metals Corp.
6. National Pipe Hanger Corporation.
7. PHD Manufacturing, Inc.
8. PHS Industries, Inc.
9. Or approved equal.

C. Galvanized, Metallic Coatings: Pre-galvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig- minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Available Manufacturers:
1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.
3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Value Engineered Products, Inc.
6. Or approved equal.

C. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

D. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

E. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Available Manufacturers:
a. Hilti, Inc.
b. ITW Ramset/Red Head.

c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.
f. Or approved equal.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc-coated steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Available Manufacturers:
a. B-Line Systems, Inc.; a division of Cooper Industries.
b. Empire Industries, Inc.
c. Hilti, Inc.
d. ITW Ramset/Red Head.
e. MKT Fastening, LLC.
f. Powers Fasteners.
g. Or approved equal.

2.6 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.7 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in

direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
   2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
   3. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 6, to allow off-center closure for hanger installation before pipe erection.
   4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 6.
   5. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 6.
   6. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 6, from 2 rods if longitudinal movement caused by expansion and contraction might occur.
   7. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 6, from single rod if horizontal movement caused by expansion and contraction might occur.
   8. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 6, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
   9. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 6, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
   10. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 6, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 6.
   2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 6, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
   2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
   3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
   4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
   5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
   2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
   3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
   4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
   5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
   6. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
   7. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
   8. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
   9. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
   10. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
   11. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
      a. Light (MSS Type 31): 750 lb.
      b. Medium (MSS Type 32): 1500 lb.
      c. Heavy (MSS Type 33): 3000 lb.
   12. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
   13. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
   14. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
   2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
   3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
   1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
   2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
   3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
   4. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
   5. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit

variability factor to 25 percent to absorb expansion and contraction of piping system from base support.

6. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.

L. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

M. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

N. Use powder-actuated fastener or mechanical-expansion anchors instead of building attachments where required in concrete construction.

O. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

3.2 HANGER AND SUPPORT INSTALLATION

A. Steel Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.

B. Trapeze Pipe Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Positioning System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture. Refer to Division 22 Section "Plumbing Fixtures" for plumbing fixtures.

G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.

H. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

J. Install lateral bracing with pipe hangers and supports to prevent swaying.

K. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

L. Load Distribution: Install hangers and supports so piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

M. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9 (for building services piping) are not exceeded.

N. Insulated Piping: Comply with the following:
   1. Attach clamps and spacers to piping.
      a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
      b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
      c. Do not exceed pipe stress limits according to ASME B31.9 for building services piping.
   2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.
      a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
   4. Shield Dimensions for Pipe: Not less than the following:
      a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
      b. NPS 4: 12 inches long and 0.06 inch thick.
      c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
      d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
      e. NPS 16 to NPS 24: 24 inches long and 0.105 inch thick.
   5. Insert Material: Length at least as long as protective shield.
   6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.4 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

3.6 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 220553

IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Valve tags.
5. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

C. Valve numbering scheme.

D. Valve Schedules: For each piping system to include in maintenance manuals.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Brass, 0.032-inch minimum thickness, and predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   4. Fasteners: Stainless-steel rivets or self-tapping screws.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and predrilled holes for attachment hardware.
   2. Letter Color: White.
   3. Background Color: Black.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

E. Pipe Label Color Schedule:
   1. Domestic Water Piping.
      a. Background: Safety green.
      b. Letter Colors: White.
   2. Sanitary Waste and Storm Drainage Piping:
      a. Background Color: Safety black.

b. Letter Color: White.
3. Natural Gas Piping:
a. Background Color: Safety yellow.
b. Letter Color: Black.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
1. Tag Material: Brass, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
2. Fasteners: Brass wire-link or beaded chain; or S-hook.

B. Valve Schedules: For each piping system, on 8-1/2-by-11-inch bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. The Valve-tag schedule shall be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:
   1. Valve-Tag Size and Shape:
      a. Cold Water: 1-1/2 inches round.
      b. Hot Water: 1-1/2 inches round.
      c. Natural Gas: 1-1/2 inches round.
   2. Valve-Tag Color:
      a. Cold Water: Green.
      b. Hot Water: Green.
      c. Natural Gas: Yellow.
   3. Letter Color:
      a. Cold Water: White.
      b. Hot Water: White.
      c. Natural Gas: Black.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 220700

PLUMBING PIPING INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes insulating the following plumbing piping services:
1. Domestic hot-water piping.
2. Domestic cold water piping.
3. Storm Water piping.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
3. Detail removable insulation at piping specialties, equipment connections, and access panels.
4. Detail application of field-applied jackets.

1.3 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed

index of 150 or less.

B. Comply with the following applicable standards and other requirements specified for miscellaneous components:
   1. Supply and Drain Protective Shielding Guards: ICC A117.1.

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General" and "Indoor Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Mineral-Fiber, Preformed Pipe Insulation: Type I, 850 Deg F Materials: Mineral or glass fibers bonded with a thermostatic resin. Comply with ASTM C 547, Type I, Grade A, without factory applied jacket.
   1. Johns Mansville, Inc.
   2. Knauf Insulation.
   3. Manson Insulation, Inc.
   4. Owens Corning.
   5. Or Approved Equal.

2.2 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Johns Mansville, Inc.
   2. P.I.C. Plastics Inc.
   3. Proto Corporation.
   4. Or Approved Equal.
   5. Adhesive: As recommended by jacket material manufacturer.
   6. Color: White.
   7. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

2.3 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Width: 3 inches.
   2. Thickness: 11.5 mils.
   3. Adhesion: 90 ounces force/inch in width.
   4. Elongation: 2 percent.
   5. Tensile Strength: 40 lbf/inch in width.
   6. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.
   1. Width: 2 inches.
   2. Thickness: 6 mils.
   3. Adhesion: 64 ounces force/inch in width.
   4. Elongation: 500 percent.
   5. Tensile Strength: 18 lbf/inch in width.

2.4 SECUREMENTS

A. Aluminum Bands: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal or closed seal.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

PART 3 EXECUTION

3.1 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation as required.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.2 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
      a. For below-ambient services, apply vapor-barrier mastic over staples.
   4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
   5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its

nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.3 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.
1. Comply with requirements in Section 078400 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

C. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078400 "Penetration Firestopping."

3.4 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles or manufacturers requirements.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.

4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. 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.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.5 INSTALLATION OF MINERAL-FIBER PREFORMED PIPE INSULATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

3.6 FIELD-APPLIED JACKET INSTALLATION

A. Where PVC jackets are used, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.
   2. Any exposed insulated piping in kitchen is to be provided with a PVC jacket.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.8 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.9 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water: Insulation shall be the following:
   1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot Water: Insulation shall be the following:
   1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

C. Storm Water: Insulation shall be the following:
   1. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

D. ADA Fixtures: Insulation will be the following:
   1. ADA-compliant molded plastic pipe covers or an under-sink protective enclosure panel.

END OF SECTION

SECTION 221116

DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
   1. Specialty valves.
   2. Flexible connectors.

1.3 SUBMITTALS

A. Product Data: For the following products:
   1. Specialty valves.
   2. Transition fittings.
   3. Flexible connectors.

B. Water Samples: Specified in "Cleaning" Article.

C. Coordination Drawings: For piping in equipment rooms and other congested areas, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Domestic water piping.

D. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 61 for potable domestic water piping and components.

1.5 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:
   1. Notify Owner no fewer than three days in advance of proposed interruption of water service.
   2. Do not proceed with interruption of water service without Owner's written permission.

1.6 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
   1. Cast-Copper Solder-Joint Fittings: ASME B16.18, pressure fittings.
   2. Wrought-Copper Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.
   3. Copper Pressure-Seal-Joint Fittings:
      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) Elkhart Products Corporation; Industrial Division.
         2) NIBCO INC.
         3) Viega; Plumbing and Heating Systems.
         4) Or approved equal.
      b. NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber O-ring seal in each end.
      c. NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

2.4 SPECIALTY VALVES

A. Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for general-duty metal valves.

B. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for balancing valves, drain valves, backflow preventers, water pressure-reducing valves, and vacuum breakers.

2.5 TRANSITION FITTINGS

A. General Requirements:
   1. Same size as pipes to be joined.
   2. Pressure rating at least equal to pipes to be joined.
   3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.
   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. Cascade Waterworks Manufacturing.
      b. Dresser, Inc.; Dresser Piping Specialties.
      c. Ford Meter Box Company, Inc. (The).
      d. JCM Industries.
      e. Viking Johnson; c/o Mueller Co.
      f. Or approved equal.

2.6 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flex-Hose Co., Inc.
   2. Flexicraft Industries.
   3. Flex Pression, Ltd.
   4. Flex-Weld, Inc.
   5. Metraflex, Inc.
   6. Unaflex, Inc.

B. Stainless-Steel-Hose Flexible Connectors: Corrugated-stainless-steel tubing with stainless-steel wire-braid covering and ends welded to inner tubing.
   1. Working-Pressure Rating: Minimum 200 psig.
   2. End Connections NPS 2 and Smaller: Threaded steel-pipe nipple.
   3. End Connections NPS 2-1/2 and Larger: Flanged steel nipple.

PART 3 EXECUTION

3.1 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve, inside the building at each domestic water service entrance. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for drain valves and strainers.

C. Install shutoff valve immediately upstream of each dielectric fitting.

D. Install water-pressure-reducing valves downstream from shutoff valves. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for pressure-reducing valves.

E. Install domestic water piping level with 0.25 percent slope downward toward drain and plumb.

F. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

G. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

H. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal and coordinate with other services occupying that space.

I. Install piping adjacent to equipment and specialties to allow service and maintenance.

J. Install piping to permit valve servicing.

K. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than system pressure rating used in applications below unless otherwise indicated.

L. Install piping free of sags and bends.

M. Install fittings for changes in direction and branch connections.

N. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

O. Install thermostats in hot-water circulation piping.

P. Install thermometers on inlet and outlet piping from each water heater.

3.3 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

D. Extruded-Tee Connections: Form tee in copper tube according to ASTM F 2014. Use tool designed for copper tube; drill pilot hole, form collar for outlet, dimple tube to form seating stop, and braze branch tube into collar.

E. Dissimilar-Material Piping Joints: Make joints using adapters compatible with materials of both piping systems.

3.4 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 22 Section "General-Duty Valves for Plumbing Piping" for valve installations.

B. Install shutoff valve close to water main on each branch and riser serving plumbing fixtures or equipment, on each water supply to equipment, and on each water supply to plumbing fixtures that do not have supply stops. Use ball valves.

C. Install drain valves for equipment at base of each water riser, at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 22 Section "Domestic Water Piping Specialties."
   1. Hose-End Drain Valves: At low points in water mains, risers, and branches.
   2. Stop-and-Waste Drain Valves: Instead of hose-end drain valves where indicated.

D. Install calibrated balancing valves in each hot-water circulation return branch and discharge side of each pump and circulator. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 22 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

3.5 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:
   1. NPS 1-1/2 and Smaller: Fitting-type coupling.
   2. NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.6 FLEXIBLE CONNECTOR INSTALLATION

A. Install bronze-hose flexible connectors in copper domestic water tubing.

B. Install stainless-steel-hose flexible connectors in steel domestic water piping.

3.7 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment" for pipe hanger and support products and installation.
   1. Vertical Piping: MSS Type 8 or 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet If Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
   2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
   3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
   4. NPS 2-1/2: 108 inches with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

3.8 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment and machines to allow service and maintenance.

C. Connect domestic water piping to exterior water-service piping. Use transition fitting to join dissimilar piping materials.

D. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

E.
1. Water Heaters: Cold-water inlet and hot-water outlet piping in sizes indicated, but not smaller than sizes of water heater connections.
2. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 22 plumbing fixture Sections for connection sizes.
3. Equipment: Cold- and hot-water supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2 and larger.

3.9 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 22 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Piping Inspections:
1. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
2. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:
   a. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   b. Final Inspection: Arrange final inspection for authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.
3. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
4. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

C. Piping Tests:
1. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
2. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
3. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.
4. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must

be repaired.

5. Repair leaks and defects with new materials and retest piping or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and for corrective action required.

D. Domestic water piping will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.11 ADJUSTING

A. Perform the following adjustments before operation:
1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.
   a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide flow of hot water in each branch.
   b. Adjust calibrated balancing valves to flows indicated.
5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.12 CLEANING

A. Clean and disinfect potable domestic water piping as follows:
1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:
   a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
   b. Fill and isolate system according to either of the following:
      1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
      2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.
   c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
   d. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

B. Prepare and submit reports of purging and disinfecting activities.

C. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.13 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Fitting Option: Extruded-tee connections and brazed joints may be used on aboveground copper tubing.

D. Aboveground domestic water piping, NPS 2, shall be the following:
   1. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B) cast- or wrought- copper solder-joint fittings; and soldered joints.
   2. Hard copper tube, ASTM B 88, Type L (ASTM B 88M, Type B); copper pressure-seal-joint fittings; and pressure-sealed joints.

END OF SECTION

SECTION 221119

DOMESTIC WATER PIPING SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following domestic water piping specialties:
1. Vacuum breakers.
2. Backflow preventers.
3. Balancing valves.
4. Temperature-actuated water mixing valves.
5. Hose bibbs.
6. Wall hydrants.
7. Drain valves.
8. Water hammer arresters.
9. Water pressure-reducing valves.

1.3 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig, unless otherwise indicated.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. 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.

B. NSF Compliance:
1. Comply with NSF 61, "Drinking Water System Components - Health Effects; Sections 1 through 9."

PART 2 PRODUCTS

2.1 WATER PRESSURE-REDUCING VALVES

A. Water Pressure Regulators.

B.
1. Manufactures: Provide Zurn Elkay Water solutions; Wilkins; model 500XL or an engineer approved equal from one of the following:
   a. Cash Acme.
   b. Conbraco Industries, Inc.
   c. FEBCO; SPX Valves & Controls.
   d. Watts Industries, Inc.; Water Products Div.
   e. Or approved equal.
2. Standard: ASSE 1003.
3. Pressure Rating: Initial working pressure of 400 PSIG (2758 kPa).
4. Size: NPS 2-1/2”.
5. End Connections: Threaded.
6. Materials.
   a. Body: Low lead cast bronze ASTM B806.
   b. Bell Housing: Low lead cast bronze ASTM B806 Cast bronze ASTM B584 (2-1/2" - 4").
   c. Fasteners: Stainless-Steel, 300 Series.
   d. Stem: Stainless-Steel, 300 Series.
   e. Plunger: Stainless-Steel, 300 Series.
   f. Low lead cast bronze ASTM B806 (2-1/2" - 4").
   g. Elastomers: Buna Nitrile (FDA approved).
   h. EPDM (FDA Approved).
   i. Springs: Stainless-Steel, 300 Series.
   j. Chrome Silicon, Epoxy Coated (2-1/2" - 4").
   k. Cartridge: Noryl™.
7. Design Inlet Pressure: 25 PSIG - 400 PSIG (172 kPa - 2758 kPa).
8. Design Outlet Pressure Setting: 15 - 75 PSI (103 kPa - 517 kPa).
9. Design Flow Rate: 8 ft/sec. flow velocity.
   a. 1” - 3” Maintains 5 PSI, or less, fall-off between 0.01 ft/sec. & 8 ft/sec. flow velocity.
   b. 4” - Maintains 10 PSI, or less, fall-off between 0.01 ft/sec. & 8 ft/sec. flow velocity.
10. Valves for Booster Heater Water Supply: Include integral thermal bypass.

11. Standard Feature Options:
    a. Dynamic-pressure sensing Venturi technology.
    b. Corrosion resistant Stainless-Steel stem.
    c. Stainless-Steel adjustment bolt and jam nut.
    d. Tapped and plugged for integral low-flow bypass (2-1/2” - 4” Flanged only).
    e. Tapped and plugged for pressure measurement instrumentation.

2.2 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Co.
      b. Conbraco Industries, Inc.
      c. Watts Industries, Inc.; Water Products Div.
      d. Zurn Plumbing Products Group; Wilkins Div.
      e. Or approved equal.

B. Hose-Connection Vacuum Breakers.
   1. Manufactures: Subject to compliance with requirements, provide products by one of the following:
      a. Conbraco Industries, Inc.
      b. MIFAB, Inc.
      c. Watts Industries, Inc.; Water Products Div.
      d. Woodford Manufacturing Company.
      e. Zurn Plumbing Products Group; Wilkins Div.
      f. Or approved equal.

C. Pressure Vacuum Breakers.
   1. Manufactures: Subject to compliance with requirements, provide products by one of the following:
      a. Ames Co.
      b. Conbraco Industries, Inc.
      c. FEBCO; SPX Valves & Controls.
      d. Watts Industries, Inc.; Water Products Div.
      e. Zurn Plumbing Products Group; Wilkins Div.
      f. Or approved equal.

2.3 BACKFLOW PREVENTERS (BFP-1)

A. Reduced-Pressure-Principle Backflow Preventers to be installed at incoming domestic water service and at any branch lines to mechanical equipment.
   1. Standard: ASSE 1013.
   2. Operation: Continuous-pressure applications.
   3. Pressure Loss: 12 psig maximum, through middle third of flow range.
   4. Size: Varies.
   5. Design Flow Rate: Varies.
   6. Selected Unit Flow Range Limits: Varies.

7. Pressure Loss at Design Flow Rate: 15 psig for sizes NPS 2 and smaller; 15 psig for NPS 2-1/2 and larger.
8. Body: Bronze for NPS 2 and smaller; cast iron with interior lining that complies with AWWA C550 or that is FDA approved for NPS 2-1/2 and larger.
9. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
10. Configuration: Designed for horizontal, straight-through flow.
11. Drain discharge through air-gap fitting to floor drain.
12. Accessories:
    a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet.
    b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet.
    c. Air-Gap Fitting: ASME A112.1.2, matching backflow-preventer connection.
13. Manufactures: Provide Zurn model 375-FSC or an engineer approved equal from one of the following:
    a. Cash Acme.
    b. Conbraco Industries, Inc.
    c. FEBCO; SPX Valves & Controls.
    d. Watts Industries, Inc.; Water Products Div.
    e. Or approved equal.

2.4 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Water-Temperature Limiting Devices:
1. Manufacturers: Provide Powers model LFMM431 or an engineer approved equal from one of the following:
    a. Armstrong International, Inc.
    b. Leonard Valve Company.
    c. Symmons Industries, Inc.
    d. Watts Industries, Inc.; Water Products Div.
    e. Zurn Plumbing Products Group; Wilkins Div.
    f. Or approved equal.
2. Standard: ASSE 1017.
3. Pressure Rating: 125 psig.
4. Type: Thermostatically controlled water mixing valve.
5. Material: Bronze body with corrosion-resistant interior components.
6. Connections: Threaded inlets and outlet.
7. Accessories: Check stops on hot- and cold-water supplies, and adjustable, temperature-control handle.
8. Tempered-Water Setting: 110 deg F.
9. Tempered-Water Design Flow Rate: 15 gpm.
10. Valve Finish: Rough bronze.

2.5 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves:
1. Standard: MSS SP-110 for standard-port, two-piece ball valves.
2. Pressure Rating: 400-psig minimum CWP.
3. Size: NPS 3/4.

4. Body: Copper alloy.
5. Ball: Chrome-plated brass.
6. Seats and Seals: Replaceable.
7. Handle: Vinyl-covered steel.
8. Inlet: Threaded or solder joint.
9. Outlet: Threaded, short nipple with garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.6 STRAINERS FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:
   1. Pressure Rating: 125 psig minimum, unless otherwise indicated.
   2. Body: Bronze for NPS 2 and smaller; cast iron with interior lining complying with AWWA C550 or FDA-approved, epoxy coating and for NPS 2-1/2 (and larger.
   3. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
   4. Screen: Stainless steel with round perforations, unless otherwise indicated.
   5. Perforation Size:
      a. Strainers NPS 2 and Smaller: 0.020 inch.
      b. Strainers NPS 2-1/2 to NPS 4: 0.045 inch.

2.7 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:
   1. AMTROL, Inc.
   2. MIFAB, Inc.
   3. PPP Inc.
   4. Sioux Chief Manufacturing Company, Inc.
   5. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   6. Watts Drainage Products Inc.
   7. Zurn Plumbing Products Group; Specification Drainage Operation.
   8. Or approved equal.
   9. Standard: ASSE 1010 or PDI-WH 201.
   10. Type: Copper tube with piston.
   11. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install backflow preventers in each water supply to mechanical equipment and systems and to other equipment and water systems that may be sources of contamination. Comply with authorities having jurisdiction.
   1. Locate backflow preventers in same room as connected equipment or system.
   2. Install drain for backflow preventers with atmospheric-vent drain connection with air-gap fitting, fixed air-gap fitting, or equivalent positive pipe separation of at least two pipe diameters in drain piping and pipe to floor drain. Locate air-gap device attached to or under backflow preventer. Simple air breaks are not acceptable for this application.
   3. Do not install bypass piping around backflow preventers.

C. Install water regulators with inlet and outlet shutoff valves and bypass with memory-stop balancing valve. Install pressure gages on inlet and outlet.

D. Install water control valves with inlet and outlet shutoff valves. Install pressure gages on inlet and outlet.

E. Install balancing valves in locations where they can easily be adjusted.

F. Install temperature-actuated water mixing valves with check stops or shutoff valves on inlets and with shutoff valve on outlet.
   1. Install thermometers and water regulators if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified.

G. Install outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

H. Install hose stations with check stops or shutoff valves on inlets and with thermometer on outlet.
   1. Install shutoff valve on outlet if specified.
   2. Install cabinet-type units recessed in or surface mounted on wall as specified. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs. Fire-retardant-treated-wood blocking is specified in Division 06 Section "Rough Carpentry."

I. Install water hammer arresters in water piping according to PDI-WH 201.

J. Install supply-type, trap-seal primer valves with outlet piping pitched down toward drain trap a minimum of 1 percent, and connect to floor-drain body, trap, or inlet fitting. Adjust valve for proper flow.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors

and Cables."

3.3 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:
   1. Primary water tempering valves.

B. Distinguish among multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations, in addition to identifying unit. Nameplates and signs are specified in Division 22 Section "Identification for Plumbing Piping and Equipment."

3.4 ADJUSTING

A. Set field-adjustable pressure set points of water pressure-reducing valves.

B. Set field-adjustable flow set points of balancing valves.

C. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION

SECTION 221316

SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following for soil, waste, and vent piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. NBR: Acrylonitrile-butadiene rubber.

D. PVC: Polyvinyl chloride plastic.

1.4 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure, unless otherwise indicated:
   1. Soil, Waste, and Vent Piping: 10-foot head of water.

1.5 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

B. Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping; "NSF-drain" for plastic drain piping; "NSF-tubular" for plastic continuous waste piping; and "NSF-sewer" for plastic sewer piping.

PART 2 PRODUCTS

2.1 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 of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 COPPER TUBE AND FITTINGS

A. Copper Type DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.4 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.

B. Shielded Couplings: ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and rubber sleeve with integral, center pipe stop.
   1. Standard & Heavy duty, Shielded, Stainless-Steel Couplings: CISPI 310, with stainless-steel corrugated shield; stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve.
      a. Available Manufacturers:
         1) ANACO.
         2) Fernco, Inc.
         3) Ideal Div.; Stant Corp.

4) Mission Rubber Co.
5) Tyler Pipe; Soil Pipe Div.
6) Or approved equal.

2.5 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent, Schedule 40.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.
1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

D. Solvent Cement: ASTM D 2564.
1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

PART 3 EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Aboveground, soil and waste piping NPS 4 and smaller shall be any of the following:
1. Hubless cast-iron soil pipe and fittings, heavy duty, shielded, stainless-steel couplings; and hubless-coupling joints.

B. Aboveground, soil and waste piping NPS 5 and larger shall be any of the following:
1. Hubless cast-iron soil pipe and fittings, heavy duty shielded, stainless-steel couplings; and hubless-coupling joints.

C. Aboveground, vent piping NPS 4 and smaller shall be any of the following:
1. Hubless cast-iron soil pipe and fittings; standard, shielded, stainless-steel couplings; and hubless-coupling joints.

D. Underground, soil, waste, and vent piping NPS 6 and smaller shall be the following:
   1. Solid wall PVC pipe, PVC socket fittings, and solvent-cemented joints.
   2. Dissimilar Pipe Material Couplings: Shielded, non-pressure pipe couplings for joining dissimilar pipe materials with small differences in OD.

3.3 PIPING INSTALLATION

A. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers.

C. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

D. Install wall-penetration fitting at each service pipe penetration through foundation wall. Make installation watertight.

E. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

F. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if 2 fixtures are installed back-to-back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

G. Lay buried building drainage piping beginning at the low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

H. Install soil and waste drainage and vent piping at the following minimum slopes, unless otherwise indicated:
   1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Sanitary Drainage Piping: 2 percent downward in direction of flow.
   3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

I. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

J. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.

C. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

D. Join hubless cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 HANGER AND SUPPORT INSTALLATION

A. Seismic-restraint devices are specified in Division 22 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Install individual, straight, horizontal piping runs according to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.

F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install hangers for PVC piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 48 inches with 3/8-inch rod.
   2. NPS 3: 48 inches with 1/2-inch rod.
   3. NPS 4: 48 inches with 5/8-inch rod.

I. Install supports for vertical PVC piping every 48 inches.

J. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/4: 72 inches with 3/8-inch rod.
   2. NPS 1-1/2 and NPS: 96 inches with 3/8-inch rod.
   3. NPS 2-1/2: 108 inches with 1/2-inch rod.

K. Install supports for vertical copper tubing every 10 feet.

L. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect soil and waste piping to exterior sanitary sewerage piping. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
   4. Equipment: Connect drainage piping as indicated. Provide shutoff valve, if indicated, and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
   5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   6. Prepare reports for tests and required corrective action.

3.8 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 221319

SANITARY WASTE PIPING SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following sanitary drainage piping specialties:
   1. Cleanouts.
   2. Floor drains.
   3. Miscellaneous sanitary drainage piping specialties.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. PP: Polypropylene plastic.

C. PVC: Polyvinyl chloride plastic.

1.4 SUBMITTALS

A. Shop Drawings: Show fabrication and installation details for frost-resistant vent terminals.
   1. Wiring Diagrams: Power, signal, and control wiring.

B. Field quality-control test reports.

C. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

B. 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.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

B. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.1 FLOOR DRAINS/SINKS

A. Cast-Iron Floor Drains (FD-1):
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Z415B or a comparable product by one of the following:
      a. Josam Company; Josam Div.
      b. MIFAB, Inc.
      c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
      d. Tyler Pipe; Wade Div.
      e. Watts Drainage Products Inc.
      f. Zurn Plumbing Products Group; Light Commercial Operation.
      g. Or approved equal.
   2. Standard: ASME A112.6.3.
   3. Pattern: Floor drain.
   4. Body Material: Cast Iron.
   5. Seepage Flange: Required.
   6. Anchor Flange: Required.
   7. Clamping Device: Required.
   8. Outlet: Bottom.
   9. Backwater Valve: Not required.
   10. Coating on Interior and Exposed Exterior Surfaces: Not required.
   11. Sediment Bucket: Not required.
   12. Top or Strainer Material: Nickel bronze.
   13. Top of Body and Strainer Finish: Nickel bronze.
   14. Top Shape: Round.
   15. Dimensions of Top or Strainer: 5 inch diameter.
   16. Top Loading Classification: Light Duty.
   17. Funnel: Not required.
   18. Inlet Fitting: Not required.

19. Trap Material: PVC.
20. Trap Pattern: Standard P-trap.
21. Trap Protection: Proset Trap Seal.

B. Cast-Iron Floor Drains: (FD-2).
1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Z505 or a comparable product by one of the following:
a. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Light Commercial Operation.
g. Or approved equal.
2. Standard: ASME A112.6.3.
3. Pattern: Floor drain.
4. Body Material: Cast Iron.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Clamping Device: Required.
8. Outlet: 3” & 4” Bottom.
9. Backwater Valve: Not required.
10. Sediment Bucket: Required.
11. Top or Strainer Material: Cast iron.
12. Top Shape: Round.
13. Dimensions of Top or Strainer: 12” diameter.
14. Top Loading Classification: Heavy Duty.
15. Funnel: Required.
16. Inlet Fitting: Not required.
17. Trap Material: PVC.
18. Trap Pattern: Standard P-trap.
19. Trap Protection: Proset Trap Seal.

2.2 CLEANOUTS

A. Exposed Metal Cleanouts:
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. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
g. Or approved equal.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected

piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts: (CO-1).
1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Z1400-BZ1 or a comparable product by one of the following:
   a. Josam Company; Josam Div.
   b. Sioux Chief Manufacturing Company, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Light Commercial Operation.
   g. Or approved equal.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Light Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts: (CO-2).
1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn Z1468 or a comparable product by one of the following:
   a. Josam Company; Josam Div.
   b. MIFAB, Inc.
   c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
   d. Tyler Pipe; Wade Div.
   e. Watts Drainage Products Inc.
   f. Zurn Plumbing Products Group; Specification Drainage Operation.
   g. Or approved equal.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round nickel-bronze, copper-alloy, or stainless-steel wall-installation frame

and cover.

2.3 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Air-Gap Fittings:
   1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
   2. Body: Bronze or cast iron.
   3. Inlet: Opening in top of body.
   4. Outlet: Larger than inlet.
   5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.

2.4 FLASHING MATERIALS

A. Lead Sheet: ASTM B 749, Type L51121, copper bearing, with the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Use: 4.0-lb/sq. ft., 0.0625-inch thickness.
   2. Vent Pipe Flashing: 3.0-lb/sq. ft., 0.0469-inch thickness.
   3. Burning: 6-lb/sq. ft., 0.0938-inch thickness.

B. Copper Sheet: ASTM B 152/B 152M, of the following minimum weights and thicknesses, unless otherwise indicated:
   1. General Applications: 12 oz./sq. ft.
   2. Vent Pipe Flashing: 8 oz./sq. ft.

C. Zinc-Coated Steel Sheet: ASTM A 653/A 653M, with 0.20 percent copper content and 0.04-inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.

D. Elastic Membrane Sheet: ASTM D 4068, flexible, chlorinated polyethylene, 40-mil minimum thickness.

E. Fasteners: Metal compatible with material and substrate being fastened.

F. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

G. Solder: ASTM B 32, lead-free alloy.

H. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.1 INSTALLATION

A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.

B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
   1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
   2. Locate at each change in direction of piping greater than 45 degrees.
   3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
   4. Locate at base of each vertical soil and waste stack.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
   1. Position floor drains for easy access and maintenance.
   2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
      a. Radius, 30 Inches or Less: Equivalent to 1 percent slope, but not less than 1/4-inch total depression.
      b. Radius, 30 to 60 Inches: Equivalent to 1 percent slope.
      c. Radius, 60 Inches or Larger: Equivalent to 1 percent slope, but not greater than 1-inch total depression.
   3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
   4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

F. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.

G. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.

H. Install through-penetration firestop assemblies in plastic conductors and stacks at floor penetrations.

I. Assemble open drain fittings and install with top of hub 1 inch above floor.

J. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

K. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

L. Install vent caps on each vent pipe passing through roof.

M. Install wood-blocking reinforcement for wall-mounting-type specialties.

N. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

O. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment to allow service and maintenance.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
   1. Lead Sheets: Burn joints of lead sheets 6.0-lb/sq. ft., 0.0938-inch thickness or thicker. Solder joints of lead sheets 4.0-lb/sq. ft., 0.0625-inch thickness or thinner.
   2. Copper Sheets: Solder joints of copper sheets.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
   1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
   2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
   3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."

F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.

G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.5 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

C. END OF SECTION 221319.

END OF SECTION

SECTION 221413

STORM DRAINAGE PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following storm drainage piping inside the building:
   1. Pipe, tube, and fittings.
   2. Special pipe fittings.
   3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working-pressure, unless otherwise indicated:
   1. Storm Drainage Piping: 10-foot head of water.

1.4 SUBMITTALS

A. Product Data: For pipe, tube, fittings, and couplings.

B. Field quality-control inspection and test reports.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, tube, fitting, and joining materials.

2.3 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class(es).

B. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.4 PVC PIPE AND FITTINGS

A. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent, Schedule 40.

B. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.

C. Adhesive Primer: ASTM F 656.
   1. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.

D. Solvent Cement: ASTM D 2564.
   1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

2.5 HUBLESS CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
   1. Heavy-Duty, Shielded, Stainless-Steel Couplings: With stainless-steel shield, stainless-steel bands and tightening devices, and ASTM C 564, rubber sleeve.
      a. Available Manufacturers:
         1) ANACO.
         2) Clamp-All Corp.
         3) Ideal Div.; Stant Corp.
         4) Mission Rubber Co.
         5) Tyler Pipe; Soil Pipe Div.

PART 3 EXECUTION

3.1 EXCAVATION

A. Refer to Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.2 PIPING APPLICATIONS

A. Flanges and unions may be used on aboveground pressure piping, unless otherwise indicated.

B. Aboveground, storm water piping NPS 4 and smaller shall be any of the following:
   1. Hubless cast-iron soil pipe and fittings, shielded, heavy duty stainless-steel couplings; and hubless-coupling joints.

C. Aboveground, storm water piping NPS 5 and larger shall be any of the following:
   1. Hubless cast-iron soil pipe and fittings, shielded, heavy duty stainless-steel couplings; and hubless-coupling joints.

D. Underground storm water piping NPS 4 and smaller shall be the following:
   1. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent, Schedule 40 and fittings; gaskets; and gasketed joints.

E. Underground storm water piping NPS 5 and larger shall be the following:
   1. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent, Schedule 40 and fittings; gaskets; and gasketed joints.

3.3 PIPING INSTALLATION

A. Storm sewer and drainage piping outside the building are specified in Division 33 Section "Storm Utility Drainage Piping."

B. Basic piping installation requirements are specified in Division 22 Section "Common Work Results for Plumbing."

C. Install cleanouts at grade and extend to where building storm drains connect to building storm

sewers. Cleanouts are specified in Division 22 Section "Storm Drainage Piping Specialties."

D. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping.

E. Install cast-iron sleeve with water stop and mechanical sleeve seal at each service pipe penetration through foundation wall. Select number of interlocking rubber links required to make installation watertight. Sleeves and mechanical sleeve seals are specified in Division 22 Section "Common Work Results for Plumbing."

F. Install wall-penetration fitting system at each service pipe penetration through foundation wall. Make installation watertight.

G. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
   1. Install encasement on underground piping according to ASTM A 674 or AWWA C105.

H. Make changes in direction for storm drainage piping using appropriate branches, bends, and long-sweep bends. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

I. Lay buried building storm drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

J. Install storm drainage piping at the following minimum slopes, unless otherwise indicated:
   1. Building Storm Drain: 1 percent downward in direction of flow for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
   2. Horizontal Storm-Drainage Piping: 2 percent downward in direction of flow.

K. Install engineered controlled-flow storm drainage piping in locations indicated.

L. Sleeves are not required for cast-iron soil piping passing through concrete slabs-on-grade if slab is without membrane waterproofing.

M. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

N. Insulate all Horizontal Storm Water piping and Roof Drain sumps with a minimum of 1-inch-thick insulation. Insulation requirements are in Division 22 Section “Plumbing Insulation.

3.4 JOINT CONSTRUCTION

A. Basic piping joint construction requirements are specified in Division 22 Section "Common Work Results for Plumbing."

B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum calked joints.

C. Hubless Cast-Iron Soil Piping Coupled Joints: Join according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

B. Shutoff Valves: Install shutoff valve on each sump pump discharge.
   1. Install gate or full-port ball valve for piping NPS 2 and smaller.
   2. Install gate valve for piping NPS 2-1/2 and larger.

C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sump pump discharge.

3.6 HANGER AND SUPPORT INSTALLATION

A. Pipe hangers and supports are specified in Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment." Install the following:
   1. Vertical Piping: MSS Type 8 or Type 42, clamps.
   2. Individual, Straight, Horizontal Piping Runs: According to the following:
      a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
      b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
      c. Longer Than 100 Feet, if Indicated: MSS Type 49, spring cushion rolls.
   3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
   4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Install supports according to Division 22 Section "Hangers and Supports for Plumbing Piping and Equipment."

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced 1 size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
   2. NPS 3: 60 inches with 1/2-inch rod.
   3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
   4. NPS 6: 60 inches with 3/4-inch rod.
   5. NPS 8 to NPS 12: 60 inches with 7/8-inch rod.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install supports for vertical steel piping every 15 feet.

H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect interior storm drainage piping to exterior storm drainage piping. Use transition fitting to join dissimilar piping materials.

C. Connect storm drainage piping to roof drains and storm drainage specialties.

3.8 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
   1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in.
   2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test storm drainage piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
   1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
   2. Leave uncovered and unconcealed new, altered, extended, or replaced storm drainage piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
   3. Test Procedure: Test storm drainage piping, except outside leaders, on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
   4. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
   5. Prepare reports for tests and required corrective action.

3.9 CLEANING

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

END OF SECTION

SECTION 221423

STORM DRAINAGE PIPING SPECIALTIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Metal roof drains.
2. Cleanouts.

D. Related Requirements:
1. Section 076200 "Sheet Metal Flashing and Trim" for penetrations of roofs.
2. Section 078413 "Penetration Firestopping" for firestopping roof penetrations.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 PRODUCTS

2.1 ROOF DRAINS

A. Roof Drains: (RD-1 & RD-2).
1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn ZC100-DP, Zurn ZC100-Z or a comparable product by one of the following:
a. Josam Company; Josam Div.

b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
c. Watts Drainage Products Inc.
2. Standard: ASME A112.21.2M.
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom.
7. Dome Material: Poly.
8. Extension Collars: Required.
9. Underdeck Clamp: Not required.
10. Sump Receiver: Not required.
11. Insulation: Insulate roof drain body.

B. Overflow Drains: (RD-2).
1. Basis-of-Design Product: Subject to compliance with requirements, provide Zurn ZC100-Z or a comparable product by one of the following:
a. Josam Company; Josam Div.
b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
c. Watts Drainage Products Inc.
2. Standard: ASME A112.21.2M.
3. Pattern: Roof drain.
4. Body Material: Cast iron.
5. Combination Flashing Ring and Gravel Stop: Required.
6. Outlet: Bottom.
7. Dome Material: Cast iron.
8. Extension Collars: Required.
9. Extension: 3”.
10. Underdeck Clamp: Not required.
11. Sump Receiver: Not required.
12. Insulation: Insulate roof drain body.

2.2 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Conductor Nozzles (DN-1).
1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes. Basis of design Zurn Z199, all nickel bronze body.
2. Size: Same as connected conductor.

2.3 CLEANOUTS

A. Exposed Metal Cleanouts:
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. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.

e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.

2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping.
4. Body Material: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Closure: Stainless-steel plug with seal.

B. Metal Floor Cleanouts: (CO-1).
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. Josam Company; Josam Div.
b. Sioux Chief Manufacturing Company, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Light Commercial Operation.
2. Standard: ASME A112.36.2M for adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Threaded, adjustable housing.
5. Body or Ferrule: Cast iron.
6. Clamping Device: Required.
7. Outlet Connection: Inside calk.
8. Closure: Brass plug with straight threads and gasket.
9. Adjustable Housing Material: Cast iron with threads.
10. Frame and Cover Material and Finish: Nickel-bronze, copper alloy.
11. Frame and Cover Shape: Round.
12. Top Loading Classification: Heavy Duty.
13. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to cleanout.
14. Standard: ASME A112.3.1.
15. Size: Same as connected branch.
16. Housing: Stainless steel.
17. Closure: Stainless steel with seal.
18. Riser: Stainless-steel drainage pipe fitting to cleanout.

C. Cast-Iron Wall Cleanouts: (CO-2).
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. Josam Company; Josam Div.
b. MIFAB, Inc.
c. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
d. Tyler Pipe; Wade Div.
e. Watts Drainage Products Inc.
f. Zurn Plumbing Products Group; Specification Drainage Operation.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.

4. Body: Hubless, cast-iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, flat, chrome-plated brass or stainless-steel cover plate with screw.
8. Wall Access: Round nickel-bronze, copper-alloy, or stainless-steel wall-installation frame and cover.

D. Test Tees:
1. Standard: ASME A112.36.2M and ASTM A 74, ASTM A 888, or CISPI 301.
2. Size: Same as connected drainage piping.
3. Body Material: Hub-and-spigot, cast-iron soil-pipe T-branch or no-hub, cast-iron soil-pipe test tee as required to match connected piping.
4. Closure Plug: Countersunk or raised head, brass.
5. Closure Plug Size: Same as, or not more than, one size smaller than cleanout size.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install roof drains at low points of roof areas according to roof membrane manufacturer's written installation instructions.
1. Install flashing collar or flange of roof drain to prevent leakage between drain and adjoining roofing. Maintain integrity of waterproof membranes where penetrated.
2. Install expansion joints, if indicated, in roof drain outlets.
3. Position roof drains for easy access and maintenance.

B. Install cleanouts in aboveground piping and building drain piping according to the following instructions unless otherwise indicated:
1. Use cleanouts the same size as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
2. Locate cleanouts at each change in direction of piping greater than 45 degrees.
3. Locate cleanouts at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate cleanouts at base of each vertical storm piping conductor.

C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

E. Install test tees in vertical conductors and near floor.

F. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

G. Install through-penetration firestop assemblies for penetrations of fire- and smoke-rated assemblies.
1. Comply with requirements in Section 078413 "Penetration Firestopping."

3.2 CONNECTIONS

A. Comply with requirements for piping specified in Section 221413 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.3 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required.

B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.

C. Set flashing on floors and roofs in solid coating of bituminous cement.

D. Secure flashing into sleeve and specialty clamping ring or device.

3.4 PROTECTION

A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.

B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

SECTION 223300

ELECTRIC WATER HEATERS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Commercial, electric, domestic-water booster heaters.
2. Commercial, electric, storage, domestic-water heaters.
3. Commercial, light-duty, storage, electric, domestic-water heaters.
4. Residential, electric, storage, domestic-water heaters.
5. Flow-control, electric, tankless, domestic-water heaters.
6. Thermostat-control, electric, tankless, domestic-water heaters.
7. Domestic-water heater accessories.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Include diagrams for power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Equipment room drawing or BIM model, drawn to scale and coordinated with all building trades.

B. Seismic Qualification Data: Certificates, for commercial domestic-water heaters, accessories, and components, from manufacturer.

C. Product Certificates: For each type of electric, domestic-water heater.

D. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

E. Source quality-control reports.

F. Field quality-control reports.

G. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.5 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.
   1. Warranty Periods: From date of Substantial Completion.
      a. Commercial, Electric, Storage, Domestic-Water Heaters:
         1) Storage Tank: 3 years.
         2) Controls and Other Components: 1 year.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by an NRTL, and marked for intended location and use.

B. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1.

C. ASME Compliance: Where ASME-code construction is indicated, fabricate and label commercial, domestic-water heater storage tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61 and NSF 372.

2.2 COMMERCIAL, ELECTRIC, DOMESTIC-WATER HEATERS

A. Commercial, Electric, Storage, Domestic-Water Heaters: (HWH-1).
   1. Basis-of-Design Product: Subject to compliance with requirements, provide AO Smith DRE-52-36 or a comparable product by one of the following:
      a. Bradford White.
      b. A.O. Smith.
      c. Rheem.
   2. Standard: UL 1453.
   3. Storage-Tank Construction: Steel, vertical arrangement.

a. Tappings: Factory fabricated of materials compatible with tank and piping connections. Attach tappings to tank before testing.
   1) NPS 2 and Smaller: Threaded ends in accordance with ASME B1.20.1.
   2) NPS 2-1/2 and Larger: Flanged ends in accordance with ASME B16.5 for steel and stainless steel flanges, and in accordance with ASME B16.24 for copper and copper-alloy flanges.
b. Pressure Rating: 150 psig.
c. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending lining material into tappings.

4. Factory-Installed, Storage-Tank Appurtenances:
   a. Anode Rod: Replaceable magnesium.
   b. Drain Valve: Corrosion-resistant metal with hose-end connection.
   c. Insulation: Comply with ASHRAE/IES 90.1.
   d. Jacket: Steel with enameled finish or high-impact composite material.
   e. Heating Elements: Electric, screw-in or bolt-on immersion type arranged in multiples of three.
   f. Temperature Control: Adjustable thermostat.
   g. Safety Controls: High-temperature-limit and low-water cutoff devices or systems.
   h. Relief Valves: ASME rated and stamped for combination temperature-and-pressure relief valves. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select one relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics:
   1. Capacity: 50 gal.
   2. Recovery: 148 gph at 100 deg F temperature rise.
   3. Temperature Setting: 125 deg.
   4. Power Demand: 36 KW.
   5. Heating Elements:
      a. Number of Elements: 6.
      b. Kilowatts Each Element: 6000 Watts.
      c. Number of Stages: 3.
      d. Non-Simultaneous.
   6. Electrical Characteristics:
      a. Volts: 208.
      b. Phases: 3.
      c. Hertz: 60 Hz.
   7. Standard: UL 499 for electric, tankless, (domestic-water-heater) heating appliance.
   8. Construction: Copper piping or tubing complying with NSF 61 and NSF 372 barrier materials for potable water, without storage capacity.
      a. Connections: ASME B1.20.1 pipe thread.
      b. Pressure Rating: 150 psig.
      c. Heating Element: Resistance heating system.
      d. Temperature Control: Thermostat.
      e. Safety Control: High-temperature-limit cutoff device or system.
      f. Jacket: Aluminum or steel with enameled finish or plastic.

2.3 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Expansion Tanks: (ET-1).
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Amtrol thermo-X-Trol model ST-5C-DD or a comparable product by one of the following:
      a. Amtrol.
      b. Watts.
      c. A.O. Smith.
   2. Description: Steel pressure-rated tank constructed with welded joints and factory-installed, butyl-rubber diaphragm. Include air precharge to minimum system-operating pressure at tank.
   3. Construction:
      a. Tappings: Factory-fabricated steel, welded to tank before testing and labeling. Include ASME B1.20.1 pipe thread.
      b. Interior Finish: Comply with NSF 61 and NSF 372 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.
      c. Air-Charging Valve: Factory installed.
   4. Capacity and Characteristics:
      a. Working-Pressure Rating: 150 psig.
      b. Capacity Acceptable: 2 gal. minimum.
      c. Air Precharge Pressure: 55 psig.

B. Drain Pans: Corrosion-resistant metal with raised edge. Include dimensions not less than base of domestic-water heater, and include drain outlet not less than NPS 3/4 with ASME B1.20.1 pipe threads.

C. Heat-Trap Fittings: Factory installed.

D. Combination Temperature-and-Pressure Relief Valves: ASME rated and stamped. Include relieving capacity at least as great as heat input, and include pressure setting less than working-pressure rating of domestic-water heater. Select relief valves with sensing element that extends into storage tank.

E. Pressure Relief Valves: ASME rated and stamped. Include pressure setting less than working-pressure rating of domestic-water heater.

F. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4.

G. Shock Absorbers: ASSE 1010 or PDI-WH 201, Size A water hammer arrester.

H. Domestic-Water Heater Mounting Brackets: Manufacturer's factory-fabricated steel bracket for wall mounting, capable of supporting domestic-water heater and water.

2.4 SOURCE QUALITY CONTROL

A. Test and inspect domestic-water heaters specified to be ASME-code construction, in accordance with ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test[commercial] domestic-water heaters to minimum of one and one-half times pressure rating before shipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

PART 3 EXECUTION

3.1 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting: Install commercial, electric, domestic-water heaters on concrete base. Comply with requirements for concrete bases specified in Section 220500 "Common Work Results for Plumbing."
   1. Exception: Omit concrete bases for commercial, electric, domestic-water heaters if installation on stand, bracket, suspended platform, or directly on floor is indicated.
   2. Maintain manufacturer's recommended clearances.
   3. Arrange units so controls and devices that require servicing are accessible.
   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 floor.
   6. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   7. Install anchor bolts to elevations required for proper attachment to supported equipment.
   8. Anchor domestic-water heaters to substrate.

B. Install electric, domestic-water heaters level and plumb, in accordance with layout drawings, original design, and referenced standards. Maintain manufacturer's recommended clearances. Arrange units so controls and devices needing service are accessible.
   1. Install shutoff valves on domestic-water-supply piping to domestic-water heaters and on domestic-hot-water outlet piping. Comply with requirements for shutoff valves specified in Section 220523 "General-Duty Valves for Plumbing Piping."

C. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

D. Install combination temperature-and-pressure relief valves in water piping for electric, domestic-water heaters without storage. Extend domestic-water heater relief-valve outlet, with drain piping same as domestic-water piping in continuous downward pitch, and discharge by positive air gap onto closest floor drain.

E. Install water-heater drain piping as indirect waste to spill by positive air gap into open drains or over floor drains. Install hose-end drain valves at low points in water piping for electric, domestic-water heaters that do not have tank drains. Comply with requirements for hose-end

drain valves specified in Section 221119 "Domestic Water Piping Specialties."

F. Install thermometers on outlet piping of electric, domestic-water heaters. Comply with requirements for thermometers specified in Section 220500 "Common Work Results for Plumbing."

G. Install piping-type heat traps on inlet and outlet piping of electric, domestic-water heater storage tanks without integral or fitting-type heat traps.

H. Fill electric, domestic-water heaters with water.

I. Charge domestic-water expansion tanks with air to required system pressure.

J. Install dielectric fittings in all locations where piping of dissimilar metals is to be joined. The wetted surface of the dielectric fitting contacted by potable water to contain less than 0.25 percent of lead by weight.

K. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.2 PIPING CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Where installing piping adjacent to electric, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections.

D. Prepare test and inspection reports.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial water heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 224000

PLUMBING FIXTURES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following conventional plumbing fixtures and related components:
1. Faucets lavatories.
2. Laminar-flow faucet-spout outlets.
3. Flushometers.
4. Toilet seats.
5. Fixture supports.
6. Water closets.
7. Lavatories.
8. Kitchen sinks.
9. Service sinks.

D. Related Sections include the following:
1. Division 22 Section "Domestic Water Piping Specialties" for backflow preventers, floor drains, and specialty fixtures not included in this Section.

1.3 DEFINITIONS

A. ABS: Acrylonitrile-butadiene-styrene plastic.

B. Accessible Fixture: Plumbing fixture that can be approached, entered, and used by people with disabilities.

C. Fitting: Device that controls the flow of water into or out of the plumbing fixture. Fittings specified in this Section include supplies and stops, faucets and spouts, shower heads and tub spouts, drains and tailpieces, and traps and waste pipes. Piping and general-duty valves are included where indicated.

D. PVC: Polyvinyl chloride plastic.

E. Solid Surface: Nonporous, homogeneous, cast-polymer-plastic material with heat-, impact-, scratch-, and stain-resistance qualities.

1.4 SUBMITTALS

A. Product Data: For each type of plumbing fixture indicated. Include selected fixture and trim, fittings, accessories, appliances, appurtenances, equipment, and supports. Indicate materials and finishes, dimensions, construction details, and flow-control rates.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Operation and Maintenance Data: For plumbing fixtures to include in emergency, operation, and maintenance manuals.

D. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain plumbing fixtures, faucets, and other components of each category through one source from a single manufacturer.
   1. Exception: If fixtures, faucets, or other components are not available from a single manufacturer, obtain similar products from other manufacturers specified for that category.

B. 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.

C. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for plumbing fixtures for people with disabilities.

D. Regulatory Requirements: Comply with requirements in Public Law 102-486, "Energy Policy Act," about water flow and consumption rates for plumbing fixtures.

E. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

F. Select combinations of fixtures and trim, faucets, fittings, and other components that are compatible.

G. Comply with the following applicable standards and other requirements specified for plumbing fixtures:
   1. Mop-Service Basins: ANSI Z124.6.
   2. Porcelain-Enameled, Formed-Steel Fixtures: ASME A112.19.4M.
   3. Solid-Surface-Material Lavatories and Sinks: ANSI/ICPA SS-1.
   4. Vitreous-China Fixtures: ASME A112.19.2M.

5. Water-Closet, Flushometer Tank Trim: ASSE 1037.

H. Comply with the following applicable standards and other requirements specified for lavatory and sink faucets:
1. Backflow Protection Devices for Faucets with Hose-Thread Outlet: ASME A112.18.3M.
2. Diverter Valves for Faucets with Hose Spray: ASSE 1025.
3. Faucets: ASME A112.18.1.
4. Hose-Connection Vacuum Breakers: ASSE 1011.
5. Hose-Coupling Threads: ASME B1.20.7.
6. Integral, Atmospheric Vacuum Breakers: ASSE 1001.
7. NSF Potable-Water Materials: NSF 61.
8. Pipe Threads: ASME B1.20.1.
9. Sensor-Actuated Faucets and Electrical Devices: UL 1951.
10. Supply Fittings: ASME A112.18.1.
11. Brass Waste Fittings: ASME A112.18.2.
12. Mixing Valve: ASSE 1017.

I. Comply with the following applicable standards and other requirements specified for miscellaneous fittings:
1. Atmospheric Vacuum Breakers: ASSE 1001.
2. Brass and Copper Supplies: ASME A112.18.1.
3. Manual-Operation Flushometers: ASSE 1037.
4. Plastic Tubular Fittings: ASTM F 409.
5. Brass Waste Fittings: ASME A112.18.2.
6. Sensor-Operation Flushometers: ASSE 1037 and UL 1951.

J. Comply with the following applicable standards and other requirements specified for miscellaneous components:
1. Flexible Water Connectors: ASME A112.18.6.
2. Floor Drains: ASME A112.6.3.
3. Grab Bars: ASTM F 446.
4. Hose-Coupling Threads: ASME B1.20.7.
5. Off-Floor Fixture Supports: ASME A112.6.1M.
6. Pipe Threads: ASME B1.20.1.
7. Plastic Toilet Seats: ANSI Z124.5.

1.6 WARRANTY

A. Special Warranties: Manufacturer's standard form in which manufacturer agrees to repair or replace components of whirlpools that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
a. Structural failures of unit shell.
b. Faulty operation of controls, blowers, pumps, heaters, and timers.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Period for Commercial Applications: One year(s) from date of Substantial Completion.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed.
   2. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed.
   3. Flushometer Valve, Repair Kits: Equal to 10 percent of amount of each type installed, but no fewer than 12 of each type.
   4. Provide hinged-top wood or metal box, or individual metal boxes, with separate compartments for each type and size of extra materials listed above.
   5. Toilet Seats: Equal to 10 percent of amount of each type installed.

PART 2 PRODUCTS

2.1 FIXTURE SUPPORTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Josam Company.
   2. MIFAB Manufacturing Inc.
   3. Smith, Jay R. Mfg. Co.
   4. Tyler Pipe; Wade Div.
   5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
   6. Zurn Plumbing Products Group; Specification Drainage Operation.
   7. Or approved equal.

B. Water Closet Supports: (P-1).

C.
   1. Description: Combination carrier designed for accessible or standard mounting height of wall-mounting, water-closet-type fixture. Include single or double, vertical or horizontal, hub-and-spigot or hubless waste fitting as required for piping arrangement; faceplates; couplings with gaskets; feet; and fixture bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.

D. Urinal Supports: (P-2).
   1. Description: Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture for wall-mounting, urinal-type fixture. Include steel uprights with feet.
   2. Accessible-Fixture Support: Include rectangular steel uprights.

E. Lavatory Supports: (P-3 & P-3A).
   1. Description: Type I, lavatory carrier with exposed arms and tie rods for wall-mounting, lavatory-type fixture. Include steel uprights with feet.
   2. Accessible-Fixture Support: Include rectangular steel uprights.

2.2 WATER CLOSETS (P-1 AND P-1A)

A. Water Closet:

B.

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
   a. Kohler Co.
   b. TOTO USA, Inc.
   c. Zurn, Inc.
   d. American Standard Companies, Inc.
   e. Or approved equal.

C. Water Closet Faucet.

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
   a. Zurn Plumbing Products Group; Commercial Brass Division.
   b. Gerber Plumbing Fixtures LLC.
   c. Sloan.

2.3 URINALS (P-2)

A. Urinal:

B.

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
   a. Kohler Co.
   b. TOTO USA, Inc.
   c. Zurn, Inc.
   d. American Standard Companies, Inc.
   e. Or approved equal.

C. Urinal Flush Valve.

D.

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
   a. Zurn Plumbing Products Group; Commercial Brass Division.
   b. Gerber Plumbing Fixtures LLC.
   c. Sloan.

2.4 LAVATORY

A. 2.4 Lavatory (P-3 & P-3A).

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
   a. Kohler Co.

b. TOTO USA, Inc.
c. Zurn, Inc.
d. American Standard companies, Inc.
e. Or approved equal.

B. Lavatory Faucets:

C.

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
   a. Chicago Faucets.
   b. American Standard, Inc.
   c. Zurn Plumbing Products Group; Commercial Brass Operation.

2.5 MOP RECEPTOR (P-6)

A. Mop Receptor:
1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
2.
   a. FiatFiat.
   b. Crane Plumbing, L.L.C./Fiat Products.
   c. Florestone Products Co., Inc.
   d. Precast Terrazzo Enterprises, Inc.
   e. Stern-Williams Co., Inc.
   f. Or approved equal.
3. Description: Terrazzo mop basin & faucet.

B. Mop Receptor Faucet:

C.

1. Subject to compliance with requirements, provide model noted in plumbing fixture schedules or an engineer approved equal from one of the following:
   a. Chicago Faucets.
   b. American Standard, Inc.
   c. Zurn Plumbing Products Group; Commercial Brass Operation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before plumbing fixture installation.

B. Examine cabinets, counters, floors, and walls for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Assemble plumbing fixtures, trim, fittings, and other components according to manufacturers' written instructions.

B. Install off-floor supports, affixed to building substrate, for wall-mounting fixtures.
   1. Use carrier supports with waste fitting and seal for back-outlet fixtures.
   2. Use carrier supports without waste fitting for fixtures with tubular waste piping.
   3. Use chair-type carrier supports with rectangular steel uprights for accessible fixtures.

C. Install back-outlet, wall-mounting fixtures onto waste fitting seals and attach to supports.

D. Install wall-mounting fixtures with tubular waste piping attached to supports.

E. Install fixtures level and plumb according to roughing-in drawings.

F. Install water-supply piping with stop on each supply to each fixture to be connected to water distribution piping. Attach supplies to supports or substrate within pipe spaces behind fixtures. Install stops in locations where they can be easily reached for operation.
   1. Exception: Use ball, gate, or globe valves if supply stops are not specified with fixture. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

G. Install trap and tubular waste piping on drain outlet of each fixture to be directly connected to sanitary drainage system.

H. Install tubular waste piping on drain outlet of each fixture to be indirectly connected to drainage system.

I. Install flushometer valves for accessible water closets and urinals with handle mounted on wide side of compartment. Install other actuators in locations that are easy for people with disabilities to reach.

J. Install toilet seats on water closets.

K. Install faucet-spout fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

L. Install water-supply flow-control fittings with specified flow rates in fixture supplies at stop valves.

M. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.

N. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes, unless otherwise indicated.

O. Install escutcheons at piping wall ceiling penetrations in exposed, finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

P. Set service basins in leveling bed of cement grout. Grout is specified in Division 22 Section "Common Work Results for Plumbing."

Q. Seal joints between fixtures and walls, floors, and countertops using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Sealants are specified in Division 07 Section "Joint Sealants."

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Verify that installed plumbing fixtures are categories and types specified for locations where installed.

B. Check that plumbing fixtures are complete with trim, faucets, fittings, and other specified components.

C. Inspect installed plumbing fixtures for damage. Replace damaged fixtures and components.

D. Test installed fixtures after water systems are pressurized for proper operation. Replace malfunctioning fixtures and components, then retest. Repeat procedure until units operate properly.

E. Install fresh batteries in sensor-operated mechanisms.

3.5 ADJUSTING

A. Operate and adjust faucets and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets and flushometer valves to produce proper flow and stream.

C. Replace washers and seals of leaking and dripping faucets and stops.

D. Install fresh batteries in sensor-operated mechanisms.

3.6 CLEANING

A. Clean fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials. Do the following:
   1. Remove faucet spouts and strainers, remove sediment and debris, and reinstall strainers and spouts.
   2. Remove sediment and debris from drains.

B. After completing installation of exposed, factory-finished fixtures, faucets, and fittings, inspect exposed finishes and repair damaged finishes.

3.7 PROTECTION

A. Provide protective covering for installed fixtures and fittings.

B. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION

SECTION 224700

ELECTRIC WATER COOLERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following water coolers and related components:
   1. Pressure water coolers.
   2. Fixture supports.

1.3 DEFINITIONS

A. Accessible Water Cooler: Fixture that can be approached and used by people with disabilities.

B. Fitting: Device that controls flow of water into or out of fixture.

C. Water Cooler: Electrically powered fixture for generating and delivering cooled drinking water.

1.4 SUBMITTALS

A. Product Data: For each fixture indicated. Include rated capacities, furnished specialties, and accessories.

B. Shop Drawings: Diagram power, signal, and control wiring.

C. Field quality-control test reports.

D. Operation and Maintenance Data: For fixtures to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. 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.

B. Regulatory Requirements: Comply with requirements in ICC A117.1, "Accessible and Usable Buildings and Facilities"; Public Law 90-480, "Architectural Barriers Act"; and Public Law 101-336, "Americans with Disabilities Act"; for fixtures for people with disabilities.

C. NSF Standard: Comply with NSF 61, "Drinking Water System Components--Health Effects," for fixture materials that will be in contact with potable water.

D. ARI Standard: Comply with ARI's "Directory of Certified Drinking Water Coolers" for style classifications.

E. ARI Standard: Comply with ARI 1010, "Self-Contained, Mechanically Refrigerated Drinking-Water Coolers," for water coolers and with ARI's "Directory of Certified Drinking Water Coolers" for type and style classifications.

F. ASHRAE Standard: Comply with ASHRAE 34, "Designation and Safety Classification of Refrigerants," for water coolers. Provide HFC 134a (tetrafluoroethane) refrigerant, unless otherwise indicated.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filter Cartridges: Equal to 50 percent of amount installed for each type and size indicated, but no fewer than 2 of each.

PART 2 PRODUCTS

2.1 PRESSURE WATER COOLERS

A. Water Cooler with Bottle Fill, (P-7):
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Elkay model LZSTL8WSSP water cooler with bottle filling station or a comparable product by one of the following:
      a. Halsey Taylor.
      b. Oasis Corporation.
      c. Sunroc Corp.
      d. Or approved equal.
   2. Description: ARI 1010, Type PB, pressure with bubbler, with bottle filling station.
      a. Cabinet: Stainless steel with stainless-steel top.
      b. Bubbler: One, with adjustable stream regulator, located on deck.
      c. Control: Push button.

d. Supply: NPS 3/8 with ball, gate, or globe valve.
e. Filter: One or more water filters complying with NSF 42 and NSF 53 for cyst and lead reduction to below EPA standards; with capacity sized for unit peak flow rate.
f. Drain: Grid with NPS 1-1/4 minimum horizontal waste and trap complying with ASME A112.18.2.
g. Cooling System: Electric, hermetically sealed compressor, cooling coil, air-cooled condensing unit, corrosion-resistant tubing, refrigerant, corrosion-resistant-metal storage tank, and adjustable thermostat.
    1) Capacity: 8 gph of 50 deg F cooled water from 80 deg F inlet water and 90 deg F ambient air temperature.
    2) Electrical Characteristics: 1/4 hp; 115-V ac; single phase; 60 Hz.

2.2 FIXTURE SUPPORTS

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Josam Co.
2. MIFAB Manufacturing, Inc.
3. Smith, Jay R. Mfg. Co.
4. Tyler Pipe; Wade Div.
5. Watts Drainage Products Inc.; a div. of Watts Industries, Inc.
6. Zurn Plumbing Products Group; Specification Drainage Operation.
7. Or approved equal.

C. Description: ASME A112.6.1M, water cooler carriers. Include vertical, steel uprights with feet and tie rods and bearing plates with mounting studs matching fixture to be supported.
1. Type I: Hanger-type carrier with two vertical uprights.
2. Type II: Bilevel, hanger-type carrier with three vertical uprights.
3. Supports for Accessible Fixtures: Include rectangular, vertical, steel uprights instead of steel pipe uprights.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine roughing-in for water and waste piping systems to verify actual locations of piping connections before fixture installation. Verify that sizes and locations of piping and types of supports match those indicated.

B. Examine walls and floors for suitable conditions where fixtures are to be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLICATIONS

A. Use carrier off-floor supports for wall-mounting fixtures, unless otherwise indicated.

B. Use chrome-plated brass or copper tube, fittings, and valves in locations exposed to view. Plain copper tube, fittings, and valves may be used in concealed locations.

3.3 INSTALLATION

A. Install off-floor supports affixed to building substrate and attach wall-mounting fixtures, unless otherwise indicated.

B. Install mounting frames affixed to building construction and attach recessed water coolers to mounting frames, unless otherwise indicated.

C. Install fixtures level and plumb. For fixtures indicated for children, install at height required by authorities having jurisdiction.

D. Install water-supply piping with shutoff valve on supply to each fixture to be connected to water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

E. Install trap and waste piping on drain outlet of each fixture to be connected to sanitary drainage system.

F. Install pipe escutcheons at wall penetrations in exposed, finished locations. Use deep-pattern escutcheons where required to conceal protruding pipe fittings. Escutcheons are specified in Division 22 Section "Common Work Results for Plumbing."

G. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant, silicone sealant. Match sealant color to fixture color.

3.4 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.5 FIELD QUALITY CONTROL

A. Water Cooler Testing: After electrical circuitry has been energized, test for compliance with requirements. Test and adjust controls and safeties.
   1. Remove and replace malfunctioning units and retest as specified above.
   2. Report test results in writing.

3.6 ADJUSTING

A. Adjust fixture flow regulators for proper flow and stream height.

B. Adjust water cooler temperature settings.

3.7 CLEANING

A. After completing fixture installation, inspect unit. Remove paint splatters and other spots, dirt, and debris. Repair damaged finish to match original finish.

B. Clean fixtures, on completion of installation, according to manufacturer's written instructions.

END OF SECTION

SECTION 230000

HEATING, VENTILATING, AND AIR CONDITIONING (HVAC)

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

B. The requirements of all other sections of Division 23 apply to this section.

1.3 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a (2) two-year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect.

1.4 DEFINITIONS

A. Provide: Means to furnish, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.5 SUMMARY

A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary to complete the installation of the work as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:
   1. Refer to Division 00 and 01 Specification Sections regarding summer school schedule and locations that will affect the mechanical work.
   2. Remove existing roof top unit and all associated controls and ductwork to points

indicated.
3. Remove split system units and all associated indoor and outdoor units, piping, controls and ductwork to points indicated.
4. Remove VRF units and all associated indoor and outdoor heat recovery units, piping and controls.
5. Remove exhaust fans, controls and ductwork to points indicated.
6. Remove existing electric baseboard and all associated controls.
7. Remove cabinet unit heaters in their entirety, including but not limited to, hangers, supports and controls.
8. Provide new gravity relief vent on roof, and all associated, controls, and supports.
9. Provide and install new rooftop units and dedicate outside air units including but not limited to, supply & return ductwork, grilles, diffusers, air duct accessories, roof curb where indicated, insulation, hangers, supports, controls and wiring as indicated on contract drawings.
10. Provide and install new variable air volume units including but not limited to, hangers, supports, controls and wiring as indicated on contract drawings.
11. Provide and install VRF systems and all associated piping, controls, specialties and appurtenances.
12. Provide electric cabinet unit heaters, including but not limited to, hangers, supports and controls.
13. Provide propeller unit heaters, electric baseboard, electric wall heaters and radiant ceiling panels, including but not limited to, hangers, supports and controls.
14. Provide exhaust fans, including but not limited to, hangers, supports and controls.
15. Provide and install insulation for piping and ductwork including requirements for internal lining for ductwork as indicated within the specifications.
16. Provide all pipe materials and ductwork materials and construction as outlined on drawings and within specifications.
17. Provide testing, adjusting and balancing for all new HVAC Systems.
18. Provide all new controls for new HVAC equipment as indicated.
19. Provide all work noted in all of the specifications and drawings.
20. Provide all cutting and patching as required to perform the work of this contract.
21. Provide all necessary permits and approvals.
22. Provide all necessary rigging as required to perform the work of this contract.
23. Provide operation and maintenance manuals and record as-built drawings for everything installed in this contract.
24. Provide instructions and factory authorized training to owner of all equipment provided in this contract.
25. Provide cleanup and removal of all construction debris and other trash on a daily basis.
26. Alternate Bids: Refer to the front end specifications and architectural drawings for a complete list of applicable alternates for Mechanical.

B. Note that this Summary of Work specification is intended to help delineate work. It does not mean that this is necessarily all of the work. It is ultimately the responsibility of the Contractor and their subcontractors to look at all the Contract Documents and all field conditions to determine the full extent of work for this project.

C. The work shall include all materials, equipment and systems shown on the drawings and work for other Divisions required to complete all the work ready for operation.

D. The Contractor shall provide all labor, material, equipment and services for the complete and proper installation and operation of the work as indicated, required or implied by the drawings and as specified herein.

E. All of the specifications listed and all of the drawings listed are part of the Contract Documents of the Contractor. The Contractor shall review all drawings, other documents and specification divisions to determine the full scope of his work.

F. It will be the responsibility of the Contractor to examine all Drawings (Architectural, Mechanical and Electrical) and contract documents to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

G. Coordination between the Mechanical Contractor and Electrical Contractor:
   1. The Electrical Contractor shall:
      a. Receive and set the motor starters, etc. as provided by the Mechanical Contractor.
      b. Provide power wiring, including final connection of same, from source to starters or contactors to motors.
      c. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
      d. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the HVAC system and as required by the National Electrical Code, or as shown on the drawings, or as specified.
      e. Adjust connections to electrical motors to insure proper rotation.
      f. Provide and install duct mounted smoke detectors and remote test stations and tie into the fire alarm system. MC will install the duct detector housing and tubing inside the ductwork and will tie in the duct detector relay into the respective unit shut-down circuit.
   2. The Mechanical Contractor will:
      a. Furnish and set all motors for equipment provided as part of the HVAC contract.
      b. Furnish all motor starters, variable frequency drives, contactors, pushbuttons and switches for local and remote control of HVAC equipment that is not provided by the Electrical Contractor and turn over to the Electrical Contractor for installation. Combination starters shall be furnished for individual (not attached to the equipment) and for packaged equipment regardless if specified or not in the respective sections of the specification.
      c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strip. Provide all control wiring for all equipment, up to and including all 120 V controls and 24V power to all Control Panels (including 120V power feeds and 120V-24V control power transformers), unless specifically indicated on electrical drawings. Only power supply connection to the mechanical unit equipment will be by the Electrical Contractor.
      d. Furnish wiring diagrams for the systems power wiring, in sufficient time to allow roughing-in of conduit in accordance with the proposed work schedule.

e. Receive and install duct detector housing and tubing and install in ductwork according to NFPA 72. Provide and install wiring and conduit to tie duct detector relay into respective unit shut-down circuit.

3. The Plumbing Contractor will:
   a. Furnish and set all motors for plumbing equipment.
   b. Coordinate locations of all equipment with both the Mechanical and Electrical Contractors.
   c. Provide the Electrical Contractor with information and instructions for connection of electrical service to water coolers, domestic hot water heater, etc.
   d. Provide and install flow switches for the fire protection system. EC to provide monitoring of the switches in the fire alarm system.
   e. Provide and install new fire pump controller/ATS switch with monitoring points for the fire alarm system.
4. The Electrical Contractor shall examine the drawings and read the specifications for the mechanical trades, and shall note all motor-driven equipment, starters and control apparatus noted, shown or specified herein.

1.6 WARRANTY

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Engineer issues his letter of “Substantial Completion.”.

B. All equipment is to include factory start-up unless the Contractor receives written permission, from the owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this School shall include a warranty on parts and labor. The duration of this warranty shall be as noted in paragraph 1.2.A above. This warranty shall supersede all notations in all the other Division 23 specification sections that are shorter than the duration in paragraph 1.2.A above.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 230500

COMMON WORK RESULTS FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following:
1. Piping materials and installation instructions common to most piping systems.
2. Dielectric fittings.
3. Mechanical sleeve seals.
4. Sleeves.
5. Escutcheons.
6. Grout.
7. Equipment installation requirements common to equipment sections.
8. Painting and finishing.
9. Supports and anchorages.
10. Concrete Bases.

1.3 DEFINITIONS

A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.

B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.

E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

F. The following are industry abbreviations for plastic materials:
   1. CPVC: Chlorinated polyvinyl chloride plastic.
   2. PE: Polyethylene plastic.
   3. PVC: Polyvinyl chloride plastic.

G. The following are industry abbreviations for rubber materials:
   1. EPDM: Ethylene-propylene-diene terpolymer rubber.
   2. NBR: Acrylonitrile-butadiene rubber.

H. References.
   1. ICC-500, FEMA 320/361 - Third Party Tested to +225 mph.
   2. ICC 2015 Energy Code - Third Party Tested to ASTM E 2078-13 Standard Test Method for Air Permeance of Building Materials.
   3. ASTM E 1980 Solar Reflectance Index (SRI).

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.

B. Welding certificates.

1.5 QUALITY ASSURANCE

A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

B. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
   1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
   2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

C. Electrical Characteristics for HVAC Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.7 COORDINATION

A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for HVAC installations.

B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

C. Coordinate requirements for access panels and doors for HVAC items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 08 Section "Access Doors and Frames."

D. CODES AND STANDARDS FOR WELDING.

E. The following codes and standards are to be followed for all welding performed on this project:
   1. ASME Section IX Boiler and Pressure Vessel Code.
   2. AWS D1.1, "Structural Welding Code--Steel."
   3. AWS D10.12, "Guide for Welding Mild Steel Pipe."
   4. ASME B31 Series, "Code for Pressure Piping.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
   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 manufacturers specified.
   2. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.

2.2 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.3 JOINING MATERIALS

A. Refer to individual Division 23 piping Sections for special joining materials not listed below.

B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
   2. AWWA C110, rubber, flat face, 1/8 inch (3.2 mm) thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.

C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:
   1. CPVC Piping: ASTM F 493.
   2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.4 DIELECTRIC FITTINGS

A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.

B. Insulating Material: Suitable for system fluid, pressure, and temperature.

C. Dielectric Unions: Factory-fabricated, union assembly, for 250-psig minimum working pressure at 180 deg F.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Eclipse, Inc.
      d. Epco Sales, Inc.
      e. Watts Industries, Inc.; Water Products Div.
      f. Zurn Industries, Inc.; Wilkins Div.

D. Dielectric Flanges: Factory-fabricated, companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
   1. Manufacturers:
      a. Capitol Manufacturing Co.
      b. Central Plastics Company.
      c. Epco Sales, Inc.
      d. Watts Industries, Inc.; Water Products Div.

E. Dielectric-Flange Kits: Companion-flange assembly for field assembly. Include flanges, full-face- or ring-type neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Central Plastics Company.
      d. Pipeline Seal and Insulator, Inc.
   2. Separate companion flanges and steel bolts and nuts shall have 150- or 300-psig minimum working pressure where required to suit system pressures.

F. Dielectric Nipples: Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.
   1. Manufacturers:
      a. Perfection Corp.
      b. Precision Plumbing Products, Inc.
      c. Sioux Chief Manufacturing Co., Inc.
      d. Victaulic Co. of America.

2.5 MECHANICAL SLEEVE SEALS

A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.6 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint.

B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.

C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
   1. Underdeck Clamp: Clamping ring with set screws.

2.7 ESCUTCHEONS

A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.

B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.

C. One-Piece, Cast-Brass Type: With set screw.
   1. Finish: Rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated.

E. One-Piece, Stamped-Steel Type: With set screw and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.

G. One-Piece, Floor-Plate Type: Cast-iron floor plate.

H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.8 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   1. Characteristics: Post-hardening, volume-adjusting, nonstaining, noncorrosive,

nongaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.
3. Packaging: Premixed and factory packaged.

PART 3 EXECUTION

3.1 DEMOLITION

A. Refer to Division 10000 Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.

B. Disconnect, demolish, and remove Mechanical systems, equipment, and components indicated to be removed.
1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and plug remaining ducts with same or compatible ductwork material.
4. Ducts to Be Abandoned in Place: Cap or plug ducts with same or compatible ductwork material.
5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.

C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

3.2 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.

B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated

otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping to permit valve servicing.

G. Install piping at indicated slopes.

H. Install piping free of sags and bends.

I. Install fittings for changes in direction and branch connections.

J. Install piping to allow application of insulation.

K. Select system components with pressure rating equal to or greater than system operating pressure.

L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
   1. New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
      c. Insulated Piping: One-piece, stamped-steel type with spring clips.
      d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
      e. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with polished chrome-plated finish.
      f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with rough-brass finish.
      g. Bare Piping in Equipment Rooms: One-piece, stamped-steel type with set screw.
      h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.

M. Sleeves are not required for core-drilled holes.

N. Permanent sleeves are not required for holes formed by removable PE sleeves.

O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.

P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
   1. Cut sleeves to length for mounting flush with both surfaces.
      a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
   2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
   3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
      a. Steel Pipe Sleeves: For pipes smaller than NPS 6.
      b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board

partitions.

c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 07 Section "Sheet Metal Flashing and Trim" for flashing.
   1) Seal space outside of sleeve fittings with grout.

4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Install steel pipe for sleeves smaller than 6 inches in diameter.
2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1-inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 07 Section "Penetration Firestopping" for materials.

T. Verify final equipment locations for roughing-in.

U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.3 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using

lead-free solder alloy complying with ASTM B 32.

E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
   1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
   2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
   3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
   4. PVC Nonpressure Piping: Join according to ASTM D 2855.

J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.

K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.

3.4 PIPING CONNECTIONS

A. Make connections according to the following, unless otherwise indicated:
   1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
   2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
   3. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.

3.5 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.

B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.

C. Install HVAC equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.

D. Install equipment to allow right of way for piping installed at required slope.

3.6 PAINTING

A. Painting of HVAC systems, equipment, and components is specified in Division 09 Sections "Interior Painting" and "Exterior Painting."

B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor HVAC materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.8 GROUTING

A. Mix and install grout for HVAC equipment base bearing surfaces, pump and other equipment base plates, and anchors.

B. Clean surfaces that will come into contact with grout.

C. Provide forms as required for placement of grout.

D. Avoid air entrapment during placement of grout.

E. Place grout, completely filling equipment bases.

F. Place grout on concrete bases and provide smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout.

3.9 CONCRETE BASES

A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions.
   1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
   2. 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 the base.
   3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   5. Install anchor bolts to elevations required for proper attachment to supported equipment.
   6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
   7. Use 3000-psi, 28-day compressive-strength concrete and reinforcement.

END OF SECTION

SECTION 230513

COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes general requirements for single-phase and polyphase, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
   1. Motor controllers.
   2. Torque, speed, and horsepower requirements of the load.
   3. Ratings and characteristics of supply circuit and required control sequence.
   4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

A. Comply with requirements in this Section except when stricter requirements are specified in HVAC equipment schedules or Sections.

B. Comply with NEMA MG 1 unless otherwise indicated.

C. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.

B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1.

C. Service Factor: 1.15.

D. Multispeed Motors: Variable torque.
   1. For motors with 2:1 speed ratio, consequent pole, single winding.
   2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed.

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
   1. Motors Smaller than 15 HP: Manufacturer's standard starting characteristic.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger; rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise; Class F insulation.

3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

B. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
1. Permanent-split capacitor.
2. Split phase.
3. Capacitor start, inductor run.
4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and Smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 230529

HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following hangers and supports for HVAC system piping and equipment:
   1. Steel pipe hangers and supports.
   2. Trapeze pipe hangers.
   3. Metal framing systems.
   4. Thermal-hanger shield inserts.
   5. Fastener systems.
   6. Pipe stands.
   7. Equipment supports.

D. Related Sections include the following:
   1. Division 23 Section(s) "Metal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society for The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

A. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

B. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel pipe hangers and supports.
   2. Thermal-hanger shield inserts.
   3. Powder-actuated fastener systems.

B. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 PRODUCTS

2.1 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 of the manufacturers specified.

2.2 STEEL PIPE HANGERS AND SUPPORTS

A. Description: MSS SP-58, Types 1 through 58, factory-fabricated components. Refer to Part 3 "Hanger and Support Applications" Article for where to use specific hanger and support types.

B. Manufacturers:
   1. AAA Technology & Specialties Co., Inc.
   2. Bergen-Power Pipe Supports.
   3. B-Line Systems, Inc.; a division of Cooper Industries.
   4. Carpenter & Paterson, Inc.
   5. Empire Industries, Inc.
   6. ERICO/Michigan Hanger Co.
   7. Globe Pipe Hanger Products, Inc.

8. Grinnell Corp.
9. GS Metals Corp.
10. National Pipe Hanger Corporation.
11. PHD Manufacturing, Inc.
12. PHS Industries, Inc.
13. Piping Technology & Products, Inc.
14. Tolco Inc.

C. Galvanized, Metallic Coatings: Pregalvanized or hot dipped.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

E. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion for support of bearing surface of piping.

2.3 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural-steel shapes with MSS SP-58 hanger rods, nuts, saddles, and U-bolts.

2.4 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:
1. B-Line Systems, Inc.; a division of Cooper Industries.
2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
4. Power-Strut Div.; Tyco International, Ltd.
5. Thomas & Betts Corporation.
6. Tolco Inc.
7. Unistrut Corp.; Tyco International, Ltd.

C. Coatings: Manufacturer's standard finish, unless bare metal surfaces are indicated.

D. Nonmetallic Coatings: Plastic coating, jacket, or liner.

2.5 THERMAL-HANGER SHIELD INSERTS

A. Description: 100-psig minimum, compressive-strength insulation insert encased in sheet metal shield.

B. Manufacturers:
1. Carpenter & Paterson, Inc.
2. ERICO/Michigan Hanger Co.

3. PHS Industries, Inc.
4. Pipe Shields, Inc.
5. Rilco Manufacturing Company, Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate or ASTM C 552, Type II cellular glass.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches (50 mm) beyond sheet metal shield for piping operating below ambient air temperature.

2.6 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
1. Manufacturers:
a. Hilti, Inc.
b. ITW Ramset/Red Head.
c. Masterset Fastening Systems, Inc.
d. MKT Fastening, LLC.
e. Powers Fasteners.

2.7 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support pad-mounted piping.

B. Low-Type, Single-Pipe Stand: One-piece stainless-steel base unit with plastic roller.

C. High-Type, Single-Pipe Stand:
1. Description: Assembly of base, vertical and horizontal members, and pipe support.
2. Base: Stainless steel.
3. Vertical Members: Two or more stainless-steel, continuous-thread rods.
4. Horizontal Member: Stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

D. High-Type, Multiple-Pipe Stand:
1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.

2. Bases: One or more; stainless steel.
3. Vertical Members: Two or more stainless steel channels.
4. Horizontal Member: stainless steel channel.
5. Pipe Supports: Stainless steel, clevis-type pipe hangers.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.
1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 EXECUTION

3.1 HANGER AND SUPPORT APPLICATIONS

A. Specific hanger and support requirements are specified in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized, metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use padded hangers for piping that is subject to scratching.

F. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated stationary pipes, NPS 1/2 to NPS 30.
2. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
3. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.

4. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
5. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
6. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
7. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.
9. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.
10. Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.
11. U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.
12. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
13. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from 2 rods if longitudinal movement caused by expansion and contraction might occur.

G. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.

H. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

I. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.

7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below, or for suspending from above by using clip and rod. Use one of the following for indicated loads:
    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.
13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

J. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:
1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

K. Comply with MSS SP-69 for trapeze pipe hanger selections and applications that are not specified in piping system Sections.

L. Comply with MFMA-102 for metal framing system selections and applications that are not specified in piping system Sections.

M. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make smooth bearing surface.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1 procedures for shielded metal arc welding, appearance and quality of welds, and methods used in correcting welding work, and 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. Finish welds at exposed connections so no roughness shows after finishing and contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.5 PAINTING

A. Touch Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 230553

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Equipment labels.
2. Warning signs and labels.
3. Pipe labels.
4. Duct labels.
5. Warning tags.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: Black.
   3. Background Color: White.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified.

C. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: Yellow.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.4 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Blue.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: 3 by 5-1/4 inches minimum.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Yellow background with black lettering.

PART 3 EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   2. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   3. At access doors, manholes, and similar access points that permit view of concealed piping.
   4. Near major equipment items and other points of origination and termination.
   5. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   6. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:
   1. Refrigerant Piping:
      a. Background Color: Black.
      b. Letter Color: White.

3.4 DUCT LABEL INSTALLATION

A. Install self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
   1. Blue: For cold-air supply ducts.
   2. Yellow: For hot-air supply ducts.
   3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
   4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

B. Locate labels near points where ducts enter into concealed spaces and at maximum intervals of 50 feet in each space where ducts are exposed or concealed by removable ceiling system.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION

SECTION 230593

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Balancing Air Systems:
a. Constant-volume air systems.
b. Variable-air-volume systems.

1.3 DEFINITIONS

A. AABC: Associated Air Balance Council.

B. NEBB: National Environmental Balancing Bureau.

C. TAB: Testing, adjusting, and balancing.

D. TABB: Testing, Adjusting, and Balancing Bureau.

E. TAB Specialist: An entity engaged to perform TAB Work.

1.4 SUBMITTALS

A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.

C. Strategies and Procedures Plan: Within 30 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.

D. Certified TAB reports.

E. Instrument calibration reports, to include the following:
   1. Instrument type and make.
   2. Serial number.
   3. Application.
   4. Dates of use.
   5. Dates of calibration.

1.5 QUALITY ASSURANCE

A. TAB Contractor Qualifications: Engage a TAB entity certified by NEBB.
   1. TAB Field Supervisor: Employee of the TAB contractor and certified by NEBB.
   2. TAB Technician: Employee of the TAB contractor and who is certified by NEBB as a TAB technician.

B. Certify TAB field data reports and perform the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.

C. TAB Report Forms: Use standard TAB contractor's forms approved by Commissioning Authority.

D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."

1.6 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.7 COORDINATION

A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

B. Perform TAB after leakage and pressure tests on air distribution systems have been satisfactorily completed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.

B. Examine systems for installed balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers. Verify that locations of these balancing devices are accessible.

C. Examine the approved submittals for HVAC systems and equipment.

D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.

E. Examine equipment performance data including fan and pump curves.
   1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
   2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.

F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.

G. Examine test reports specified in individual system and equipment Sections.

H. Examine HVAC equipment and filters and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

I. Examine terminal units, such as variable-air-volume boxes, and verify that they are accessible and their controls are connected and functioning.

J. Examine strainers. Verify that startup screens are replaced by permanent screens with indicated perforations.

K. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

L. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

M. Examine system pumps to ensure absence of entrained air in the suction piping.

N. Examine operating safety interlocks and controls on HVAC equipment.

O. Report deficiencies discovered before and during performance of TAB procedures. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.2 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system-readiness checks and prepare reports. Verify the following:
1. Permanent electrical-power wiring is complete.
2. Automatic temperature-control systems are operational.
3. Equipment and duct access doors are securely closed.
4. Balance, smoke, and fire dampers are open.
5. Isolating and balancing valves are open and control valves are operational.
6. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
7. Windows and doors can be closed so indicated conditions for system operations can be met.

3.3 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing" and in this Section.
1. Comply with requirements in ASHRAE 62.1, Section 7.2.2, "Air Balancing."

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary for TAB procedures.
1. After testing and balancing, install test ports and duct access doors that comply with requirements in Division 23 Section "Air Duct Accessories."
2. Install and join new insulation that matches removed materials. Restore insulation, coverings, vapor barrier, and finish according to Division 23 Section "HVAC Insulation."

C. Mark equipment and balancing devices, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.4 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.

B. Prepare schematic diagrams of systems' "as-built" duct layouts.

C. For variable-air-volume systems, develop a plan to simulate diversity.

D. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.

E. Check airflow patterns from the outdoor-air louvers and dampers and the return- and exhaust-air dampers through the supply-fan discharge and mixing dampers.

F. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

G. Verify that motor starters are equipped with properly sized thermal protection.

H. Check dampers for proper position to achieve desired airflow path.

I. Check for airflow blockages.

J. Check condensate drains for proper connections and functioning.

K. Check for proper sealing of air-handling-unit components.

L. Verify that air duct system is sealed as specified in Division 23 Section "Metal Ducts."

3.5 PROCEDURES FOR CONSTANT-VOLUME AIR SYSTEMS

A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
   1. Measure total airflow.
      a. Where sufficient space in ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow.
   2. Measure fan static pressures as follows to determine actual static pressure:
      a. Measure outlet static pressure as far downstream from the fan as practical and upstream from restrictions in ducts such as elbows and transitions.
      b. Measure static pressure directly at the fan outlet or through the flexible connection.
      c. Measure inlet static pressure of single-inlet fans in the inlet duct as near the fan as possible, upstream from the flexible connection, and downstream from duct restrictions.
      d. Measure inlet static pressure of double-inlet fans through the wall of the plenum that houses the fan.
   3. Measure static pressure across each component that makes up an air-handling unit, rooftop unit, and other air-handling and -treating equipment.
      a. Report the cleanliness status of filters and the time static pressures are measured.
   4. Measure static pressures entering and leaving other devices, such as sound traps, heat-recovery equipment, and air washers, under final balanced conditions.
   5. Review Record Documents to determine variations in design static pressures versus actual static pressures. Calculate actual system-effect factors. Recommend adjustments to accommodate actual conditions.

6. Obtain approval from Engineer for adjustment of fan speed higher or lower than indicated speed. Comply with requirements in Division 23 Sections for air-handling units for adjustment of fans, belts, and pulley sizes to achieve indicated air-handling-unit performance.
7. Do not make fan-speed adjustments that result in motor overload. Consult equipment manufacturers about fan-speed safety factors. Modulate dampers and measure fan-motor amperage to ensure that no overload will occur. Measure amperage in full-cooling, full-heating, economizer, and any other operating mode to determine the maximum required brake horsepower.

B. Adjust volume dampers for main duct, submain ducts, and major branch ducts to indicated airflows within specified tolerances.
1. Measure airflow of submain and branch ducts.
a. Where sufficient space in submain and branch ducts is unavailable for Pitot-tube traverse measurements, measure airflow at terminal outlets and inlets and calculate the total airflow for that zone.
2. Measure static pressure at a point downstream from the balancing damper, and adjust volume dampers until the proper static pressure is achieved.
3. Remeasure each submain and branch duct after all have been adjusted. Continue to adjust submain and branch ducts to indicated airflows within specified tolerances.

C. Measure air outlets and inlets without making adjustments.
1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust air outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using branch volume dampers rather than extractors and the dampers at air terminals.
1. Adjust each outlet in same room or space to within specified tolerances of indicated quantities without generating noise levels above the limitations prescribed by the Contract Documents.
2. Adjust patterns of adjustable outlets for proper distribution without drafts.

3.6 PROCEDURES FOR VARIABLE-AIR-VOLUME SYSTEMS

A. Compensating for Diversity: When the total airflow of all terminal units is more than the indicated airflow of the fan, place a selected number of terminal units at a minimum set-point airflow with the remainder at maximum-airflow condition until the total airflow of the terminal units equals the indicated airflow of the fan. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.

B. Pressure-Independent, Variable-Air-Volume Systems: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:
1. Set outdoor-air dampers at minimum, and set return- and exhaust-air dampers at a position that simulates full-cooling load.
2. Select the terminal unit that is most critical to the supply-fan airflow and static pressure. Measure static pressure. Adjust system static pressure so the entering static pressure for the critical terminal unit is not less than the sum of the terminal-unit manufacturer's

recommended minimum inlet static pressure plus the static pressure needed to overcome terminal-unit discharge system losses.

3. Measure total system airflow. Adjust to within indicated airflow.
4. Set terminal units at maximum airflow and adjust controller or regulator to deliver the designed maximum airflow. Use terminal-unit manufacturer's written instructions to make this adjustment. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Set terminal units at minimum airflow and adjust controller or regulator to deliver the designed minimum airflow. Check air outlets for a proportional reduction in airflow the same as described for constant-volume air systems.
    a. If air outlets are out of balance at minimum airflow, report the condition but leave outlets balanced for maximum airflow.
6. Remeasure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow.
    a. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
7. Measure static pressure at the most critical terminal unit and adjust the static-pressure controller at the main supply-air sensing station to ensure that adequate static pressure is maintained at the most critical unit.
8. Record final fan-performance data.

3.7 PROCEDURES FOR MOTORS

A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
    1. Manufacturer's name, model number, and serial number.
    2. Motor horsepower rating.
    3. Motor rpm.
    4. Efficiency rating.
    5. Nameplate and measured voltage, each phase.
    6. Nameplate and measured amperage, each phase.
    7. Starter thermal-protection-element rating.

B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.8 PROCEDURES FOR CONDENSING UNITS

A. Verify proper rotation of fans.

B. Measure entering- and leaving-air temperatures.

C. Record compressor data.

3.9 TOLERANCES

A. Set HVAC system's air flow rates within the following tolerances:
   1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 10 percent.
   2. Air Outlets and Inlets: Plus or minus 10 percent.

3.10 REPORTING

A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

B. Status Reports: Prepare biweekly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.11 FINAL REPORT

A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
   1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
   2. Include a list of instruments used for procedures, along with proof of calibration.

B. Final Report Contents: In addition to certified field-report data, include the following:
   1. Fan curves.
   2. Manufacturers' test data.
   3. Field test reports prepared by system and equipment installers.
   4. Other information relative to equipment performance; do not include Shop Drawings and product data.

C. General Report Data: In addition to form titles and entries, include the following data:
   1. Title page.
   2. Name and address of the TAB contractor.
   3. Project name.
   4. Project location.
   5. Architect's name and address.
   6. Engineer's name and address.
   7. Contractor's name and address.
   8. Report date.
   9. Signature of TAB supervisor who certifies the report.
   10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:
    a. Indicated versus final performance.
    b. Notable characteristics of systems.
    c. Description of system operation sequence if it varies from the Contract Documents.
12. Nomenclature sheets for each item of equipment.
13. Data for terminal units, including manufacturer's name, type, size, and fittings.
14. Notes to explain why certain final data in the body of reports vary from indicated values.
15. Test conditions for fans and pump performance forms including the following:
    a. Settings for outdoor-, return-, and exhaust-air dampers.
    b. Conditions of filters.
    c. Cooling coil, wet- and dry-bulb conditions.
    d. Face and bypass damper settings at coils.
    e. Fan drive settings including settings and percentage of maximum pitch diameter.
    f. Inlet vane settings for variable-air-volume systems.
    g. Settings for supply-air, static-pressure controller.
    h. Other system operating conditions that affect performance.

D. System Diagrams: Include schematic layouts of air distribution systems. Present each system with single-line diagram and include the following:
1. Quantities of outdoor, supply, return, and exhaust airflows.
2. Duct, outlet, and inlet sizes.
3. Pipe and valve sizes and locations.
4. Terminal units.
5. Balancing stations.
6. Position of balancing devices.

E. Roof -Top-Unit Test Reports: For roof-top units with coils, include the following:
1. Unit Data:
    a. Unit identification.
    b. Location.
    c. Make and type.
    d. Model number and unit size.
    e. Manufacturer's serial number.
    f. Unit arrangement and class.
    g. Discharge arrangement.
    h. Sheave make, size in inches, and bore.
    i. Center-to-center dimensions of sheave, and amount of adjustments in inches.
    j. Number, make, and size of belts.
    k. Number, type, and size of filters.
2. Motor Data:
    a. Motor make, and frame type and size.
    b. Horsepower and rpm.
    c. Volts, phase, and hertz.
    d. Full-load amperage and service factor.
    e. Sheave make, size in inches, and bore.
    f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
3. Test Data (Indicated and Actual Values):
    a. Total air flow rate in cfm.
    b. Total system static pressure in inches wg.

c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Filter static-pressure differential in inches wg.
f. Cooling-coil static-pressure differential in inches wg.
g. Heating-coil static-pressure differential in inches wg.
h. Outdoor airflow in cfm.
i. Return airflow in cfm.
j. Outdoor-air damper position.
k. Return-air damper position.

F. Fan Test Reports: For supply, return, and exhaust fans, include the following:
1. Fan Data:
a. System identification.
b. Location.
c. Make and type.
d. Model number and size.
e. Manufacturer's serial number.
f. Arrangement and class.
g. Sheave make, size in inches, and bore.
h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
2. Motor Data:
a. Motor make, and frame type and size.
b. Horsepower and rpm.
c. Volts, phase, and hertz.
d. Full-load amperage and service factor.
e. Sheave make, size in inches, and bore.
f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
a. Total airflow rate in cfm.
b. Total system static pressure in inches wg.
c. Fan rpm.
d. Discharge static pressure in inches wg.
e. Suction static pressure in inches wg.

G. Round, Flat-Oval, and Rectangular Duct Traverse Reports: Include a diagram with a grid representing the duct cross-section and record the following:
1. Report Data:
a. System and air-handling-unit number.
b. Location and zone.
c. Traverse air temperature in deg F.
d. Duct static pressure in inches wg.
e. Duct size in inches.
f. Duct area in sq. ft.
g. Indicated air flow rate in cfm.
h. Indicated velocity in fpm.
i. Actual air flow rate in cfm.
j. Actual average velocity in fpm.
k. Barometric pressure in psig.

H. Air-Terminal-Device Reports:
1. Unit Data:
a. System and air-handling unit identification.
b. Location and zone.
c. Apparatus used for test.
d. Area served.
e. Make.
f. Number from system diagram.
g. Type and model number.
h. Size.
i. Effective area in sq. ft.
2. Test Data (Indicated and Actual Values):
a. Air flow rate in cfm.
b. Air velocity in fpm.
c. Preliminary air flow rate as needed in cfm.
d. Preliminary velocity as needed in fpm.
e. Final air flow rate in cfm.
f. Final velocity in fpm.
g. Space temperature in deg F.

3.12 INSPECTIONS

A. Initial Inspection:
1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
2. Check the following for each system:
a. Measure airflow of at least 10 percent of air outlets.
b. Measure room temperature at each thermostat/temperature sensor. Compare the reading to the set point.
c. Verify that balancing devices are marked with final balance position.
d. Note deviations from the Contract Documents in the final report.

B. Final Inspection:
1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Commissioning Authority.
2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Commissioning Authority.
3. Commissioning Authority shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be

considered incomplete and shall be rejected.

C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
   1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
   2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.

D. Prepare test and inspection reports.

3.13 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.

B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

SECTION 230700

HVAC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
2. Adhesives.
3. Mastics.
4. Lagging adhesives.
5. Sealants.
6. Factory-applied jackets.
7. Field-applied jackets.
8. Tapes.
9. Securements.

D. Related Sections:
1. Division 23 Section "Metal Ducts" for duct liners.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, thickness, and jackets (both factory and field applied, if any).

B. Shop Drawings:
1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each

type of insulation.
5. Detail removable insulation at piping specialties, equipment connections, and access panels.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.
8. Detail field application for each equipment type.

C. Qualification Data: For qualified Installer.

D. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

E. Field quality-control reports.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Fire-Test-Response Characteristics: Insulation and related materials shall have fire-test-response characteristics indicated, as determined by testing identical products per ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing and inspecting agency.
1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Before preparing piping and ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in Part 3 schedule articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Flexible Elastomeric: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

F. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type III with factory-applied FSP jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Duct Wrap.
      b. Johns Manville; Microlite.
      c. Knauf Insulation; Duct Wrap.
      d. Manson Insulation Inc.; Alley Wrap.
      e. Owens Corning; All-Service Duct Wrap.

G. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IA or Type IB. For duct and plenum applications, provide insulation with factory-applied FSK jacket. For equipment applications, provide insulation with factory-applied FSK jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corp.; Commercial Board.

b. Fibrex Insulations Inc.; FBX.
c. Johns Manville; 800 Series Spin-Glas.
d. Knauf Insulation; Insulation Board.
e. Manson Insulation Inc.; AK Board.
f. Owens Corning; Fiberglas 700 Series.

H. Mineral-Fiber, Preformed Pipe Insulation:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Fibrex Insulations Inc.; Coreplus 1200.
b. Johns Manville; Micro-Lok.
c. Knauf Insulation; 1000 Pipe Insulation.
d. Manson Insulation Inc.; Alley-K.
e. Owens Corning; Fiberglas Pipe Insulation.
2. Type I, 850 deg F Materials: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 547, Type I, Grade A, with factory-applied ASJ. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.
3. Conductivity: 0.28 Btu*in./(h*ft2 °F).

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Aeroflex USA Inc.; Aeroseal.
b. Armacell LCC; 520 Adhesive.
c. Foster Products Corporation, H. B. Fuller Company; 85-75.
d. RBX Corporation; Rubatex Contact Adhesive.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products, Division of ITW; CP-82.
b. Foster Products Corporation, H. B. Fuller Company; 85-20.
c. ITW TACC, Division of Illinois Tool Works; S-90/80.
d. Marathon Industries, Inc.; 225.
e. Mon-Eco Industries, Inc.; 22-25.

2.3 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-C-19565C, Type II.

B. Vapor-Barrier Mastic: Water based; suitable for indoor and outdoor use on below ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-35.
      b. Foster Products Corporation, H. B. Fuller Company; 30-90.
      c. ITW TACC, Division of Illinois Tool Works; CB-50.
      d. Marathon Industries, Inc.; 590.
      e. Mon-Eco Industries, Inc.; 55-40.
      f. Vimasco Corporation; 749.
   2. Water-Vapor Permeance: ASTM E 96, Procedure B, 0.013 perm at 43-mil dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 180 deg F.
   4. Solids Content: ASTM D 1644, 59 percent by volume and 71 percent by weight.
   5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above ambient services.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-10.
      b. Foster Products Corporation, H. B. Fuller Company; 35-00.
      c. ITW TACC, Division of Illinois Tool Works; CB-05/15.
      d. Marathon Industries, Inc.; 550.
      e. Mon-Eco Industries, Inc.; 55-50.
      f. Vimasco Corporation; WC-1/WC-5.
   2. Water-Vapor Permeance: ASTM F 1249, 3 perms at 0.0625-inch dry film thickness.
   3. Service Temperature Range: Minus 20 to plus 200 deg F.
   4. Solids Content: 63 percent by volume and 73 percent by weight.
   5. Color: White.

2.4 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-52.
      b. Foster Products Corporation, H. B. Fuller Company; 81-42.
      c. Marathon Industries, Inc.; 130.
      d. Mon-Eco Industries, Inc.; 11-30.
      e. Vimasco Corporation; 136.
   2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over duct, equipment, and pipe insulation.
   3. Service Temperature Range: Minus 50 to plus 180 deg F.
   4. Color: White.

2.5 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Childers Products, Division of ITW; CP-76-8.
      b. Foster Products Corporation, H. B. Fuller Company; 95-44.
      c. Marathon Industries, Inc.; 405.
      d. Mon-Eco Industries, Inc.; 44-05.
      e. Vimasco Corporation; 750.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: Aluminum.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:
   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. Childers Products, Division of ITW; CP-76.
   2. Materials shall be compatible with insulation materials, jackets, and substrates.
   3. Fire- and water-resistant, flexible, elastomeric sealant.
   4. Service Temperature Range: Minus 40 to plus 250 deg F.
   5. Color: White.

2.6 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:
   1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
   2. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.7 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Johns Manville; Zeston.
      b. P.I.C. Plastics, Inc.; FG Series.
      c. Proto PVC Corporation; LoSmoke.
      d. Speedline Corporation; SmokeSafe.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: White.
   4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.
      a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges,

unions, reducers, end caps, soil-pipe hubs, traps, and mechanical joints.

5. Factory-fabricated tank heads and tank side panels.

C. Self-Adhesive Outdoor Jacket: 60-mil-thick, laminated vapor barrier and waterproofing membrane for installation over insulation located aboveground outdoors; consisting of a rubberized bituminous resin on a crosslaminated polyethylene film covered with stucco-embossed aluminum-foil facing.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Polyguard Products, Inc.; Alumaguard 60.

D. Outdoor insulation PVC Jacket: Insulation Protector for Refrigeration Piping on Outdoor applications that complies with mandatory requirements. Engineered PVC Material is UV/Weather Resistant and a Class II Vapor Retarder. Insulation Protection System consists of an Engineered and Formulated PVC Sheeted Material to Specifically protect outdoor piping insulation, it is designed and manufactured as a flexible PVC jacket, with a permanent non-adhesive dual bonded self-gripping integral fastening system. The fastening system allows the protector to be Removable and Reusable for ease of Maintenance, as required by code bodies. The Insulation Protector consists of resilient PVC Material that is Class "A" Fire/Smoke Rated, Vapor Retarder, Anti-Fungal, and Anti-Microbial.
   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. Airex: Eflexguard.
      b. Childers Products, Division of ITW.
      c. Foster Products Corportaion.
      d. Or Approved Equal.
   2. Adhesive: As recommended by jacket material manufacturer.
   3. Color: White.
      a. Shapes: 90-degree, short- and long-radius elbows, mechanical joints.
   4. Comply with ASTM E96 and ASTM G153.

2.8 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0835.
      b. Compac Corp.; 104 and 105.
      c. Ideal Tape Co., Inc., an American Biltrite Company; 428 AWF ASJ.
      d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.
   2. Width: 3 inches.
   3. Thickness: 11.5 mils.
   4. Adhesion: 90 ounces force/inch in width.
   5. Elongation: 2 percent.
   6. Tensile Strength: 40 lbf/inch in width.
   7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.
   1. Products: Subject to compliance with requirements, provide one of the following:

a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
b. Compac Corp.; 110 and 111.
c. Ideal Tape Co., Inc., an American Biltrite Company; 491 AWF FSK.
d. Venture Tape; 1525 CW, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive. Suitable for indoor and outdoor applications.
1. Products: Subject to compliance with requirements, provide one of the following:
a. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0555.
b. Compac Corp.; 130.
c. Ideal Tape Co., Inc., an American Biltrite Company; 370 White PVC tape.
d. Venture Tape; 1506 CW NS.
2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.9 SECUREMENTS

A. Bands:
1. Products: Subject to compliance with requirements, provide one of the following:
a. Childers Products; Bands.
b. PABCO Metals Corporation; Bands.
c. RPR Products, Inc.; Bands.
2. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M, Type 304 or Type 316; 0.015 inch thick, 3/4 inch wide with wing seal.
3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 3/4 inch wide with wing seal.

B. Insulation Pins and Hangers:
1. Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated.
a. Products: Subject to compliance with requirements, provide one of the following:
1) AGM Industries, Inc.; CWP-1.
2) GEMCO; CD.
3) Midwest Fasteners, Inc.; CD.
4) Nelson Stud Welding; TPA, TPC, and TPS.
2. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.135-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
a. Products: Subject to compliance with requirements, provide one of the following:

1) AGM Industries, Inc.; CWP-1.
2) GEMCO; Cupped Head Weld Pin.
3) Midwest Fasteners, Inc.; Cupped Head.
4) Nelson Stud Welding; CHP.

3. Metal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series T.
      2) GEMCO; Perforated Base.
      3) Midwest Fasteners, Inc.; Spindle.
   b. Baseplate: Perforated, galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
4. Nonmetal, Adhesively Attached, Perforated-Base Insulation Hangers: Baseplate fastened to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) GEMCO; Nylon Hangers.
      2) Midwest Fasteners, Inc.; Nylon Insulation Hangers.
   b. Baseplate: Perforated, nylon sheet, 0.030 inch thick by 1-1/2 inches in diameter.
   c. Spindle: Nylon, 0.106-inch-diameter shank, length to suit depth of insulation indicated, up to 2-1/2 inches.
   d. Adhesive: Recommended by hanger manufacturer. Product with demonstrated capability to bond insulation hanger securely to substrates indicated without damaging insulation, hangers, and substrates.
5. Self-Sticking-Base Insulation Hangers: Baseplate welded to projecting spindle that is capable of holding insulation, of thickness indicated, securely in position indicated when self-locking washer is in place. Comply with the following requirements:
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; Tactoo Insul-Hangers, Series TSA.
      2) GEMCO; Press and Peel.
      3) Midwest Fasteners, Inc.; Self Stick.
   b. Baseplate: Galvanized carbon-steel sheet, 0.030 inch thick by 2 inches square.
   c. Spindle: Copper- or zinc-coated, low carbon steel, fully annealed, 0.106-inch-diameter shank, length to suit depth of insulation indicated.
   d. Adhesive-backed base with a peel-off protective cover.
6. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick, galvanized-steel sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) AGM Industries, Inc.; RC-150.
      2) GEMCO; R-150.
      3) Midwest Fasteners, Inc.; WA-150.

4) Nelson Stud Welding; Speed Clips.

b. Protect ends with capped self-locking washers incorporating a spring steel insert to ensure permanent retention of cap in exposed locations.

7. Nonmetal Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch-thick nylon sheet, with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) GEMCO.
      2) Midwest Fasteners, Inc.

C. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

D. Wire: 0.062-inch soft-annealed, stainless steel.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. C & F Wire.
      b. Childers Products.
      c. PABCO Metals Corporation.
      d. RPR Products, Inc.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
   1. Verify that systems and equipment to be insulated have been tested and are free of defects.
   2. Verify that surfaces to be insulated are clean and dry.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Surface Preparation: Clean and prepare surfaces to be insulated. Before insulating, apply a corrosion coating to insulated surfaces as follows:
   1. Stainless Steel: Coat 300 series stainless steel with an epoxy primer 5 mils thick and an epoxy finish 5 mils thick if operating in a temperature range between 140 and 300 deg F. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.
   2. Carbon Steel: Coat carbon steel operating at a service temperature between 32 and 300 deg F with an epoxy coating. Consult coating manufacturer for appropriate coating materials and application methods for operating temperature range.

C. Coordinate insulation installation with the trade installing heat tracing. Comply with

requirements for heat tracing that apply to insulation.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.
   1. Install insulation continuously through hangers and around anchor attachments.
   2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
   3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
   4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:
   1. Draw jacket tight and smooth.
   2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.

3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.
   a. For below ambient services, apply vapor-barrier mastic over staples.
4. Cover joints and seams with tape as recommended by insulation material manufacturer to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to duct and pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above ambient services, do not install insulation to the following:
1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.
1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.

4. Seal jacket to wall flashing with flashing sealant.

C. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

D. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.
   1. Comply with requirements in Division 7 Section "Through-Penetration Firestop Systems" for firestopping and fire-resistive joint sealers.

E. Insulation Installation on Pumps:
   1. Fabricate metal boxes lined with insulation. Fit boxes around pumps and coincide box joints with splits in pump casings. Fabricate joints with outward bolted flanges. Bolt flanges on 6-inch centers, starting at corners. Install 3/8-inch diameter fasteners with wing nuts. Alternatively, secure the box sections together using a latching mechanism.
   2. Fabricate boxes from stainless steel, at least 0.040 inch thick.
   3. For below ambient services, install a vapor barrier at seams, joints, and penetrations. Seal between flanges with replaceable gasket material to form a vapor barrier.

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:
   1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity, unless otherwise indicated.
   2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
   3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
   4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
   5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and

replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below ambient services, provide a design that maintains vapor barrier.

6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below ambient services and a breather mastic for above ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Label the outside insulation jacket of each union with the word "UNION." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, 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.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:
1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 FLEXIBLE ELASTOMERIC INSULATION INSTALLATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:
   1. Install pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
   4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install mitered sections of pipe insulation.
   2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed valve covers manufactured of same material as pipe insulation when available.
   2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   3. Install insulation to flanges as specified for flange insulation application.
   4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.7 MINERAL-FIBER INSULATION INSTALLATION

A. Insulation Installation on Straight Pipes and Tubes:
   1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
   2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
   3. For insulation with factory-applied jackets on above ambient surfaces, secure laps with outward clinched staples at 6 inches o.c.
   4. For insulation with factory-applied jackets on below ambient surfaces, do not staple longitudinal tabs but secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:
   1. Install preformed pipe insulation to outer diameter of pipe flange.
   2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
   3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
   4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of same material as straight segments of pipe insulation when available.
   2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
   3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
   4. Install insulation to flanges as specified for flange insulation application.

E. Blanket Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
   1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
   2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
   3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
      a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
      b. On duct sides with dimensions larger than 18 inches, place pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
      c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
      d. Do not overcompress insulation during installation.
      e. Impale insulation over pins and attach speed washers.
      f. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
   4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
      a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
      b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.

5. Overlap unfaced blankets a minimum of 2 inches on longitudinal seams and end joints. At end joints, secure with steel bands spaced a maximum of 18 inches o.c.
6. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
7. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

F. Board Insulation Installation on Ducts and Plenums: Secure with adhesive and insulation pins.
1. Apply adhesives according to manufacturer's recommended coverage rates per unit area, for 100 percent coverage of duct and plenum surfaces.
2. Apply adhesive to entire circumference of ducts and to all surfaces of fittings and transitions.
3. Install either capacitor-discharge-weld pins and speed washers or cupped-head, capacitor-discharge-weld pins on sides and bottom of horizontal ducts and sides of vertical ducts as follows:
    a. On duct sides with dimensions 18 inches and smaller, place pins along longitudinal centerline of duct. Space 3 inches maximum from insulation end joints, and 16 inches o.c.
    b. On duct sides with dimensions larger than 18 inches, space pins 16 inches o.c. each way, and 3 inches maximum from insulation joints. Install additional pins to hold insulation tightly against surface at cross bracing.
    c. Pins may be omitted from top surface of horizontal, rectangular ducts and plenums.
    d. Do not overcompress insulation during installation.
    e. Cut excess portion of pins extending beyond speed washers or bend parallel with insulation surface. Cover exposed pins and washers with tape matching insulation facing.
4. For ducts and plenums with surface temperatures below ambient, install a continuous unbroken vapor barrier. Create a facing lap for longitudinal seams and end joints with insulation by removing 2 inches from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch outward-clinching staples, 1 inch o.c. Install vapor barrier consisting of factory- or field-applied jacket, adhesive, vapor-barrier mastic, and sealant at joints, seams, and protrusions.
    a. Repair punctures, tears, and penetrations with tape or mastic to maintain vapor-barrier seal.
    b. Install vapor stops for ductwork and plenums operating below 50 deg F at 18-foot intervals. Vapor stops shall consist of vapor-barrier mastic applied in a Z-shaped pattern over insulation face, along butt end of insulation, and over the surface. Cover insulation face and surface to be insulated a width equal to 2 times the insulation thickness but not less than 3 inches.
5. Install insulation on rectangular duct elbows and transitions with a full insulation section for each surface. Groove and score insulation to fit as closely as possible to outside and inside radius of elbows. Install insulation on round and flat-oval duct elbows with individually mitered gores cut to fit the elbow.
6. Insulate duct stiffeners, hangers, and flanges that protrude beyond insulation surface with 6-inch-wide strips of same material used to insulate duct. Secure on alternating sides of stiffener, hanger, and flange with pins spaced 6 inches o.c.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications, install with longitudinal seams along top and bottom of tanks and vessels. Seal with manufacturer's recommended adhesive.
   1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

3.9 FINISHES

A. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Tests and Inspections:
   1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.
   2. Inspect field-insulated equipment, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.
   3. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and threelocations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, concealed supply and outdoor air.

2. Indoor, exposed supply and outdoor air.
3. Indoor, concealed return located in nonconditioned space.
4. Indoor, exposed return located in nonconditioned space.
5. Indoor, concealed exhaust between isolation damper and penetration of building exterior.
6. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:
1. Fibrous-glass ducts.
2. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
3. Factory-insulated flexible ducts.
4. Factory-insulated plenums and casings.
5. Flexible connectors.
6. Vibration-control devices.
7. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Rectangular, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

B. Round, supply-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

C. Rectangular, return-air duct air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

D. Round, return-air duct air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

E. Rectangular, unconditioned outdoor-air duct insulation shall be one of the following:
1. Mineral-Fiber Blanket: 3 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 2 inches thick and 2-lb/cu. ft. nominal density.

F. Rectangular, exhaust-air duct insulation between isolation damper and penetration of building exterior shall be one of the following:
1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
2. Mineral-Fiber Board: 1-1/2 inches thick and 2-lb/cu. ft. nominal density.

3.13 EQUIPMENT INSULATION SCHEDULE

A. Insulation materials and thicknesses are identified below. If more than one material is listed for a type of equipment, selection from materials listed is Contractor's option.

B. Insulate indoor and outdoor equipment in paragraphs below that is not factory insulated.

3.14 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:
   1. Drainage piping located in crawl spaces.
   2. Underground piping.
   3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.15 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be one of the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.
      b. Flexible Elastomeric: 3/4 inch thick.

B. Refrigerant Liquid, Suction and Hot-Gas Flexible Tubing for ductless split systems:
   1. Refer to specification Division 23 Section " REFRIGERANT PIPINGRefrigerant Piping" for pre-insulated pipe sets.

C. Refrigerant Suction and Hot-Gas Flexible Tubing for VRF systems:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick.

3.16 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant, Liquid, Suction and Hot-Gas Flexible Tubing for individual split systems: Refer to specification Division 23 Section " REFRIGERANT PIPINGRefrigerant Piping" for pre-insulated pipe sets.

B. Outdoor Refrigerant Suction and Hot-Gas Flexible Tubing for VRF systems:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1-1/8” inch thick Aeroflex Aerocel UV resistant insulation.

3.17 OUTDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. Refrigerant Piping, Exposed: Outdoor insulation PVC Jacket Airex Eflexguard or approved equal with Airex Titan outlet TGS Series at refrigerant piping exterior wall penetrations.

END OF SECTION

SECTION 230900

INSTRUMENTATION AND CONTROL FOR HVAC

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes control equipment for HVAC systems and components, including control components for terminal heating and cooling units not supplied with factory-wired controls.

D. Scope of work includes all work associated with new equipment controls, including but not limited to controllers and appurtenances not factory required and as required to meet the sequences of operation indicated on contract documents, as well as installation of all controls appurtenances shipped loose from factory, and all wiring, programming, and graphics for Schneider Electric EcoStruxure BMS system.

E. Related Sections include the following:
1. Division 23 Section "Meters and Gages" for measuring equipment that relates to this Section.

1.3 DEFINITIONS

A. DDC: Direct digital control.

B. LAN: Local Area Network.

1.4 SUBMITTALS

A. Product Data: Include manufacturer's technical literature for each control device. Indicate dimensions, capacities, performance characteristics, electrical characteristics, finishes for materials, and installation and startup instructions for each type of product indicated.
   1. DDC System Hardware: Bill of materials of equipment indicating quantity, manufacturer, and model number. Include technical data for operator workstation equipment, interface equipment, control units, transducers/transmitters, sensors, actuators, valves, relays/switches, control panels, and operator interface equipment.
   2. Controlled Systems: Instrumentation list with element name, type of device, manufacturer, model number, and product data. Include written description of sequence of operation including schematic diagram.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Bill of materials of equipment indicating quantity, manufacturer, and model number.
   2. Schematic flow diagrams showing fans, pumps, coils, dampers, valves, and control devices.
   3. Wiring Diagrams: Power, signal, and control wiring.
   4. Details of control panel faces, including controls, instruments, and labeling.
   5. Written description of sequence of operation.
   6. Schedule of dampers including size, leakage, and flow characteristics.
   7. Schedule of valves including flow characteristics.
   8. DDC System Hardware:
      a. Wiring diagrams for control units with termination numbers.
      b. Schematic diagrams and floor plans for field sensors and control hardware.
      c. Schematic diagrams for control, communication, and power wiring, showing trunk data conductors and wiring between operator workstation and control unit locations.
   9. Control System Software: List of color graphics indicating monitored systems, data (connected and calculated) point addresses, output schedule, and operator notations.
   10. Controlled Systems:
      a. Schematic diagrams of each controlled system with control points labeled and control elements graphically shown, with wiring.
      b. Scaled drawings showing mounting, routing, and wiring of elements including bases and special construction.
      c. Written description of sequence of operation including schematic diagram.
      d. Points list.

C. Qualification Data: For Installer.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For HVAC instrumentation and control system 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. Maintenance instructions and lists of spare parts for each type of control device and compressed-air station.
   2. Interconnection wiring diagrams with identified and numbered system components and devices.

3. Keyboard illustrations and step-by-step procedures indexed for each operator function.
4. Inspection period, cleaning methods, cleaning materials recommended, and calibration tolerances.
5. Calibration records and list of set points.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Automatic control system manufacturer's authorized representative who is trained and approved for installation of system components required for this Project.

B. 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.

1.6 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate supply of electrical branch circuits for control units.

C. Coordinate equipment with Division 16 Section "Motor-Control Centers" to achieve compatibility with motor starters and annunciation devices.

1.7 WARRANTY.

A. 2-year parts and service warranty.

B. All zone thermostats as part of this contract shall have no LCD display screen and with occupancy override unless otherwise noted. All remote standalone sensors (non-communication to building Supervisory Controller) shall be provided with standalone thermostat with locking non-clear metal vented cover. Provide all thermostats in gymnasium in clear lockable vented enclosure.

C. Provide unit scheduling function through Individual Building Supervisory Controllers. Scheduling shall be unit specific with the ability to group like units and zones.

D. All controls shall be hard-wired, including all controllers and sensors. Wireless controls shall not be acceptable.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design Product: Subject to compliance with requirements, provide Schneider Electric Ecostruxture products by CM3 or one of the following pre-qualified manufacturers. MP/RP BACnet series, b3 BACnet series, MNB BACnet, MNL LON, Xenta LON series installed by approved manufacturer's local field office or authorized distributor.
   1. Conexus.
   2. CM3 Building Solutions.
   3. The Tri-M Group, LLC.

2.2 SYSTEM ARCHITECTURE

A. General.
   1. The BAS shall provide control, alarm detection, scheduling, reporting and information management for the entire building, and interface with the Local Area Network (LAN) or Wide Area Network (WAN) as required.
   2. The Building Automation System (BAS) shall consist of:
      a. Network Server/Controllers (NSCs),
      b. Standalone Digital Control Units (SDCUs).
      c. Administration and Programming Workstations (APWs).
      d. Enterprise Server (ES).
      e. Report Server (RS).
      f. Web-based Operator Workstations (WOWs).
   3. Where two or more NSCs are included, an Enterprise Server is required, which enables multiple NSCs (including all graphics, alarms, schedules, trends, programming, and configuration) to be accessible from Workstations simultaneously for operations and engineering tasks.
   4. The Enterprise Level BAS shall be able to host up to 250 Network Servers (NSCs) beneath it.
   5. For Enterprise reporting capability and robust reporting capability outside of the trend chart and listing ability of the Workstation, a Reports Server shall be installed on a Microsoft Windows SQL based computer. The Reports Server can be installed on the same computer as the Enterprise Server.
   6. The system shall be designed with a top-level 10/100bT Ethernet network, using the BACnet/IP, and/or Modbus TCP protocol.

B. Modbus RTU, Modbus TCP, BACnet MS/TP, BACnet IP, and WebServices shall be native to the NSCs. There shall not be a need to provide multiple NSCs to support all the network protocols, nor should there be a need to supply additional software to allow these protocols to be natively supported.

C. A Fieldbus network of Standalone Digital Control Units (SDCUs) using the BACnet IP, BACnet MS/TP protocol shall connect the SDCUs with an Ethernet-level NSC using managed Ethernet switches where required. The NSC shall have a fixed IP address for connection the facility network and the SDCUs shall have separate, non-facility BACnet addresses assigned and managed by the NSC.

D. BACnet IP Fieldbus SDCUs shall consist of one or more BACnet/IP field buses managed by the Network Server Controller. The field bus layer shall consist of up to 50 IP SDCUs in daisy chain topology, or 39 if using RSTP, per layer, with a max of 5 sub networks in daisy chain for a total of 250 SDCUs or 6 sub networks in RSTP for a total of 234 SDCUs.

E. BACnet MS/TP Fieldbus SDCUs shall consist of one or more BACnet MS/TP field buses managed by the Network Server Controller. Minimum speed shall be 76.8kbps. The field bus layer consists of an RS485, token passing bus that supports up to 127 Standalone Digital Control Units (SDCUs) for operation of HVAC and lighting equipment. These devices shall conform to BACnet standard 135-2004. The NSCs shall be capable of at least two BACnet MS/TP field buses for a total capability of 254 SDCUs per NSC.

F. BAS LAN Segmentation: The BAS shall be capable of being segmented, through software, into multiple local area networks (LANs) distributed over a wide area network (WAN). Workstations can manage a single LAN (or building), and/or the entire system with all portions of that LAN maintaining its own, current database.

G. Standard Network Support: All NSCs, Workstation(s) and Servers shall be capable of residing directly on the owner's Ethernet TCP/IP LAN/WAN with no required gateways. Furthermore, the NSC's, Workstation(s), and Server(s) shall be capable of using standard, commercially available, off-the-shelf Ethernet infrastructure components such as routers, switches and hubs. With this design the owner may utilize the investment of a new enterprise network or structured cabling system. This also allows the option of the maintenance of the LAN/WAN to be performed by the owner's Information Systems Department as all devices utilize standard TCP/IP components.

H. Web Services: The installed system shall be able to use web services to "consume" information within the Network Server/Controllers (NSCs) with other products and systems. Inability to perform web services within the NSCs will be unacceptable. The NSC shall be able to "consume" data into the system via SOAP and REST web services.

I. System Expansion.
   1. The BAS system shall be scalable and expandable at all levels of the system using the same software interface, and the same TCP/IP level and fieldbus level controllers. Systems that require replacement of either the workstation software or field controllers in order to expand the system shall not be acceptable.
   2. Web-based operation shall be supported directly by the NSCs and require no additional software.
   3. The system shall be capable of using graphical and/or line application programming language for the Network Server Controllers.
   4. All Network Server Controllers must natively support the open systems protocols of: BACnet IP, BACnet MS/TP, Modbus TCP and Modbus RTU protocols.

2.3 OPERATOR WORKSTATION REQUIREMENTS

A. General.
   1. The operator workstation portion of the BAS shall consist of one or more full-powered configuration and programming workstations, and one or more web-based operator workstations. For this project provide a minimum of 2 concurrent operator users and/or 1

concurrent engineering user.

2. The programming and configuration workstation software shall allow any user with adequate permission to create and/or modify any or all parts of the NSC and/or Enterprise Server database.
3. Web-based workstations shall have a minimum of 5 concurrent operator users.
4. All configuration workstations shall be personal computers operating under the Microsoft Windows operating system. The application software shall be capable of communication to all Network Server Controllers and shall feature high-resolution color graphics, alarming, trend charting. It shall be user configurable for all data collection and data presentation functions.
5. A minimum of 2 physical Workstations shall be allowed on the Ethernet network. In this client/server configuration, any changes or additions made from one workstation will automatically appear on all other workstations since the changes are accomplished to the databases within the NSC.

B. Workstation, Programming Workstation, and Enterprise Server Requirements:
   1. Processor Intel Core i5 @ 3.0 GHz or better.
   2. Memory: Minimum: 8GB RAM, 300 GB or larger hard disk, DVD drive.
   3. Operating systems:
      a. Microsoft Windows 11 64-bit (Pro).
   4. 10/100MBPS Ethernet NIC.
   5. SQL (Report Server only) Software - Microsoft SQL Server 2008 R2 with SP2 or 2012 64-bit (Standard and Express with Advanced Services).
   6. License agreement for all applicable software.

C. Web-Based Operator PC Requirements - Any user on the network can access the system, using Internet Explorer 11, or Mozilla Firefox, or Google Chrome.

D. System Software Architecture.
   1. System architecture shall be truly client server in that the Workstation shall operate as the client while the NSCs shall operate as the servers. The client is responsible for the data presentation and validation of inputs while the server is responsible for data gathering and delivery.
   2. The workstation functions shall include monitoring and programming of all DDC controllers. Monitoring consists of alarming, reporting, graphic displays, long term data storage, automatic data collection, and operator-initiated control actions such as schedule and setpoint adjustments.
   3. Programming of controllers shall be capable of being done either off-line or on-line from any programming workstation. All information will be available in graphic displays. Graphic displays will feature animation effects to enhance the presentation of the data, to alert operators of problems, and to facilitate location of information throughout the DDC system. All operator functions shall be selectable.
   4. The software shall be designed so that each user of the software can have a unique username and password. This username/password combination shall be linked to a set of capabilities within the software, set by and editable only by, a system administrator. The sets of capabilities shall range from View only, Acknowledge alarms, Enable/disable and change values, Program, and Administer. The system shall allow the above capabilities to be applied independently to each and every class of object in the system. The system must allow a minimum of 256 users to be configured per workstation. Additionally, the software shall enable the ability to add/remove users based upon Microsoft Windows

Security Domains that enable the customer IT department to assist in user access.

a. Additional requirements include mandatory change of passwords:
b. No general accounts, one account per user.
c. Capability to integrate and use Windows Active Directory for user log on credentials.
d. Include a timed auto log off feature.
e. Use TLS 1.2 encryption or higher.
f. Capability to use blacklisted and whitelisted IPs/MAC addresses to gate access.
g. All devices and software that support HTTP shall allow disabling the HTTP access and require access via HTTPS.
h. All devices that have web portals for the configuration of IP addresses and other configuration attributes shall have the ability, through commands issued, to disable this service upon completion. A direct connection method with ASCII commands shall enable this service again if changes need to be applied. Loss of power or cycling the device shall not reverse this command. Disabling this web portal eliminates the security risk and the need for updating security patches.
i. All devices shall support SNMP V3 monitoring of network performance and stack statistics for the purpose of managing denial of service attacks.
j. The Integrated Control Platform shall support the feature to alarm on a predetermined period of time until the default password for each device is changed from the default factory setting.
k. The Integrated Control Platform shall support encrypted password authentication for all web services whether serving or consuming.

E. Web-based Operator Software.
1. General:
a. Day-to-day operation of the system shall be accessible through a standard web browser interface, allowing technicians and operators to view any part of the system from anywhere on the network.
b. The system shall be able to be accessed on site via a mobile device environment with, at a minimum, access to overwrite and view system values.
2. Graphic Displays.
a. The browser-based interface must share the same graphical displays as the Administration and Programming Workstations, presenting dynamic data on site layouts, floor plans, and equipment graphics. The browser’s graphics shall support commands to change setpoints, enable/disable equipment and start/stop equipment.
b. Through the browser-based interface, operators must be able to navigate through the entire system, and change the value or status of any point in any controller. Changes are effective immediately to the controller, with a record of the change stored in the system database.
3. Alarm Management.
a. Systems requiring additional client software to be installed on a PC for viewing the webstation from that PC will not be considered.
b. Through the browser interface, a live alarm viewer identical to the alarm viewer on the Administration and Programming workstation shall be presented, if the user’s password allows it. Users must be able to receive alarms, silence alarms, and acknowledge alarms through a browser. If desired, specific operator text must be able to be added to the alarm record before acknowledgement, attachments shall be viewable, and alarm checklists shall be available.

4. Groups and Schedules.
    a. Through the browser interface, operators must be able to view pre-defined groups of points, with their values updated automatically.
    b. Through the browser interface, operators must be able to change schedules - change start and stop times, add new times to a schedule, and modify calendars.
5. User Accounts and Audit Trail.
    a. The same user accounts shall be used for the browser interface and for the operator workstations. Operators must not be forced to memorize multiple passwords.
    b. All commands and user activity through the browser interface shall be recorded in the system's activity log, which can be later searched and retrieved by user, date, or both.

F. User Workstation:
1. The BAS workstation software shall allow the creation of a custom, browser-style interface linked to the user when logging into any workstation. Additionally, it shall be possible to create customized workspaces that can be assigned to user groups. This interface shall support the creation of "hot-spots" that the user may link to view/edit any object in the system or run any object editor or configuration tool contained in the software. Furthermore, this interface must be able to be configured to become a user's "PC Desktop" - with all the links that a user needs to run other applications. This, along with the Windows user security capabilities, will enable a system administrator to setup workstation accounts that not only limit the capabilities of the user within the BAS software, but may also limit what a user can do on the PC and/or LAN/WAN. This might be used to ensure, for example, that the user of an alarm monitoring workstation is unable to shutdown the active alarm viewer and/or unable to load software onto the PC.
2. Webstations shall have the capability to automatically re-direct to an HTTPS connection to ensure more secure communications.
3. Personalized layouts and panels based on username and passwords within workstations shall be extended to webstations to ensure consistent user experiences between the two user interfaces.
4. Workstations, Servers and NSCs shall have the ability to be located in different time zones, which are then synchronized via the NTP server.
5. Workstation shall indicate at all times the communication status between it and the server.

G. Administration and Programming Workstation.
1. The workstation software shall use a familiar Windows Explorer style interface for an operator or programmer to view and/or edit any object (controller, point, alarm, report, schedule, etc.) in the entire system. In addition, this interface shall present a "network map" of all controllers and their associated points, programs, graphics, alarms, and reports in an easy to understand structure. All object names shall be alphanumeric and use Windows long filename conventions.
2. The configuration interface shall also include support for user defined object types. These object types shall be used as building blocks for the creation of the BAS database. They shall be created form the base object types within the system input, output, string variables, setpoints, etc., alarm algorithms, alarm notification objects, reports, graphics displays, schedules, and programs. Groups of user defined object types shall be able to be set up as a predefined aggregate of subsystems and systems. The configuration interface shall support copying/pasting and exporting/importing portions of the database for additional efficiency. The system shall also maintain a link to all "child" objects created. If a user wishes to make a change to a parent object, the software shall ask the user if

he/she wants to update all of the child objects with the change.

H. Color Graphic Displays.
   1. The Administration and Programming Workstation shall allow for the creation of user defined, color graphic displays for the viewing of mechanical and electrical systems, or building schematics. These graphics shall contain point information from the database including any attributes associated with the point (engineering units, etc.). In addition operators shall be able to command equipment or change setpoints from a graphic through the use of the mouse.
   2. Requirements of the color graphic subsystem include:
      a. At a minimum, the user shall have the ability to import.gif,.png,.bmp,.jpeg,.tif, and CAD generated picture files as background displays, and layering shall be possible.
      b. The system shall support HTML5 enabled graphics.
      c. It shall be possible for the user to use JavaScript to customize the behavior of each graphic.
      d. The editor shall use Scalable Vector Graphics (SVG) technology.
      e. A built-in library of animated objects such as dampers, fans, pumps, buttons, knobs, gauges, ad graphs which can be “dropped” on a graphic through the use of a software configuration “wizard”. These objects shall enable operators to interact with the graphic displays in a manner that mimics their mechanical equivalents found on field installed control panels.
      f. Support for high definition icons shall be included and automatically chosen if viewing on a high definition display such as Retina or 4K displays.
      g. Using the mouse, operators shall be able to adjust setpoints, start or stop equipment, modify PID loop parameters, or change schedules.
      h. Status changes or alarm conditions must be able to be highlighted by objects changing screen location, size, color, text, blinking or changing from one display to another.
      i. Ability to link graphic displays through user defined objects, alarm testing, or the result of a mathematical expression. Operators must be able to change from one graphic to another by selecting an object with a mouse - no menus will be required.
      j. It shall be possible to create and save graphical components and JavaScript code in reusable and transferrable, customized libraries.
      k. Graphics should rescale based on whatever monitor or viewing device is being used.
      l. Be able to create graphics on varying layers that can be moved and repeated.
      m. Be able to create graphics within varying window panes that can be moved and/or re-referenced. For example, creating the graphical menu within a pane and referencing it on every graphics page, therefore not rebuilding thus allowing for a single spot for updates that get pushed to all the pages that reference it.
      n. The ability to create re-usable cascading menus.
      o. The ability to have multiple instances of a graphic and edit one instance to change all.
   3. Additionally, the Graphics Editor portion of the Engineering Workstation Software shall provide the following capabilities:
      a. Create, Modify and save pages.
      b. Modify an existing symbol and Group and Ungroup symbols.
      c. Place a symbol on a page and Rotate and Mirror a symbol.
      d. Place analog dynamic data and changeable setpoints on a page.
      e. Place binary dynamic data using custom state descriptors on a page.

f. Create motion through the use of animated.gif files or JavaScript.
g. Place links to other pages, websites, notes, time schedules and various files like.pdf,.doc,.exe etc. on the Workstation using a fixed symbol or flyover on a page.
h. Place alarm indicators on a page.
i. Change symbol/text/value color as a function of an analog or binary variable.
j. All symbols used in the creation of graphic pages shall be saved to a library file for use by the owner.

I. Automatic monitoring.
1. The software shall allow for the automatic collection of data and reporting from any controller or NSC. The frequency of data collection shall be user-configurable.

J. Alarm Management.
1. The software shall be capable of accepting alarms directly from NSCs or controllers, or generating alarms based on evaluation of data in controllers and comparing to limits or conditional equations configured through the software. Any alarm (regardless of its origination) will be integrated into the overall alarm management system and will appear in all standard alarm reports, be available for operator acknowledgment, and have the option for displaying graphics, or reports.
2. Alarm management features shall include:
a. A minimum of 1000 alarm notification levels at the NSC, workstation, and webstation levels. At the Enterprise level the minimum number of active and viewable alarms shall be 10,000. Each notification level will establish a unique set of parameters for controlling alarm display, distribution, acknowledgment, keyboard annunciation, and record keeping.
b. Automatic logging in the database of the alarm message, point name, point value, source device, timestamp of alarm, username and time of acknowledgement, username and time of alarm silence (soft acknowledgement).
c. Playing an audible sound on alarm initiation or return to normal.
d. Sending an email page to anyone specifically listed on the initial occurrence of an alarm. The ability to utilize email paging of alarms shall be a standard feature of the software using Simple Mail Transfer Protocol (SMTP) with support for secure email using Simple Mail Transfer Protocol Secure (SMTPS) No special software interfaces shall be required and no email client software must be running in order for email to be distributed. The email notification shall be able to be sent to an individual user or a user group.
e. Individual alarms shall be able to be re-routed to a user at user-specified times and dates. For example, a critical high temp alarm can be configured to be routed to a Facilities Dept. workstation during normal working hours (7am-4pm, Mon-Fri) and to a Central Alarming workstation at all other times.
f. An active alarm viewer shall be included which can be customized for each user or user type to hide or display any alarm attributes.
g. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of user actions for certain alarms.
h. The active alarm viewer can be configured such that an operator must type in text in an alarm entry and/or pick from a drop-down list of causes for certain alarms. This ensures accountability (audit trail) for the response to critical alarms.
i. The active alarm viewer can be configured such that an operator must confirm that all of the steps in a check list have been accomplished prior to acknowledging the alarm.

j. The active alarm viewer shall, if filtered, show the quantity of visible and total number of alarms that are not equal to 'normal' and the quantity of disabled and hidden alarms.
k. The alarm viewer can be configured to auto hide alarms when triggered.
l. An operator shall have the capability to assign an alarm to another user of the system.
m. Time schedules shall be able to be used to set control notifications to users.
n. An operator shall have the capability to save and apply alarm favorites.
o. Alarm notifications must support multiple distribution methods within one notification.

K. Report Generation.
1. The Reports Server shall be able to process large amounts of data and produce meaningful reports to facilitate analysis and optimization of each installation.
2. Reports shall be possible to generate and view from the operator Workstation, and/or Webstation, and/or directly from a reports-only web interface.
3. A library of predefined automatically generated reports that prompt users for input prior to generation shall be available. The properties and configurations made to these reports shall be possible to save as Dashboard reports, so that the configurations are saved for future used.
4. It shall be possible to create reports standard tools, such as Microsoft Report Builder 2.0 or Visual Studio, shall be used for customized reports.
5. Additional reports or sets of reports shall be downloadable, transferrable, and importable.
6. All reports shall be able to be set up to automatically run or be generated on demand.
7. Each report shall be capable of being automatically emailed to a recipient in Microsoft Word, Excel, and/or Adobe.pdf format.
8. Reports can be of any length and contain any point attributes from any controller on the network.
9. Image management functionality shall be possible to enable the system administrators to easily upload new logos or images to the system.
10. It shall be possible to run other executable programs whenever a report is initiated.
11. Report Generator activity can be tied to the alarm management system, so that any of the configured reports can be displayed in response to an alarm condition.
12. Minimum supplied reports shall include:
a. Activities Per Server Report.
b. Activities Per User Report.
c. Alarm Amount by Category Report.
d. Alarm Amount by Type Report.
e. Alarms Per Sever Report.
f. Current Alarm Report.
g. Most Active Alarm Report.
h. System Errors Per Server Report.
i. Top Activities Report.
j. Top Alarms Report.
k. Top System Errors Report.
l. Trend Log Comparison Report.
m. User Logins Report.
n. Users and Groups Reports.
13. Minimum Energy Reports shall include:

a. Energy Monitoring Calendar Consumption Report: Shall provide an interactive report that shows the energy usage on one or multiple selected days.
b. Energy Monitoring Consumption Breakdown Report: Shall provide a report on energy consumption broken down using sub-metering.
c. Energy Monitoring Consumption Report: Shall show the energy consumption against a specified target value.

L. Scheduling.
1. From the workstation or webstation, it shall be possible to configure and download schedules for any of the controllers on the network.
2. Time of day schedules shall be in a calendar style and viewable in both a graphical and tabular view.
3. Schedules shall be programmable for a minimum of one year in advance.
4. To change the schedule for a particular day, a user shall simply select the day and make the desired modifications.
5. Additionally, from the operator webstations, each schedule will appear on the screen viewable as the entire year, monthly, week and day. A simple mouse click shall allow switching between views. It shall also be possible to scroll from one month to the next and view or alter any of the schedule times.
6. Schedules will be assigned to specific controllers and stored in their local RAM memory. Any changes made at the workstation will be automatically updated to the corresponding schedule in the controller.
7. It shall be possible to assign a lead schedule such that shadow/local schedules are updated based upon changes in the Lead.
8. It shall be possible to assign a list(s) of exception event days, dates, date ranges to a schedule.
9. It shall be possible to view combined views showing the calendar and all prioritized exemptions on one screen.
10. It should accommodate a minimum of 16 priority levels.
11. Values should be able to be controlled directly from a schedule, without the need for special program logic.

M. Programmer's Environment.
1. Programming shall allow both graphical block format and line-programming format. For both languages, the programmer will be able to configure application software for custom program development, and write global control programs. Both languages will have debugging capabilities in their editors.
2. Programming of the NSC and SDCUs shall be available offline from system prior to deployment into the field. All engineering tasks shall be possible, except, of course, the viewing of live tasks or values.
3. It shall be possible to save custom programs as libraries for reuse throughout the system. A wizard tool shall be available for loading programs from a library file in the program editor.
4. It shall be possible to view graphical programming live and real-time from the Workstation.
5. The system shall be capable of creating ‘binding templates’ allowing the user to bind multiple points to multiple objects all at once.
6. Key terms should automatically complete when typing (IntelliType).
7. Applications should be able to be assigned different priorities and cycle times for a prioritized execution of different functions.

8. The system shall be able to create macro objects that allow common objects such as power meters, VFD drives, etc. to be integrated into the system with simple import actions without the need of complicated programming or configuration setups.
9. The workstation software shall have an application to save and restore programming and graphic files. The application must also be able to save/reload individual programs in the controller allowing modification of control programs without disturbing any other online functions.

N. Audit Trail.
1. The workstation software shall automatically log and timestamp every operation that a user performs at a workstation, from logging on and off a workstation to changing a point value, modifying a program, enabling/disabling an object, viewing a graphic display, running a report, modifying a schedule, etc.
2. It shall be possible to view a history of alarms, user actions, and commands for any system object individually or at least the last 5000 records of all events for the entire system from Workstation.
3. The Enterprise server shall be able to store up to 5 million events.
4. The event view shall support viewing of up to 100,000 events.
5. It shall be possible to save custom filtered views of event information that are viewable and configurable in Workstation.
6. It shall be capable to search and view all forced values within the system.

2.4 NETWORK SERVER CONTROLLERS (NSCS)

A. Network Router Controllers shall combine both network routing functions, control functions, and server functions into a single unit.

B. The NSC shall be classified as a “native” BACnet device, supporting the BACnet Network Server Controller (B-BC) profile. Controllers that support a lesser profile such as B-SA are not acceptable. NSCs shall be tested and certified by the BACnet Testing Laboratory (BTL) as BACnet Network Server Controllers (B-BC).

C. The NSC shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the NRS.

D. The NSCs shall be capable of whitelisting IPs to restrict access to a pre-defined list of hosts or devices.

E. Whitelisting of file extensions for documents shall be capable.

F. Encrypted and authenticated communication shall be configurable for non-open protocol communications using TLS 1.2.

G. The NSCs shall support Simple Network Management Protocol version 3 (SNMPv3) for monitoring of the NSCs using a Network Management Tool.

H. The NSCs shall support remote system logging for used by System Information and Event Monitoring (SIEM) software.

I. They shall also be responsible for monitoring and controlling their own HVAC equipment such as an AHU, chiller system or boiler system.

J. They shall also contain graphics, trends, trend charts, alarm views, and other similar presentation objects that can be served to workstations or web-based interfaces. A sufficient number of NSCs shall be supplied to fully meet the requirements of this specification and the attached point list.

K. Each NSC shall be capable of executing application control programs to provide:
1. Calendar functions.
2. Scheduling.
3. Trending.
4. Alarm monitoring and routing.
5. Time synchronization by means of an Internet site including automatic synchronization.
6. Native integration of Modbus controller data or BACnet controller data.

L. Hardware Specifications.
1. Memory:
   a. The operating system of the controller, application programs, and all other portions of the configuration database, shall be stored in non-volatile, FLASH memory. Servers/Controllers shall contain enough memory for the current application, plus required history logging, plus a minimum of 20% additional free memory.
2. Each NSC shall provide the following on-board hardware for communication:
   a. Two 10/100b Ethernet for communication to Workstations, other NRCs, IP field bus controllers, other SDCUs, and onto the internet.
      1) The two Ethernet ports shall support active switch and BACnet/IP communication protocols.
      2) Support IPv4 addressing.
      3) Ethernet port 1 shall support static or DHCP client configuration for communication to Workstation or other NSCs.
      4) Ethernet port 2 shall support switch mode or DHCP server to set addressing of DHCP client devices.
      5) It shall be possible to disable Ethernet port 2.
      6) In DHCP server mode, the Ethernet port 2 shall support 50 BACnet/IP field controllers in daisy chain configuration directly from the port.
      7) Each NSC shall be able to support a total of 250 IP SDCUs in daisy chain configuration (5 sub networks via switch).
      8) If using RSTP (Rapid Spanning Tree Protocol) with a managed switch (with IEEE 802.1W or IEEE 802.1Q-2014 support), Ethernet port 2 shall support up to 39 devices.
      9) Each NSC shall be able to support a total of 234 IP SDCUs in RSTP configuration (6 sub networks via managed switch).
      10) Where a switch is needed, use Planet IGS-801M, or other equal and approved equivalent.
   b. Two RS-485 ports for communication to BACnet MSTP bus or serial Modbus (software configurable).
   c. One device USB port.
   d. One host USB port.

M. Modular Expandability:
   1. The system shall employ a modular I/O design to allow expansion. Input and output capacity is to be provided through plug-in modules of various types. It shall be possible to combine I/O modules as desired to meet the I/O requirements for individual control applications.
   2. One shall be able to “hot-change” (hot-swap) the I/O modules preserving the system on-line without any intervention on the software; addressing and configuration shall be automatic.
   3. If for any reason the backplane of the modular I/O system were to fail, I/O module addresses will be protected.

N. Hardware Override Switches:
   1. All digital outputs shall, optionally, include three position manual override switches to allow selection of the ON, OFF, or AUTO output state. These switches shall be built into the unit and shall provide feedback to the controller so that the position of the override switch can be obtained through software. In addition each analog output shall be equipped with an override potentiometer to allow manual adjustment of the analog output signal over its full range, when the 3 position manual override switch is placed in the ON position.

O. Universal Input Temperatures.
   1. All universal inputs directly connected to the NSC via modular expansion shall be capable of using the following thermistors for use in the system without any external converters needed.
      a. 10 kohm Type I, II, III, IV or V.
      b. 1.8 kohm (Xenta), 1 kOhm (Balco), 20 kOhm (Honeywell) and 2.2 kOhm (JCI).

P. Local Status Indicator Lamps:
   1. The NSC shall provide as a minimum LED indication of CPU status, Ethernet LAN status, and field bus status. For each input or output, provide LED indication of the value of the point (On/Off). The LED indication shall support software configuration to set whether the illumination of the LED corresponds to On or Off or whether the color when illuminated is Red or Green.

Q. Real Time Clock (RTC):
   1. Each NSC shall include a real time clock, accurate to 10 seconds per day. The RTC shall provide the following: time of day, day, month, year, and day of week. Each NSC will allow for its own UTC offset, depending upon the time zone. When the time zone is set, the NSC will also store the appropriate times for daylight savings time.
   2. The RTC date and time shall also be accurate, up to 30 days, when the NSC is powerless.
   3. No batteries may be used to for the backup of the RTC.

R. Power Supply:
   1. The 24 VDC power supply for the NSCs shall provide 30 watts of available power for the NSC and any associated IO modules. The system shall support the use of more than one power supply if heavily power consuming modules are required.
   2. The power supply, NSC, and I/O modules shall connect power wise and communication wise via the separate terminal base allowing for ease of replacement and no separate or loose wiring.

S. Automatic Restart After Power Failure:
   1. Upon restoration of power after an outage, the NSC shall automatically and without human intervention update all monitored functions, resume operation based on current, synchronize time and status, and implement special start-up strategies as required.
   2. During a power failure, the NSC shall retain all programs, configuration data, historical data, and all other data that is configured to be retained. There shall be no time restriction for this retention and it must not use batteries to achieve it.

T. Software Specifications.
   1. The operating system of the controller, application programs, and all other portions of the configuration database such as graphics, trends, alarms, views, etc., shall be stored in non-volatile, FLASH memory. There will be no restrictions placed on the type of application programs in the system. Each NSC shall be capable of parallel processing, executing all control programs simultaneously. Any program may affect the operation of any other program. Each program shall have the full access of all I/O facilities of the processor. This execution of control function shall not be interrupted due to normal user communications including interrogation, program entry, printout of the program for storage, etc.
   2. Each NSC shall have an available capacity of 4 GB of memory. This shall represent 2 GB for application and historical data and 2 GB dedicated for backup storage.

U. User Programming Language:
   1. The application software shall be user programmable. This includes all strategies, sequences of operation, control algorithms, parameters, and setpoints. The source program shall be either a script-based structured text or graphical function block based and fully programmable by the user. The language shall be structured to allow for the configuration of control programs, schedules, alarms, reports, telecommunications, local displays, mathematical calculations, and histories. Users shall be able to place comments anywhere in the body of either script or function block programs.
   2. Network Server Controllers that use a “canned” program method will not be accepted.

V. Control Software:
   1. The NSC shall have the ability to perform the following pre-tested control algorithms:
      a. Proportional, Integral plus Derivative Control (PID).
      b. Two Position Control.
      c. Digital Filter.
      d. Ratio Calculator.
      e. Equipment Cycling Protection.

W. Mathematical Functions:
   1. Each controller shall be capable of performing basic mathematical functions (+, -, *, /), squares, square roots, exponential, logarithms, Boolean logic statements, or combinations of both. The controllers shall be capable of performing complex logical statements including operators such as >, <, =, and, or, exclusive or, etc. These must be able to be used in the same equations with the mathematical operators and nested up to five parentheses deep.

X. NSCs shall have the ability to perform any or all of the following energy management routines:
   1. Time of Day and Calendar Scheduling with Holiday and Temporary Overrides.

2. Optimal Start & Optimal Stop with Night Setback Control.
3. Enthalpy Switchover (Economizer).
4. Peak Demand Limiting.
5. Temperature Compensated Duty Cycling.
6. Supply Fan demand based pressure reset.
7. Heating/Cooling Interlock with Hot/Cold Deck Reset.
8. Hot Water, Chilled Water and Condenser Reset.
9. Chiller Sequencing and Chiller Plant Optimization.

Y. History Logging:
1. Each NSC controller shall be capable of LOCALLY logging any input, output, calculated value or other system variable either over user defined time intervals ranging from 1 second to 1440 minutes or based upon a user configurable change of value. A minimum of 1000 logs, with a minimum of 100,000 records, shall be stored. Each log can record either the instantaneous, average, minimum or maximum value of the point. Logged data shall be downloadable to a higher level NSC long term archiving based upon user-defined time intervals, or manual command.
2. For extended trend logging a minimum of 1500 trends shall be capable, with a minimum number of 600,000 records within.
3. Management of a power meter replacement to ensure meter log data is accurate shall be possible in the NSC.
4. Every hardware input and output point, hosted within the NSC and attached I/O modules, shall be trended automatically without the requirement for manual creation, and each of these logs shall log values based upon a change of value and store at least 500 trend samples before replacing the oldest sample with new data.
5. The presentation of logged data shall be built into the server capabilities of the NSC. Presentation can be in time stamped list formats or in a chart format with fully configurable pen colors, weights, scales and time spans.
6. Tooltips shall be present, magnetic, and visible based on users preference.
7. Comments shall be visible whenever viewing the trend log list.
8. System shall give indication of memory usage and be able to alert the user if too many logs are allocated.

Z. Alarm Management:
1. For each system point, alarms can be created based on high/low limits or in comparison to other point values. All alarms will be tested each scan of the NSC and can result in the display of one or more alarm messages or reports.
2. There is no limit to the number of alarms that can be created for any point.
3. Alarms can be configured to be generated based upon a single system condition or multiple system conditions.
4. Alarms will be generated based on an evaluation of the alarm conditions and can be presented to the user in a fully configurable order, by priority, by time, by category, etc. These configurable alarm views will be presented to a user upon logging into the system regardless of whether the log in takes place at a WorkStation or a Webstation.
5. The alarm management system shall support the ability to create and select cause and action notes to be selected and associated with an alarm event. Checklists shall also be possible in order to present to an operator a suggested mode of troubleshooting. When acknowledging an alarm, it shall be possible to assign it to a user of the system such that the user is notified of the assignment and is made responsible for the alarm resolution.
6. Alarms must be capable of being routed to any BACnet workstation that conforms to the

B-OWS device profile and uses the BACnet/IP protocol.

AA. Embedded Web Server.
1. Each NSC must have the ability to serve out web pages containing the same information that is available from the WorkStation. The development of the screens to accomplish shall not require any additional engineering labor over that required to show them at the WorkStation itself.
2. The NSC shall be configurable to logging all Embedded Web Server access attempts.
3. The NSC shall have the option to redirect HTTP based Embedded Web Server connections to secure, HTTPS connections.
4. The NSC shall authenticate and authorize all users connecting to the Embedded Web Server.
5. The NSC shall provide to ability to configure an automatic logoff for Embedded Web Server users that have not had any activity for an adjustable time period.

2.5 BACNET IP FIELDBUS CONTROLLERS (SDCUS)

A. Controllers - BACnet/IP Protocol.
1. All BACnet/IP Fieldbus controllers shall be BACnet Testing Laboratory listed (v12 or later) as specified BACnet Advanced Application Controller (B-AAC).
2. All BACnet/IP Fieldbus controllers shall use the following communication specifications and achieve performance as specified herein:
   a. All controllers shall be able to communicate peer-to-peer without the need for a NSC.
   b. Any BACnet/IP Fieldbus controllers on the Ethernet Data Link/Physical layer shall be able to act as a Master to allow for the exchange and sharing of data variables and messages with any other controller connected on the same communication cabling. Slave controllers are not acceptable.

B. The BACnet/IP Fieldbus controllers shall be equipped with 2x 10/100bT Ethernet communication ports with active switch and will support BACnet/IP communication protocols with the following configurations:
1. Supporting IPv4 addressing.
2. Supporting Static IP setting, DHCP client and Auto-IP address acquisition.
3. It shall be possible to disable Ethernet port 2.

C. Topologies.
1. BACnet/IP Fieldbus controllers shall support daisy chain topology of up to 50 controllers. In case of any disruption to the communication, a system alarm shall notify the NSC/BMS of the point disruption has occurred.
2. BACnet/IP Fieldbus Controllers shall support RSTP loop whereby up to 39 controllers are supported.
   a. In case of any disruption there shall be no communication interruption.
   b. In case of any disruption there shall be system alarms that will inform the operator of the disruption.

D. Performance.
   1. Each BACnet/IP Fieldbus Controllers shall have a 32-bit microprocessor operating at 500 MHz and support a BACnet protocol stack in accordance with the ANSI/ASHRAE Standard 135-2008 and the BACnet Device Profile supported.
   2. They shall be multi-tasking, real-time digital control processors consisting of communication controllers, controls processing, power supplies with built-in inputs and outputs.

E. Programmability.
   1. The BACnet/IP Fieldbus controllers shall support both script programming language and graphical that will be consistent with the NSC.
   2. The control program will reside within the same enclosure as the input/output circuitry, that reads inputs and controls outputs.
   3. All control sequences programmed into the BACnet/IP Fieldbus Controllers shall be stored in non-volatile memory, which is not dependent upon the presence of a battery, to be retained.
   4. BACnet/IP Fieldbus controllers shall communicate with the Network Server Controller (NSC) via a BACnet/IP connection at a baud rate of not less than 100 Mbps.
   5. BACnet/IP Fieldbus controllers shall support a dedicated communications port for connecting and supplying power to a matching room temperature and/or humidity sensor and/or CO2 and/or presence detector that does not utilize any of the I/O points of the controller.
   6. BACnet/IP Fieldbus controllers (Excluding VAV) shall support an add-on display to supply and provide access in real-time for monitoring inputs and overriding of outputs.
   7. The override functionality must be supported by a dedicated processor to assure reliable operation (overriding of output).
   8. Each BACnet/IP Fieldbus controller shall have sufficient memory, to support its own operating system and databases, including:
      a. Control processes.
      b. Energy management applications.
      c. Alarm management.
      d. Historical/trend data.
      e. Maintenance support applications.
      f. Custom processes.
      g. Manal override monitoring.
   9. Each BACnet/IP Fieldbus controller shall support local trend data up to 2x the built-in I/O and at a minimum be capable of holding 5 days @ 15 min intervals locally.
   10. The BACnet/IP Fieldbus controller analog or universal input shall use a 16 bit A/D converter.
   11. The BACnet/IP Fieldbus controller analog or universal output shall use a 10 bit D/A converter.
   12. Built-in I/O: each BACnet/IP Fieldbus controllers shall support:
      a. At minimum 8 and up to 20 configurable IO channels to monitor and to control the following types of inputs and outputs without the addition of equipment inside or outside the DDC Controller cabinet.
         1) Universal Inputs - the following thermistors for use in the system without any external converters needed.
            a) 10 kohm Type I, II, III, IV or V.
            b) 1.8 kohm (Xenta), 1 kOhm (Balco), 20 kOhm (Honeywell) and 2.2 kOhm

(JCI).
2) Analog inputs.
a) Current Input - 0-20 mA.
b) Voltage Input 0-10 Vdc.
3) Digital inputs from dry contact closure, pulse accumulators, voltage sensing.
4) Digital outputs.
5) Analog outputs of 4-20 mA and/or 0-10 Vdc.

13. Real Time Clock (RTC):
a. Each BACnet/IP Fieldbus controller shall include a real time clock, accurate to +/-1 minute per month. The RTC shall provide the following: time of day, day, month, year, and day of week.
b. The RTC date and time shall also be accurate, up to 7 days, when the BACnet/IP Fieldbus controller is powerless.
c. No batteries may be used to for the backup of the RTC.
14. The BACnet/IP Fieldbus controller for Variable Air Volume (VAV) applications.
a. The BACnet/IP Fieldbus controller for VAV applications shall include a built-in 'flow thru' differential pressure transducer.
b. The VAV differential pressure transducer shall have a measurement range of 0 to 1 in. W.C. and measurement accuracy of ±5% at 0.001 to 1 in. W.C. and a minimum resolution of 0.001 in. W.C., insuring primary air flow conditions shall be controlled and maintained to within ±5% of setpoint at the specified minimum and maximum air flow parameters.
c. The BACnet/IP FieldBus controller for VAV applications shall support a dedicated commissioning tool for air flow balancing.
d. The BACnet/IP Fieldbus controller for VAV applications shall require no programing for air balancing algorithm.
e. All balancing parameters shall be synchronized in NSC.
15. Each BACnet/IP Fieldbus controller shall have a minimum of 10% spare capacity for each point type represented on the controller for future point connection.
16. Power Requirements.{BIP}{BIP}: 24VDC (21 to 33 VDC) and 24 VAC +/-20% with local transformer power.

F. Commissioning Tool - The BACnet/IP Fieldbus controller shall be supported via a dedicate mobile based commissioning tool for configuration, programming, air balancing and I/O checkout.
1. The Commissioning Tool shall be supported across: iOS, Android and Windows 10 platforms.
2. The Commissioning Tool shall be available for download on App Store, Google Store and Windows Store.
3. Commissioning Tool Interface to BACnet/IP Fieldbus controllers shall be via a Bluetooth adapter interface through the Intelligent Space Sensor or via a Wi-Fi access point on the LAN.
4. Functionality.
a. Device Configuration - the Commissioning Tool shall be able to set or edit all Network configurations associated with the BACnet/IP Fieldbus controller.
b. Programming - The Commissioning Tool shall be able to load offline engineered applications directly in to the controller directly.
c. Air Balancing.
1) The Commissioning Tool shall allow the air balancer to manually control the

action of the actuator including the following function: open VAV damper, close VAV damper, open all VAV dampers, and close all VAV dampers.

2) The Commissioning Tool shall be able to generate Air Balancing report.

d. IO Checkout.
   1) The Commissioning Tool shall be able to support overriding of the outputs and reading value of inputs live.
   2) The Commissioning Tool shall be able to support generation of I/O checkout report.
e. There shall be no limit to the number of Commissioning Tools that can be used on a network segment, however, one connection per controller is recommended.

G. Intelligent Space Sensors - The BACnet/IP Fieldbus controller shall support a dedicated RJ45 communication port to communicate and power up to 4 intelligent wall mount sensors without the use of on board inputs or outputs.
   1. The Intelligent Space Sensor shall communicate with the BACnet/IP Fieldbus controller through the sensor port and via category 5 or category 6 cable.
   2. The Intelligent Space Sensor shall provide 2 RJ45 communication ports that will allow communication with parent BACnet/IP Field controller upstream and additional Intelligent Space Sensors downstream.
   3. The Intelligent Space Sensor shall provide ambient space condition sensing without the use of hardware I/O.
   4. Each Intelligent Space Sensor shall provide a color touch display with a Minimum 61 mm (2.4”) by 61 mm (2.4”) display that is backlit.
   5. The Intelligent Space Sensor shall be capable of displaying measured space temperature from 0 to 50 °C (32 to 122 °F) with accuracy of ±0.2 °C (±0.4 °F) selectable for 0.1 or 1 degree display resolution of °F or °C. Sensing Element: 10k Type 3 Thermistor, Accuracy of ±0.2 °C (±0.4 °F).
   6. The Intelligent Space Sensor shall have the option for humidity sensor support sensing humidity from 0 % RH to 100 % RH Digital humidity indication (selectable for 0.1 or 1% RH with selectable display resolution of 0.1 or 1 % RH, Accuracy: ±2 % RH.

H. The Intelligent Space Sensor shall have the option for support of CO2 sensor with display resolution with 0 to 2000 ppm resolution.
   1. Accuracy: ±30 ppm ±2% of measured value.
   2. Operating elevation: 0 to 16,000 ft.
   3. Temperature dependence: 0.11% FS per ˚F.
   4. Stability: <2% of FS over life of sensor (15 years).
   5. Sensing method: Non-dispersive infrared (NDIR), diffusion sampling.

I. The Intelligent Space Sensor shall have the option for motion sensor.

J. Display options: The Intelligent Space Sensor shall be capable of displaying the following elements:
   1. Space temperature.
   2. Cooling space temperature set point.
   3. Heating space temperature set point.
   4. Current heating or cooling mode.
   5. Current occupancy mode.
   6. Fan speed.
   7. Current time.

2.6 BACNET MSTP FIELDBUS CONTROLLERS (SDCUS)

A. Field Bus Wiring and Termination.
   1. The wiring of MSTP controller shall use a bus or daisy chain concept with no tees, stubs.
   2. Each field bus shall have a termination resistor at both ends of each segment.

B. Field Bus Devices.
   1. General Requirements.
      a. Devices shall have a light indicating that they are powered.
      b. Application programs shall be stored in a manner such that a loss of power does not result in a loss of the application program or configuration parameter settings. (Battery backup, flash memory, etc.).

C. Advance Application Controllers (B-AAC).
   1. The key characteristics of a B-AAC are:
      a. They have physical input and output circuits for the connection of analog input devices, binary input devices, pulse input devices, analog output devices, and binary output devices. The number and type of input and output devices supported will vary by model.
      b. They may or may not provide support for additional input and output devices beyond the number of circuits that are provided on the basic circuit board. Support for additional I/O shall be provided by additional circuit boards that physically connect to the basic controller.
      c. The application to be executed by a B-AAC is created by an application engineer using the vendor's application programming tool.
      d. If local time schedules are embedded, the B-AAC shall support the editing of time schedule entries from any BACnet OWS that supports the BACnet service for writing of time schedule parameters.
      e. If local trend logging is embedded, the B-AAC shall support the exporting of trend log data to any BACnet OWS that supports the read range BACnet service for trending.
      f. If local alarm message initiation is embedded, the B-AAC shall:
         1) Deliver alarm messages to any BACnet OWS that supports the BACnet service for receiving alarm messages and is configured to be a recipient off the alarm message.
         2) Support alarm acknowledgement from any BACnet OWS that supports the BACnet service for executing alarm/event acknowledgement,
      g. Shall support the reading of analog and binary data from any BACnet OWS or Building Controller that supports the BACnet service for the reading of data.
      h. Shall support the control of the out of service property and assignment of value or state to analog and binary objects from any BACnet OWS that supports writing to the out of service property and the value property of analog and binary objects.
      i. Shall support the receipt and response to Time Synchronization commands from a BACnet Building Controller.
      j. Shall support the "Who is" and "I am." BACnet services.
      k. Shall support the "Who has" and "I have." BACnet services.
   2. Analog Input Circuits.
      a. The resolution of the A/D chip shall not be greater than 0.01 Volts per increment. For an A/D converter that has a measurement range of 0 to 10 VDC and is 10 bit, the resolution is 10/1024 or 0.00976 Volts per increment.

b. For non-flow sensors, the control logic shall provide support for the use of a calibration offset such that the raw measured value is added to the (+/-) offset to create a calibration value to be used by the control logic and reported to the Operator Workstation (OWS).
c. For flow sensors, the control logic shall provide support for the use of an adjustable gain and an adjustable offset such that a two point calibration concept can be executed (both a low range value and a high range value are adjusted to match values determined by a calibration instrument).
d. For non-linear sensors such as thermistors and flow sensors the B-AAC shall provide software support for the linearization of the input signal.

3. Binary Input Circuits.
   a. Dry contact sensors shall wire to the controller with two wires.
   b. An external power supply in the sensor circuit shall not be required.
4. Pulse Input Circuits.
   a. Pulse input sensors shall wire to the controller with two wires.
   b. An external power supply in the sensor circuit shall not be required.
   c. The pulse input circuit shall be able to process up to 20 pulses per second.
5. True Analog Output Circuits.
   a. The logical commands shall be processed by a digital to analog (D/A) converter chip. The 0% to 100% control signal shall be scalable to the full output range which shall be either 0 to 10 VDC, 4 to 20 milliamps or 0 to 20 milliamps or to ranges within the full output range (Example: 0 to 100% creates 3 to 6 VDC where the full output range is 0 to 10 VDC).
   b. The resolution of the D/A chip shall not be greater than 0.04 Volts per increment or 0.08 milliamps per increment.
6. Binary Output Circuits.
   a. Single pole, single throw or single pole, double throw relays with support for up to 230 VAC and a maximum current of 2 amps.
   b. Voltage sourcing or externally powered triacs with support for up to 30 VAC and 0.5 amps at 24 VAC.
7. Program Execution.
   a. Process control loops shall operate in parallel and not in sequence unless specifically required to operate in sequence by the sequence of control.
   b. The sample rate for a process control loop shall be adjustable and shall support a minimum sample rate of 1 second.
   c. The sample rate for process variables shall be adjustable and shall support a minimum sample rate of 1 second.
   d. The sample rate for algorithm updates shall be adjustable and shall support a minimum sample rate of 1 second.
   e. The application shall have the ability to determine if a power cycle to the controller has occurred and the application programmer shall be able to use the indication of a power cycle to modify the sequence of controller immediately following a power cycle.

2.7 CONTROL DAMPERS

A. Unless otherwise specified elsewhere, shall be as below or as scheduled on drawings.
   1. Outdoor and/or return air mixing dampers and face and bypass (F&BP) dampers shall be parallel blade, arranged to direct airstreams toward each other.

2. Other modulating dampers shall be the opposed blade type.
3. Two position shutoff dampers may be parallel or opposed blade type with blade and side seals.

B. Damper frames shall be 13 gauge galvanized steel channel or 1/8 inch extruded aluminum with reinforced corner bracing.

C. Damper blades shall not exceed 20 centimeters (eight inches) in width or 125 centimeters (48 inches) in length. Blades are to be suitable for medium velocity performance (2000 FPM). Blades shall be not less than 16 gauge.

D. Damper shaft bearings shall be as recommended by manufacturer for application, oil impregnated sintered bronze or better.

E. All blade edges and top and bottom of the frame shall be provided with replaceable butyl rubber or neoprene seals. Side seals shall be spring-loaded stainless steel. The blade seals shall provide for a maximum leakage rate of 10 CFM per square foot at four inches w.g. differential pressure. Provide air foil blades suitable for a wide-open face velocity of 1500 FPM.

F. Individual damper sections shall not be larger than 48 inches by 60 inches. Provide a minimum of one damper actuator per section.

G. Modulating dampers shall provide a linear flow characteristic where possible.

H. Dampers shall have exposed linkages.

I. Approved manufacturer: Ruskin or approved equal.

2.8 ELECTRIC ACTUATORS FOR CONTROL DAMPERS OR CONTROL VALVES

A. The actuator shall have mechanical or electronic stall protection to prevent damage to the actuator throughout the rotation of the actuator.

B. Where shown, for power failure/safety applications, an internal mechanical, spring return mechanism shall be built into the actuator housing. Alternatively, an uninterruptible power supply (UPS) may be provided.

C. Proportional actuators shall accept a 0 to 10 VDC or 0 to 20 mA control signal and provide a 2 to 10 VDC or 4 to 20 mA operating range.

D. All 24 VAC/VDC actuators shall operate on Class 2 wiring.

E. All non-spring return actuators shall have an external manual gear release to allow manual positioning of the damper when the actuator is not powered. Spring return actuators with more than 7 N.m (60 inches-pound) torque capacity shall have a manual crank for this purpose.

F. Approved manufacturer: Belimo.

2.9 TEMPERATURE SENSORS

A. Temperature sensors shall be Resistance Temperature Device (RTD) or thermistor.

B. Duct sensors shall be single point or averaging as shown. Averaging sensors shall be a minimum of five feet in length per ten square feet of duct cross section.

C. Immersion sensors shall be provided with a separable stainless steel well. Pressure rating of well is to be consistent with the system pressure in which it is to be installed. The well must withstand the flow velocities in the pipe.

D. Space sensors shall be equipped with setpoint adjustment, override switch, and/or communication port as shown.

E. Provide matched temperature sensors for differential temperature measurement.

F. Low Limit Thermostats: Low limit air stream thermostats shall be UL listed, vapor pressure type, with an element of 20 feet minimum length. Element shall respond to the lowest temperature sensed by any one foot section. The low limit thermostat shall be manual reset only.

2.10 HUMIDITY SENSORS

A. Duct and room sensors shall have a sensing range of 20 percent to 80 percent.

B. Duct sensors shall be provided with a sampling chamber.

C. Outdoor air humidity sensors shall have a sensing range of 20 percent to 95 percent relative humidity. They shall be suitable for ambient conditions of -40 degrees F to 170 degrees F.

D. Humidity sensor's drift shall not exceed one percent of full scale per year.

2.11 RELAYS

A. Control relays shall be UL listed plug-in type with dust cover and LED "energized" indicator. Contact rating, configuration, and coil voltage shall be suitable for application.

2.12 LOCAL CONTROL ENCLOSURES

A. All indoor control cabinets shall be fully enclosed NEMA 1 construction with (hinged door) key lock latch and removable sub panels. A single key shall be common to all field panels and sub panels.

B. Interconnections between internal and face mounted devices shall be pre-wired with color coded stranded conductors neatly installed in plastic troughs and/or tie wrapped. Terminals for field connections shall be UL listed for 600 volt service, individually identified per control/interlock drawings, with adequate clearance for field wiring. Control terminations for

field connection shall be individually identified per control drawings.

C. Provide on/off circuit breaker with proper over current rating for control power sources to each local panel.

D. All outside mounted enclosures shall meet the NEMA-4 rating.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that power supply is available to control units.

3.2 INSTALLATION

A. Install software in control units and operator workstation(s). Implement all features of programs to specified requirements and as appropriate to sequence of operation.

B. Connect and configure equipment and software to achieve sequence of operation specified.

C. Verify location of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation. Install devices 48 inches above the floor.
   1. Install averaging elements in ducts and plenums in crossing or zigzag pattern.

D. Install damper motors on outside of duct in warm areas, not in locations exposed to outdoor temperatures.

E. Install labels and nameplates to identify control components according to Division23 Section "Mechanical Identification."

F. Install hydronic instrument wells, valves, and other accessories according to Division 23 Section "Hydronic Piping."

G. Install duct volume-control dampers according to Division 23 Sections specifying air ducts.

H. Install electronic and fiber-optic cables according to Division 26 Section "Voice and Data Communication Cabling."

I. Install raceways, boxes, and cabinets according to Division 16 Section "Raceways and Boxes."

J. Install building wire and cable according to Division 16 Section "Conductors and Cables."

K. Install signal and communication cable according to Division 16 Section "Voice and Data Communication Cabling."
   1. Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.

2. Install exposed cable in raceway.
3. Install concealed cable in raceway.
4. Bundle and harness multiconductor instrument cable in place of single cables where several cables follow a common path.
5. Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
6. Number-code or color-code conductors for future identification and service of control system, except local individual room control cables.
7. Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.

L. Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected in interlock circuit of power controllers.

M. Connect hand-off-auto selector switches to override automatic interlock controls when switch is in hand position.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
1. Operational Test: After electrical circuitry has been energized, start units to confirm proper unit operation. Remove and replace malfunctioning units and retest.
2. Test and adjust controls and safeties.
3. Test each point through its full operating range to verify that safety and operating control set points are as required.
4. Test each control loop to verify stable mode of operation and compliance with sequence of operation. Adjust PID actions.
5. Test each system for compliance with sequence of operation.
6. Test software and hardware interlocks.

C. DDC Verification:
1. Verify that instruments are installed before calibration, testing, and loop or leak checks.
2. Check instruments for proper location and accessibility.
3. Check instrument installation for direction of flow, elevation, orientation, insertion depth, and other applicable considerations.
4. Check flow instruments. Inspect tag number and line and bore size, and verify that inlet side is identified and that meters are installed correctly.
5. Check temperature instruments and material and length of sensing elements.
6. Check control valves. Verify that they are in correct direction.
7. Check DDC system as follows:
   a. Verify that DDC controller power supply is from emergency power supply, if applicable.
   b. Verify that wires at control panels are tagged with their service designation and approved tagging system.
   c. Verify that spare I/O capacity has been provided.

d. Verify that DDC controllers are protected from power supply surges.

D. Replace damaged or malfunctioning controls and equipment and repeat testing procedures.

3.4 ADJUSTING

A. Calibrating and Adjusting:
1. Calibrate instruments.
2. Make three-point calibration test for both linearity and accuracy for each analog instrument.
3. Calibrate equipment and procedures using manufacturer's written recommendations and instruction manuals. Use test equipment with accuracy at least double that of instrument being calibrated.
4. Control System Inputs and Outputs:
   a. Check analog inputs at 0, 50, and 100 percent of span.
   b. Check analog outputs using milliampere meter at 0, 50, and 100 percent output.
   c. Check digital inputs using jumper wire.
   d. Check digital outputs using ohmmeter to test for contact making or breaking.
   e. Check resistance temperature inputs at 0, 50, and 100 percent of span using a precision-resistant source.
5. Flow:
   a. Set differential pressure flow transmitters for 0 and 100 percent values with 3-point calibration accomplished at 50, 90, and 100 percent of span.
   b. Manually operate flow switches to verify that they make or break contact.
6. Pressure:
   a. Calibrate pressure transmitters at 0, 50, and 100 percent of span.
   b. Calibrate pressure switches to make or break contacts, with adjustable differential set at minimum.
7. Temperature:
   a. Calibrate resistance temperature transmitters at 0, 50, and 100 percent of span using a precision-resistance source.
   b. Calibrate temperature switches to make or break contacts.
8. Stroke and adjust control valves and dampers with positioners, following manufacturer's recommended procedure, so that valve and damper is 0, 50, and 100 percent closed.
9. Provide diagnostic and test instruments for calibration and adjustment of system.
10. Provide written description of procedures and equipment for calibrating each type of instrument. Submit procedures review and approval before initiating startup procedures.

B. Adjust initial temperature and humidity set points.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain HVAC instrumentation and controls. Refer to Division 1 Section "Demonstration and Training." Training shall be set for a period of (2) 4 hour sessions with owner designated personnel.

END OF SECTION

SECTION 232113

HYDRONIC PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:
   1. Condensate-drain piping.
   2. Safety-valve-inlet and -outlet piping.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:
   1. Condensate-Drain Piping: 150 deg F.
   2. Safety-Valve-Inlet and -Outlet Piping: Equal to the pressure of the piping system to which it is attached.

1.5 SUBMITTALS

A. Product Data: For each type of the following:
   1. Plastic pipe and fittings with solvent cement.
   2. Pressure-seal fittings.

3. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
4. Air control devices.
5. Hydronic specialties.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

C. Welding certificates.

D. Qualification Data: For Installer.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications:
1. Installers of Pressure-Sealed Joints: Installers shall be certified by the pressure-seal joint manufacturer as having been trained and qualified to join piping with pressure-seal pipe couplings and fittings.

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.
1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 01.

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Annealed-Temper Copper Tubing: ASTM B 88, Type K.

C. DWV Copper Tubing: ASTM B 306, Type DWV.

D. Wrought-Copper Fittings: ASME B16.22.
   1. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
   2. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.
   3. Flaring of tube or fitting ends to accommodate alternate sized couplings is not permitted.

E. Wrought-Copper Unions: ASME B16.22.

F. Copper or Bronze Pressure-Seal Fittings:
   1. Manufacturers: All boiler venting shall be furnished by the boiler manufacturer. Subject to compliance with requirements, provide products by one of the following:
      a. Mueller Industries, Inc.
      b. Nibco Inc.
      c. Viega LLC.
   2. Housing: Copper.
   3. O-Rings and Pipe Stops: EPDM.
   4. Tools: Manufacturer's special tools.
   5. Minimum 200-psig working-pressure rating at 250 deg F.

2.2 PLASTIC PIPE AND FITTINGS

A. PVC Plastic Pipe: ASTM D 1785, Schedules 40 and 80, plain ends as indicated in Part 3 "Piping Applications" Article.

B. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D 2466 for Schedule 40 pipe; ASTM D 2467 for Schedule 80 pipe.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
   1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
      a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
      b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper

with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

G. Solvent Cements for Joining Plastic Piping:
   1. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
      a. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      b. Adhesive primer shall have a VOC content of 550 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
      c. Solvent cement and adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

H. Gasket Material: Thickness, material, and type suitable for fluid to be handled and working temperatures and pressures.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric-Flange Insulating Kits:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Advance Products & Systems, Inc.
      b. Pipeline Seal and Insulator, Inc.
   2. Description:
      a. Nonconducting materials for field assembly of companion flanges.
      b. Pressure Rating: 150 psig.
      c. Gasket: Neoprene or phenolic.
      d. Bolt Sleeves: Phenolic or polyethylene.
      e. Washers: Phenolic with steel backing washers.

C. Dielectric Nipples:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Victaulic Company of America.
   2. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.5 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 23 Section "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 23 Section "Instrumentation and Control for HVAC."

2.6 AIR CONTROL DEVICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Amtrol, Inc.
   2. Armstrong Pumps, Inc.
   3. Bell & Gossett Domestic Pump; a division of ITT Industries.
   4. Taco.

B. Manual Air Vents:
   1. Body: Bronze.
   2. Internal Parts: Nonferrous.
   3. Operator: Screwdriver or thumbscrew.
   4. Inlet Connection: NPS 1/2.
   5. Discharge Connection: NPS 1/8.
   6. CWP Rating: 150 psig.
   7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:
   1. Body: Bronze or cast iron.
   2. Internal Parts: Nonferrous.
   3. Operator: Noncorrosive metal float.
   4. Inlet Connection: NPS 1/2.
   5. Discharge Connection: NPS 1/4.
   6. CWP Rating: 150 psig.
   7. Maximum Operating Temperature: 240 deg F.

PART 3 EXECUTION

3.1 PIPING APPLICATIONS

A. Condensate-Drain Piping:
   1. Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
   2. Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

B. Air-Vent Piping:
   1. Inlet: Same as service where installed with metal-to-plastic transition fittings for plastic piping systems according to the piping manufacturer's written instructions.
   2. Outlet: Type K, annealed-temper copper tubing with pressure-sealed or flared joints.

3.2 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Division 23 Section "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Division 23 Section "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.3 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:
1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.
6. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.

C. Install hangers for steel piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 7 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 7 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 10 feet; minimum rod size, 3/8 inch.

D. Install hangers for drawn-temper copper piping with the following maximum spacing and minimum rod sizes:
1. NPS 3/4: Maximum span, 5 feet; minimum rod size, 1/4 inch.
2. NPS 1: Maximum span, 6 feet; minimum rod size, 1/4 inch.
3. NPS 1-1/2: Maximum span, 8 feet; minimum rod size, 3/8 inch.
4. NPS 2: Maximum span, 8 feet; minimum rod size, 3/8 inch.

E. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading. Space and install hangers with the fewest practical rigid anchor points.

F. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.4 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.

B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
   1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
   2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

H. Grooved Joints: Assemble joints with coupling and gasket, lubricant, and bolts. Cut or roll grooves in ends of pipe based on pipe and coupling manufacturer's written instructions for pipe wall thickness. Use grooved-end fittings and rigid, grooved-end-pipe couplings.

I. Pressure-Sealed Joints: Use manufacturer-recommended tool and procedure. Leave insertion marks on pipe after assembly.

END OF SECTION

SECTION 232300

REFRIGERANT PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes refrigerant piping used for air-conditioning applications.

1.3 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R454B:
   1. Suction Lines for Heat-Pump Applications: 535 psig.
   2. Hot-Gas and Liquid Lines: 535 psig.

B. Line Test Pressure for Refrigerant R-32:
   1. Suction Lines for Heat-Pump Applications: 535 psig.
   2. Liquid Lines: 535 psig.

1.4 SUBMITTALS

A. Product Data: For each type of valve and refrigerant piping specialty indicated. Include pressure drop, based on manufacturer's test data, for the following:
   1. Thermostatic expansion valves.
   2. Solenoid valves.
   3. Filter dryers.
   4. Strainers.
   5. Pressure-regulating valves.

B. Shop Drawings: Show layout of refrigerant piping and specialties, including pipe, tube, and fitting sizes, flow capacities, valve arrangements and locations, slopes of horizontal runs, oil traps, double risers, wall and floor penetrations, and equipment connection details. Show interface and spatial relationships between piping and equipment.
   1. Shop Drawing Scale: 1/4 inch equals 1 foot.
   2. Refrigerant piping indicated on Drawings is schematic only. Size piping and design actual piping layout, including oil traps, double risers, specialties, and pipe and tube sizes to accommodate, as a minimum, equipment provided, elevation difference between compressor and evaporator, and length of piping to ensure proper operation and compliance with warranties of connected equipment.

C. Welding certificates.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For refrigerant valves and piping specialties to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

B. Comply with ASHRAE 15, "Safety Code for Refrigeration Systems."

C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.6 PRODUCT STORAGE AND HANDLING

A. Store piping in a clean and protected area with end caps in place to ensure that piping interior and exterior are clean when installed.

1.7 COORDINATION

A. Coordinate size and location of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Copper Tube: ASTM B 88, Type K or L, ASTM B 280, Type ACR.

B. Wrought-Copper Fittings: ASME B16.22.

C. Wrought-Copper Unions: ASME B16.22.

D. Solder Filler Metals: ASTM B 32. Use 95-5 tin antimony or alloy HB solder to join copper socket fittings on copper pipe.

E. Brazing Filler Metals: AWS A5.8.

F. Flexible Connectors:
   1. Body: Tin-bronze bellows with woven, flexible, tinned-bronze-wire-reinforced protective jacket.
   2. End Connections: Socket ends.
   3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch-long assembly.
   4. Pressure Rating: Factory test at minimum 500 psig.
   5. Maximum Operating Temperature: 250 deg F.

2.2 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
   1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
   2. Diaphragm: Phosphor bronze and stainless steel with stainless-steel spring.
   3. Operator: Rising stem and hand wheel.
   4. Seat: Nylon.
   5. End Connections: Socket, union, or flanged.
   6. Working Pressure Rating: 700 psig.
   7. Maximum Operating Temperature: 275 deg F.

B. Packed-Angle Valves:
   1. Body and Bonnet: Forged brass or cast bronze.
   2. Packing: Molded stem, back seating, and replaceable under pressure.
   3. Operator: Rising stem.
   4. Seat: Nonrotating, self-aligning polytetrafluoroethylene.
   5. Seal Cap: Forged-brass or valox hex cap.
   6. End Connections: Socket, union, threaded, or flanged.
   7. Working Pressure Rating: 700 psig.
   8. Maximum Operating Temperature: 275 deg F.

C. Check Valves:
   1. Body: Ductile iron, forged brass, or cast bronze; globe pattern.
   2. Bonnet: Bolted ductile iron, forged brass, or cast bronze; or brass hex plug.
   3. Piston: Removable polytetrafluoroethylene seat.
   4. Closing Spring: Stainless steel.
   5. Manual Opening Stem: Seal cap, plated-steel stem, and graphite seal.
   6. End Connections: Socket, union, threaded, or flanged.
   7. Maximum Opening Pressure: 0.50 psig.
   8. Working Pressure Rating: 500 psig.
   9. Maximum Operating Temperature: 275 deg F.

D. Service Valves:
   1. Body: Forged brass with brass cap including key end to remove core.

2. Core: Removable ball-type check valve with stainless-steel spring.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Copper spring.
5. Working Pressure Rating: 700 psig.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
1. Body and Bonnet: Plated steel.
2. Solenoid Tube, Plunger, Closing Spring, and Seat Orifice: Stainless steel.
3. Seat: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and 24-V ac coil.
6. Working Pressure Rating: 400 psig.
7. Maximum Operating Temperature: 240 deg F.
8. Manual operator.

F. Safety Relief Valves: Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
1. Body and Bonnet: Ductile iron and steel, with neoprene O-ring seal.
2. Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Seat Disc: Polytetrafluoroethylene.
4. End Connections: Threaded.
5. Working Pressure Rating: 550 psig.
6. Maximum Operating Temperature: 240 deg F.

G. Thermostatic Expansion Valves: Comply with ARI 750.
1. Body, Bonnet, and Seal Cap: Forged brass or steel.
2. Diaphragm, Piston, Closing Spring, and Seat Insert: Stainless steel.
3. Packing and Gaskets: Non-asbestos.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: 40 deg F.
6. Superheat: Adjustable.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
9. Working Pressure Rating: 700 psig.

H. Straight-Type Strainers:
1. Body: Welded steel with corrosion-resistant coating.
2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
4. Working Pressure Rating: 500 psig.
5. Maximum Operating Temperature: 275 deg F.

I. Angle-Type Strainers:
1. Body: Forged brass or cast bronze.
2. Drain Plug: Brass hex plug.
3. Screen: 100-mesh monel.
4. End Connections: Socket or flare.
5. Working Pressure Rating: 500 psig.
6. Maximum Operating Temperature: 275 deg F.

J. Moisture/Liquid Indicators:
   1. Body: Forged brass.
   2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
   3. Indicator: Color coded to show moisture content in ppm.
   4. Minimum Moisture Indicator Sensitivity: Indicate moisture above 60 ppm.
   5. End Connections: Socket or flare.
   6. Working Pressure Rating: 550 psig.
   7. Maximum Operating Temperature: 240 deg F.

K. Replaceable-Core Filter Dryers: Comply with ARI 730.
   1. Body and Cover: Painted-steel shell with ductile-iron cover, stainless-steel screws, and neoprene gaskets.
   2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
   3. Desiccant Media: Activated alumina.
   4. End Connections: Socket.
   5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
   6. Maximum Pressure Loss: 2 psig.
   7. Working Pressure Rating: 550 psig.
   8. Maximum Operating Temperature: 240 deg F.

L. Receivers: Comply with ARI 495.
   1. Comply with ASME Boiler and Pressure Vessel Code; listed and labeled by an NRTL.
   2. Comply with UL 207; listed and labeled by an NRTL.
   3. Body: Welded steel with corrosion-resistant coating.
   4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
   5. End Connections: Socket or threaded.
   6. Working Pressure Rating: 500 psig.
   7. Maximum Operating Temperature: 275 deg F.

M. Liquid Accumulators: Comply with ARI 495.
   1. Body: Welded steel with corrosion-resistant coating.
   2. End Connections: Socket or threaded.
   3. Working Pressure Rating: 550 psig.
   4. Maximum Operating Temperature: 275 deg F.

2.3 REFRIGERANTS

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:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Atofina Chemicals, Inc.
   2. DuPont Company; Fluorochemicals Div.
   3. Honeywell, Inc.; Genetron Refrigerants.
   4. INEOS Fluor Americas LLC.

C. ASHRAE 34, R-32: Difluoromethane.

PART 3 EXECUTION

3.1 PIPING APPLICATIONS FOR REFRIGERANT R-32

A. Suction and Liquid line sets for ductless split systems: PDM Gelcopper, pre-insulated Type ACR piping with polyethylene closed cell insulation. Insulation thickness: 1".

B. Suction Lines NPS 1 and Smaller for VRF system piping: Copper, Type ACR, annealed-temper tubing and wrought-copper fittings with ZoomLock Braze-Free joints or brazed joints.

C. Hot-Gas and Liquid Lines for VRF system piping:
   1. NPS 5/8 and Smaller: Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with ZoomLock Braze-Free joints or brazed joints.
   2. NPS 3/4 to NPS 1 and Smaller: Copper, Type K, annealed- or drawn-temper tubing and wrought-copper fittings with ZoomLock Braze-Free joints or brazed joints.

D. Safety-Relief-Valve Discharge Piping:
   1. Copper, Type ACR, annealed- or drawn-temper tubing and wrought-copper fittings with brazed joints.

3.2 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless valves in suction and discharge lines of compressor.

B. Install service valves for gage taps at inlet and outlet of hot-gas bypass valves and strainers if they are not an integral part of valves and strainers.

C. Install a check valve at the compressor discharge and a liquid accumulator at the compressor suction connection.

D. Except as otherwise indicated, install diaphragm packless valves on inlet and outlet side of filter dryers.

E. Install a full-sized, three-valve bypass around filter dryers.

F. Install solenoid valves upstream from each expansion valve and hot-gas bypass valve. Install solenoid valves in horizontal lines with coil at top.

G. Install thermostatic expansion valves as close as possible to distributors on evaporators.
   1. Install valve so diaphragm case is warmer than bulb.
   2. Secure bulb to clean, straight, horizontal section of suction line using two bulb straps. Do not mount bulb in a trap or at bottom of the line.
   3. If external equalizer lines are required, make connection where it will reflect suction-line pressure at bulb location.

H. Install safety relief valves where required by ASME Boiler and Pressure Vessel Code. Pipe

safety-relief-valve discharge line to outside according to ASHRAE 15.

I. Install moisture/liquid indicators in liquid line at the inlet of the thermostatic expansion valve or at the inlet of the evaporator coil capillary tube.

J. Install strainers upstream from and adjacent to the following unless they are furnished as an integral assembly for device being protected:
   1. Solenoid valves.
   2. Thermostatic expansion valves.
   3. Hot-gas bypass valves.
   4. Compressor.

K. Install filter dryers in liquid line between compressor and thermostatic expansion valve, and in the suction line at the compressor.

L. Install receivers sized to accommodate pump-down charge.

M. Install flexible connectors at compressors.

3.3 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems; indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Shop Drawings.

B. Install refrigerant piping according to ASHRAE 15.

C. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

F. Install piping adjacent to machines to allow service and maintenance.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Select system components with pressure rating equal to or greater than system operating pressure.

J. Install piping as short and direct as possible, with a minimum number of joints, elbows, and fittings.

K. Arrange piping to allow inspection and service of refrigeration equipment. Install valves and

specialties in accessible locations to allow for service and inspection.

L. Install refrigerant piping in rigid or flexible conduit in locations where exposed to mechanical injury.

M. Slope refrigerant piping as follows:
1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
2. Install horizontal suction lines with a uniform slope downward to compressor.
3. Install traps and double risers to entrain oil in vertical runs.
4. Liquid lines may be installed level.

N. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.

O. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

P. Seal penetrations through fire and smoke barriers according to Division 07 Section "Penetration Firestopping."

Q. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

R. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

S. Seal pipe penetrations through exterior walls according to Division 07 Section "Joint Sealants" for materials and methods.

T. Identify refrigerant piping and valves according to Division 23 Section "Identification for HVAC Piping and Equipment."

3.4 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Fill pipe and fittings with an inert gas (nitrogen or carbon dioxide), during brazing or welding, to prevent scale formation.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," Chapter "Pipe and Tube."
1. Use Type BcuP, copper-phosphorus alloy for joining copper socket fittings with copper pipe.
2. Use Type BAg, cadmium-free silver alloy for joining copper with bronze or steel.

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."

B. Install the following pipe attachments:
   1. Adjustable steel clevis hangers for individual horizontal runs less than 20 feet long.
   2. Roller hangers and spring hangers for individual horizontal runs 20 feet or longer.
   3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
   4. Spring hangers to support vertical runs.
   5. Copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for copper tubing with the following maximum spacing and minimum rod sizes:
   1. NPS 1/2: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   2. NPS 5/8: Maximum span, 60 inches; minimum rod size, 1/4 inch.
   3. NPS 1: Maximum span, 72 inches; minimum rod size, 1/4 inch.
   4. NPS 1-1/4: Maximum span, 96 inches; minimum rod size, 3/8 inch.
   5. NPS 1-1/2: Maximum span, 96 inches; minimum rod size, 3/8 inch.

D. Support multifloor vertical runs at least at each floor.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections and prepare test reports.

B. Tests and Inspections:
   1. Comply with ASME B31.5, Chapter VI.
   2. Test refrigerant piping, specialties, and receivers. Isolate compressor, condenser, evaporator, and safety devices from test pressure if they are not rated above the test pressure.
   3. Test high- and low-pressure side piping of each system separately at not less than the pressures indicated in Part 1 "Performance Requirements" Article.
      a. Fill system with nitrogen to the required test pressure.
      b. System shall maintain test pressure at the manifold gage throughout duration of test.
      c. Test joints and fittings with electronic leak detector or by brushing a small amount of soap and glycerin solution over joints.
      d. Remake leaking joints using new materials, and retest until satisfactory results are achieved.

3.7 SYSTEM CHARGING

A. Charge system using the following procedures:
   1. Install core in filter dryers after leak test but before evacuation.
   2. Evacuate entire refrigerant system with a vacuum pump to 500 micrometers. If vacuum holds for 12 hours, system is ready for charging.

3. Break vacuum with refrigerant gas, allowing pressure to build up to 2 psig.
4. Charge system with a new filter-dryer core in charging line.

3.8 ADJUSTING

A. Adjust thermostatic expansion valve to obtain proper evaporator superheat.

B. Adjust high- and low-pressure switch settings to avoid short cycling in response to fluctuating suction pressure.

C. Adjust set-point temperature of air-conditioning or chilled-water controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
1. Verify that compressor oil level is correct.
2. Open compressor suction and discharge valves.
3. Open refrigerant valves except bypass valves that are used for other purposes.
4. Check open compressor-motor alignment and verify lubrication for motors and bearings.

E. Replace core of replaceable filter dryer after system has been adjusted and after design flow rates and pressures are established.

END OF SECTION

SECTION 233113

METAL DUCTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Single-wall rectangular ducts and fittings.
   2. Single-wall round ducts and fittings.
   3. Sheet metal materials.
   4. Duct liner.
   5. Sealants and gaskets.
   6. Hangers and supports.
   7. Double-wall rectangular ducts and fittings.
   8. Double-wall round and flat-oval ducts and fittings.

B. Related Sections:
   1. Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
   2. Division 23 Section "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1-2004.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:
   1. Liners and adhesives.
   2. Sealants and gaskets.

B. Shop Drawings:
   1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   2. Factory- and shop-fabricated ducts and fittings.
   3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
   4. Elevation of top of ducts.
   5. Dimensions of main duct runs from building grid lines.
   6. Fittings.
   7. Reinforcement and spacing.
   8. Seam and joint construction.
   9. Penetrations through fire-rated and other partitions.
   10. Equipment installation based on equipment being used on Project.
   11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
   12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
   2. Suspended ceiling components.
   3. Structural members to which duct will be attached.
   4. Size and location of initial access modules for acoustical tile.
   5. Penetrations of smoke barriers and fire-rated construction.
   6. Items penetrating finished ceiling including the following:
      a. Lighting fixtures.
      b. Air outlets and inlets.
      c. Speakers.
      d. Sprinklers.
      e. Access panels.
      f. Perimeter moldings.

D. Welding certificates.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:
   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
   2. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum," for aluminum supports.

3. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-Up."

C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated. Ductwork shall be mechanical fastened and sealed. Mechanical fasteners for use with flexible non-metallic air ducts shall comply with UL 181B and shall be marked "181 B-C".

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-4, "Transverse (Girth) Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 1-5, "Longitudinal Seams - Rectangular Ducts," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 2, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Lindab Inc.
      b. McGill AirFlow LLC.
      c. SEMCO Incorporated.
      d. Sheet Metal Connectors, Inc.

e. Spiral Manufacturing Co., Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Transverse Joints - Round Duct," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Seams - Round Duct and Fittings," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
1. Galvanized Coating Designation: G60.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Carbon-Steel Sheets: Comply with ASTM A 1008/A 1008M, with oiled, matte finish for exposed ducts.

D. Stainless-Steel Sheets: Comply with ASTM A 480/A 480M, Type 304 or 316, as indicated in the "Duct Schedule" Article; cold rolled, annealed, sheet. Exposed surface finish shall be No. 2B, No. 2D, No. 3, or No. 4 as indicated in the "Duct Schedule" Article.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.
1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 DUCT LINER

A. Fibrous-Glass Duct Liner: Comply with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. CertainTeed Corporation; Insulation Group.
      b. Johns Manville.
      c. Knauf Insulation.
      d. Owens Corning.
      e. Maximum Thermal Conductivity:
         1) Type I, Flexible: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
         2) Type II, Rigid: 0.23 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
      a. For indoor applications, use adhesive that has a VOC content of 80 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

B. Insulation Pins and Washers:
   1. Cupped-Head, Capacitor-Discharge-Weld Pins: Copper- or zinc-coated steel pin, fully annealed for capacitor-discharge welding, 0.106-inch diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   2. Insulation-Retaining Washers: Self-locking washers formed from 0.016-inch thick galvanized steel; with beveled edge sized as required to hold insulation securely in place but not less than 1-1/2 inches in diameter.

C. Shop Application of Duct Liner: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-19, "Flexible Duct Liner Installation."
   1. Adhere a single layer of indicated thickness of duct liner with at least 90 percent adhesive coverage at liner contact surface area. Attaining indicated thickness with multiple layers of duct liner is prohibited.
   2. Apply adhesive to transverse edges of liner facing upstream that do not receive metal nosing.
   3. Butt transverse joints without gaps, and coat joint with adhesive.
   4. Fold and compress liner in corners of rectangular ducts or cut and fit to ensure butted-edge overlapping.
   5. Do not apply liner in rectangular ducts with longitudinal joints, except at corners of ducts, unless duct size and dimensions of standard liner make longitudinal joints necessary.
   6. Secure liner with mechanical fasteners 4 inches from corners and at intervals not exceeding 12 inches transversely; at 3 inches from transverse joints and at intervals not exceeding 18 inches longitudinally.
   7. Secure transversely oriented liner edges facing the airstream with metal nosings that have either channel or "Z" profiles or are integrally formed from duct wall. Fabricate edge facings at the following locations:
      a. Fan discharges.
      b. Intervals of lined duct preceding unlined duct.
   8. Secure insulation between perforated sheet metal inner duct of same thickness as specified for outer shell. Use mechanical fasteners that maintain inner duct at uniform distance from outer shell without compressing insulation.
      a. Sheet Metal Inner Duct Perforations: 3/32-inch diameter, with an overall open area

of 23 percent.

9. Terminate inner ducts with buildouts attached to fire-damper sleeves, dampers, turning vane assemblies, or other devices. Fabricated buildouts (metal hat sections) or other buildout means are optional; when used, secure buildouts to duct walls with bolts, screws, rivets, or welds.

2.5 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:
   1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
   2. Tape Width: 3 inches.
   3. Sealant: Modified styrene acrylic.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   7. Service: Indoor and outdoor.
   8. Service Temperature: Minus 40 to plus 200 deg F.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.
   10. For indoor applications, use sealant that has a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   11. Tape shall comply with UL 181B and shall be marked "181 B-FX".

C. Water-Based Joint and Seam Sealant:
   1. Application Method: Brush on.
   2. Solids Content: Minimum 65 percent.
   3. Shore A Hardness: Minimum 20.
   4. Water resistant.
   5. Mold and mildew resistant.
   6. VOC: Maximum 75 g/L (less water).
   7. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
   8. Service: Indoor or outdoor.
   9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.
   10. Sealant shall comply with UL 181B and shall be marked "181 B-M".

D. Flanged Joint Sealant: Comply with ASTM C 920.
   1. General: Single-component, acid-curing, silicone, elastomeric.
   2. Type: S.
   3. Grade: NS.
   4. Class: 25.
   5. Use: O.
   6. For indoor applications, use sealant that has a VOC content of 250 g/L or less when

calculated according to 40 CFR 59, Subpart D (EPA Method 24).

E. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

F. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.

F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.
2. Supports for Stainless-Steel Ducts: Stainless-steel shapes and plates.
3. Supports for Aluminum Ducts: Aluminum or galvanized steel coated with zinc chromate.

2.7 DOUBLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Lindab Inc.
2. McGill AirFlow LLC.
3. SEMCO Incorporated.
4. Sheet Metal Connectors, Inc.
5. Spiral Manufacturing Co., Inc.

B. Rectangular Ducts: Fabricate ducts with indicated dimensions for the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

D. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

E. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   3. Coat insulation with antimicrobial coating.
   4. Cover insulation with polyester film complying with UL 181, Class 1.

G. Inner Duct: Minimum 0.028-inch thick perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.

H. Formed-on Transverse Joints (Flanges): Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Traverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

I. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.8 DOUBLE-WALL ROUND DUCTS AND FITTINGS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Lindab Inc.
   2. McGill AirFlow LLC.
   3. SEMCO Incorporated.
   4. Sheet Metal Connectors, Inc.
   5. Spiral Manufacturing Co., Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension) of the inner duct.

C. Outer Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on static-pressure class unless otherwise indicated.
   1. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
      a. Transverse Joints in Ducts Larger Than 48 Inches in Diameter: Flanged.
   2. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
      a. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
      b. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.
   3. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Inner Duct: Minimum 0.028-inch perforated galvanized sheet steel having 3/32-inch-diameter perforations, with overall open area of 23 percent.

E. Interstitial Insulation: Fibrous-glass liner complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."
   1. Maximum Thermal Conductivity: 0.27 Btu x in./h x sq. ft. x deg F at 75 deg F mean temperature.
   2. Install spacers that position the inner duct at uniform distance from outer duct without compressing insulation.
   3. Coat insulation with antimicrobial coating.
   4. Cover insulation with polyester film complying with UL 181, Class 1.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Division 23 Section "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
   1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
   2. Outdoor, Supply-Air Ducts: Seal Class A.
   3. Outdoor, Exhaust Ducts: Seal Class C.
   4. Outdoor, Return-Air Ducts: Seal Class C.
   5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
   6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than2-Inch wg: Seal Class A.
   7. Unconditioned Space, Exhaust Ducts: Seal Class C.
   8. Unconditioned Space, Return-Air Ducts: Seal Class B.
   9. Conditioned Space, Supply-Air Ducts in Pressure Classes2-Inch wg and Lower: Seal Class C.
   10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
   11. Conditioned Space, Exhaust Ducts: Seal Class B.
   12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 4-1, "Rectangular Duct Hangers Minimum Size," and Table 4-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of

16 feet.

F. 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.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Division 09 painting Sections.

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections[, selected by Architect from sections installed,] totaling no less than 25 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
   6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.
   2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."
      a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.9 DUCT SCHEDULE

A. Supply Ducts:
   1. Ducts Connected to DOAS & Roof Top Units:
      a. Pressure Class: Positive 3-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 6.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.
   2. Ducts Connected to Fan Coil Units and Terminal Units:
      a. Pressure Class: Positive 1-inch wg.
      b. Minimum SMACNA Seal Class: C.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 12.
   3. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive 2-inch wg.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 3.
      d. SMACNA Leakage Class for Round and Flat Oval: 3.

B. Return Ducts:
   1. Ducts Connected to DOAS Units, Roof Top Units:
      a. Pressure Class: Positive or negative 3-inch wg.
      b. Minimum SMACNA Seal Class: A.
      c. SMACNA Leakage Class for Rectangular: 6.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.
   2. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive or negative 2-inch wg.
      b. Minimum SMACNA Seal Class: B.
      c. SMACNA Leakage Class for Rectangular: 3.
      d. SMACNA Leakage Class for Round and Flat Oval: 3.

C. Exhaust Ducts:
   1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
      a. Pressure Class: Negative 1-inch wg.
      b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
      c. SMACNA Leakage Class for Rectangular: 12.
      d. SMACNA Leakage Class for Round and Flat Oval: 6.
   2. Ducts Connected to Equipment Not Listed Above:
      a. Pressure Class: Positive or negative 2-inch wg.

b. Minimum SMACNA Seal Class: B if negative pressure, and A if positive pressure.
c. SMACNA Leakage Class for Rectangular: 6.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

D. Outdoor-Air (Not Filtered, Heated, or Cooled) Ducts:
1. Ducts Connected to Fan Coil Units and Terminal Units:
a. Pressure Class: Positive or negative 1-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 12.
d. SMACNA Leakage Class for Round and Flat Oval: 6.
2. Ducts Connected to Equipment Not Listed Above:
a. Pressure Class: Positive or negative 3-inch wg.
b. Minimum SMACNA Seal Class: A.
c. SMACNA Leakage Class for Rectangular: 3.
d. SMACNA Leakage Class for Round and Flat Oval: 3.

E. Intermediate Reinforcement:
1. Galvanized-Steel Ducts: Galvanized steel.
2. Stainless-Steel Ducts:
a. Exposed to Airstream: Match duct material.
b. Not Exposed to Airstream: Match duct material.

F. Liner Schedule:
1. Provide acoustical lining 30 ft upstream and downstream of all roof top units and DOAS equipment on supply and return ductwork, whether indicated on the drawings or not. Air handling equipment includes, but is not limited to, DOAS units and roof top units. If a branch takeoff occurs in the 10 ft, line entire takeoff. Provide acoustical lining for all outside air plenums, return air plenums and transfer ducts.
2. Provide acoustical lining 10 ft downstream of all exhaust fans, whether indicated on the drawings or not.
3. Liner type and thickness:
a. Supply Air Ducts: Fibrous glass, Type I, 1 inch thick.
b. Return Air Ducts: Fibrous glass, Type I, 1 inch thick.
c. Exhaust Air Ducts: Fibrous glass, Type I, 1 inch thick.
d. Supply Fan Plenums: Fibrous glass, Type II, 1 inch thick.
e. Transfer Ducts: Fibrous glass, Type I, 1 inch thick.

G. Double-Wall Duct Interstitial Insulation (Exposed RTU-2 System Ductwork Only):
1. Supply Air Ducts: 1 inch thick.
2. Return Air Ducts: 1 inch thick.

H. Elbow Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
a. Velocity 1000 fpm or Lower:
1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio and two vanes.
2) Mitered Type RE 4 with vanes.
b. Velocity 1000 to 1500 fpm:
1) Radius Type RE 1 with minimum 1.0 radius-to-diameter ratio and two vanes.
2) Radius Type RE 3 with minimum 0.5 radius-to-diameter ratio and two vanes.

3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

c. Velocity 1500 fpm or Higher:
1) Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
2) Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Elbows."
a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-3, "Vanes and Vane Runners," and Figure 2-4, "Vane Support in Elbows."

3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-3, "Round Duct Elbows."
a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
1) Velocity 1000 fpm or Lower: 0.5 radius-to-diameter ratio and three segments for 90-degree elbow.
2) Velocity 1000 to 1500 fpm: 1.0 radius-to-diameter ratio and four segments for 90-degree elbow.
3) Velocity 1500 fpm or Higher: 1.5 radius-to-diameter ratio and five segments for 90-degree elbow.
4) Radius-to Diameter Ratio: 1.5.
b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam.

I. Branch Configuration:
1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-6, "Branch Connections."
a. Rectangular Main to Rectangular Branch: 45-degree entry.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "90 Degree Tees and Laterals," and Figure 3-5, "Conical Tees." Saddle taps are permitted in existing duct.
a. Velocity 1000 fpm or Lower: Conical tap.
b. Velocity 1000 to 1500 fpm: Conical tap.
c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 233116

PRE-MANUFACTURED EXTERIOR DUCTING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Phenolic-foam ducts and fittings.

D. Related Sections:
1. Section 230593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for nonmetal ducts.
2. Section 233113 "Metal Ducts" for single- and double-wall, rectangular and round ducts.
3. Section 233300 "Air Duct Accessories" for dampers, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Duct hangers and supports shall withstand the effects of gravity and wind loads and stresses within limits and under conditions described in SMACNA's "Phenolic Duct Construction Standards."

B. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.4 SUBMITTALS

A. Product Data: For each type of the following products:
1. Phenolic-foam duct materials.

B. Shop Drawings:
1. Product Data: Manufacturer's data sheets on each product to be used, including:

a. Physical properties, performance criteria, and product limitations.
b. Preparation instructions and recommendations.
c. Storage and handling requirements and recommendations.
d. Installation methods.

2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
3. Duct layout indicating sizes and pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.
8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Hangers and supports, including methods for duct and building attachment and vibration isolation.
12. Installer qualifications.

C. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.
f. Perimeter moldings.

D. Welding certificates.

E. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

B. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

C. Installer Qualifications: Pre-manufactured ducting shall be installed by experienced contractors who have received appropriate training for the installation of pre-insulated ducts

and approved by the manufacturer or manufacturer's representative.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PHENOLIC-FOAM DUCTS AND FITTINGS

A. Manufacturers:
   1. Basis of Design: Dual-Tech System by PTM Manufacturing, LLC 800-455-1402.
   2. Thermaduct LLC.
   3. PRO-R.
   4. Tuff Duct Systems.

2.2 PRE-INSULATED HVAC DUCTWORK SYSTEM

A. Pre-Insulated HVAC Ductwork System: Provide Kingspan KoolDuct® System for supply, return, fresh, and exhaust air ductwork as shown on the Drawings. System shall include panels, fabrication methods, coupling systems, and accessories to provide a complete system to meet the following performance criteria:
   1. Classification: UL Listed as a Class 1 Air Duct, to UL 181, NFPA 90A and NFPA 90B.
   2. 2015 SMACNA Phenolic Duct Construction Standards in combination with Kingspan Insulation certified fabrication standards.
   3. Fire and Smoke Performance when tested in accordance with ASTM E84 or UL 723:
      a. Flame Spread: <=25.
      b. Smoke Developed: <=50.
   4. Materials: CFC/HCFC free, zero Ozone Depletion Potential (ODP), fiber-free rigid thermoset phenolic insulation core faced with 1 mil low vapor permeability aluminum foil reinforced with glass scrim. Foil is branded on inside of duct and plain on the outer facing.
   5. Nominal Density: 3.4 to 3.75 pcf (55 to 60 kg/m3).
   6. Closed Cell Content: minimum 90 percent.
   7. Compressive Strength: Minimum 29 psi (200 kPa) at 10 percent compression.
   8. Air Leakage: SMACNA Air Leakage Class 3.
   9. Mean Air Velocity: Maximum 5000 fpm (25.4 m/s) with all joints sealed.
   10. Design Pressures:
      a. Positive Pressure: Maximum 4 inch w.g. (1000 Pa).
      b. Negative Pressure: Maximum 3 inch w.g. (750 Pa).
   11. Commissioning Pressures - As designed to, max commissioning 4 inch w.g. (1000Pa.).
   12. Noise-Reduction Coefficient: 0.05 minimum when tested according to ASTM C 423, Mounting A.
   13. Temperature Range: Internal air temperature range -15 to 185 deg. F (-26 to 85 C) during

continuous operation, inside ducts or ambient surrounding temperature.

14. Thermal Resistance, Wall Thickness and R-Value:
    a. 2-3/8” Double layer: R-16.2.
    b. Provide elastomeric foam liner: Provide acoustical lining 10 ft upstream and downstream of all energy recovery equipment on supply and return ductwork, whether indicated on the drawings or not. Air handling equipment includes, but is not limited to, air handling units, energy recovery units & roof top units.
    c. Thermal Conductivity: at 50 to 74 deg. F, mean 0.146 Btu inch per square foot per hour deg. F per ASTM C518.
15. Typical Configuration: Rectangular.

2.3 ACCESSORIES

A. Fittings: In accordance with SMACNA Phenolic Duct Construction Standards or the ASHRAE Design Fundamentals Handbook Chapter 35 or the SMACNA HVAC Duct Systems Design Manual.

B. Support Systems:
1. Tiger Support and round galvanized wire or cable, or threaded rods.
2. Galvanized steel channel support with round galvanized wire or cable, or threaded rods.
3. Duct corner saddle with galvanized wire or cable.

C. Coupling Systems:
1. Tiger Clip Coupling System.
2. Aluminum Grip Coupling System.
3. 4-Bolt Coupling System.

D. Dampers:
1. Volume control dampers per 2015 SMACNA’s Phenolic Duct Construction Standards. Per SMACNA, dampers in any ductwork greater than 12” in either dimension are required to be an opposed blade damper.
2. Fire dampers.

E. Access Doors:
1. Metal insulated access doors.

F. Turning Vanes:
1. Where indicated, turning vanes shall be used in fittings to optimize airflow characteristics.
2. Turing vanes shall be 2” double wall construction 26-gauge galvanized steel mounted on corresponding 2” rail.

G. Reinforcement Systems:
1. Kingspan Reinforcement system as dictated by the Kingspan KoolDuct® fabrication manual.
2. ½” or ¾” EMT conduit reinforcements. Spacing requirements remain dictated by the Kingspan KoolDuct® fabrication manual.

H. V-Groove sealant:
   1. Kingspan KoolDuct® sealant shall be used.

I. Tape:
   1. Comply with UL 181A.
   2. Pressure-sensitive aluminum foil tape imprinted with manufacturer with UL markings, manufacturer name, and date.
   3. Minimum Width: 3 inch.
   4. Water, mold, and mildew resistant.

J. Kingspan KoolDuct® silicone sealant:
   1. Tiger clip coupling system.
      a. Kingspan KoolDuct® silicone sealant shall be used when joining duct segments together.

K. Self-Adhesive Gaskets:
   1. Aluminum Grip Coupling System.
      a. 15mm x 15mm gasket material as directed by Kingspan shall be used when joining duct segments together.
   2. 4-Bolt Coupling System.
      a. 15mm x 15mm gasket material as directed by Kingspan shall be used when joining duct segments together.

L. Duct Connections:
   1. Factory Manufactured all Aluminum Grip Flange available profiles*
      a. Grip flange*
      b. F-flange*
      c. H-flange*
      d. U-flange*
   2. 4-Bolt Coupling System*
   3. Tiger coupling connection to be cleaned thoroughly, apply Kingspan KoolDuct® silicone sealant ensuring minimum air leakage and UL rated tape to be applied to external seams and rubbed down firmly to ensure a permanent, smooth, wrinkle-free bond.

2.4 FABRICATION

A. Fabricate ductwork with panels, joints, seams, transitions, reinforcements, supports, elbows, connections, and accessories in accordance with SMACNA 2015 “Phenolic Duct Construction Standards” in combination with Kingspan Insulation certified fabrication.

2.5 FINISH

A. Interior Ductwork - Standard Finish: Factory-applied aluminum foil vapor barrier facing.

B. Exterior Ductwork - Dual-Tech® pre-fabricated, double layer ducting system utilizing the Kingspan KoolDuct® system. Ductwork shall consist of multiple layers to generate the required R-Value. See NON-FIBROUS, CLOSED CELL, EXTERIOR DUCTWORK AND INSULATION SYSTEM section.
   1. R-Values: 2-3/8” Double layer: R-16.2.
   2. Exterior jacket shall be.032” Kynar 500 finished aluminum in a custom color chosen by the architect.

2.6 HANGERS AND SUPPORTS

A. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   2. Exception: Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

B. Hanger Materials: Galvanized sheet steel or threaded steel rod.
   1. Hangers Installed in Corrosive Atmospheres: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
   2. Strap and Rod Sizes: Comply with SMACNA’s “HVAC Duct Construction Standards - Metal and Flexible” for steel sheet width and thickness and for steel rod diameters.
   3. Galvanized-steel straps attached to aluminum ducts shall have contact surfaces painted with zinc-chromate primer.

C. Penetration into duct is not permitted.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
   1. Supports for Galvanized-Steel Ducts: Stainless-steel shapes and plates.
   2. Supports for Stainless-Steel Ducts: Stainless-steel support materials.
   3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts with fewest possible joints.

C. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

D. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

E. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

F. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges. Overlap openings on four sides by at least 1-1/2 inches.

G. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 233300 "Air Duct Accessories" for fire and smoke dampers.

H. Protect duct interiors from the moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "Duct Cleanliness for New Construction Guidelines."

I. Install foam ducts and fittings to comply with manufacturer’s guidelines.

J. Ducting system sections shall be fitted into place and connected using aluminum flange and gasket as designed by manufacturer.

K. Weather barrier shall be fabricated of mill finished embossed aluminum sheeting, 0.032” in thickness. Exposed seams to be covered with 1” butyl and a 8” embossed aluminum beaded bands, secured with #10 self-tapping, stainless screws with weather seal washers.

L. At weather barrier abutment locations, and industrial grade RTV silicone caulk shall be utilized, where applicable.

M. Seams exposed to the weather shall be covered and sealed with a 1” wide by 1/8” thick butyl compound.

N. All screws utilized to fasten panel system together shall be #10 x ½” self-tapping, stainless steel, weather seal washer screws.

O. Contact cement or 2-sided adhesive tape shall be utilized for laminating insulation material to the weather barrier sheeting.

P. All internal seams must be fully sealed with an unbroken layer of silicone sealant.

Q. Each ductwork section must be duly connected with a jointing system approved duct system manufacturer, and sufficient silicone sealant should be applied in order to seal the rigid phenolic insulation panel and ensure minimum air leakage.

R. Ductwork reinforcement, if necessary, shall be applied to protect against side deformation from both positive and negative pressure.

S. All external seams where two separate panels join must be taped to achieve a permanent bond and a smooth wrinkle free appearance.

3.2 HANGER AND SUPPORT INSTALLATION

A. Install hangers and supports for phenolic-foam ducts and fittings to comply with manufacturer’s guidelines.

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
   1. Where practical, install concrete inserts before placing concrete.
   2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. 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.

3.3 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Division 23 Section "Air Duct Accessories."

B. Comply with SMACNA's "Phenolic Duct Construction Standards" for branch, outlet and inlet, and terminal unit connections.

3.4 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:
   1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
   2. Test the following systems:
      a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
   3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   4. Test for leaks before applying external insulation.
   5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.

6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:
   1. Visually inspect duct system to ensure that no visible contaminants are present.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.5 DUCT CLEANING

A. Clean new duct system(s) before testing, adjusting, and balancing.

B. Clean all exterior aluminum jacketing during and after completion of construction.

3.6 START UP

A. Air Balance: Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC."

3.7 DUCT SCHEDULE

A. Outdoor Ducts and Fittings:
   1. Phenolic-Foam Rectangular Ducts and Fittings:
      a. Minimum Panel Thickness: 1-3/32 inches.
      b. Aluminum Cladding: Minimum 0.032 inch thick.
      c. Polymeric Sealing System: Coat ducts, including gang-nail couplings, grip flanges, and couplings.
   2. Custom Color: Selected by architect.

END OF SECTION

SECTION 233300

AIR DUCT ACCESSORIES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Backdraft and pressure relief dampers.
2. Manual volume dampers.
3. Fire dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Flexible ducts.
9. Duct accessory hardware.
10. Duct silencers.

D. Related Sections:
1. Division 23 Section "HVAC Gravity Ventilators" for roof-mounted ventilator caps.
2. Division 28 Section "Fire Detection and Alarm" for duct-mounted fire and smoke detectors.

1.3 SUBMITTALS

A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
a. Special fittings.
b. Manual volume damper installations.
c. Control damper installations.

d. Wiring Diagrams: For power, signal, and control wiring.

B. Performance Data:
1. Silencer manufacturer to provide submittal drawings detailing all duct silencer data specified in the mechanical drawing schedule.
2. Submit laboratory acoustic and aerodynamic performance obtained according to ASTM E477-06a and so certified when submitted for approval. The laboratory must be currently NVLAP accredited for the ASTM E477-06a test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Shop drawings submitted without proper certifications will be rejected.
a. Submitted silencer pressure drops shall not exceed those listed in the silencer schedule. Silencer pressure drop measurements shall be made in accordance with the ASTM E-477-06a test standard. Tests shall be conducted and reported on the identical units for which acoustical data is presented.
b. The manufacturer shall supply certified dynamic insertion loss and self-noise power level data for each scheduled silencer. The data shall match the project's air distribution system requirement for forward or reverse flow, and total system airflow. All ASTM E-477-06a tests to obtain this data shall be conducted in the same facility and shall utilize the same silencer.
c. Silencer dynamic insertion loss shall not be less than that listed in the silencer schedule.
d. Silencer generated noise shall not be greater than that listed in the silencer schedule.

C. Source quality-control reports:
1. Silencer manufacturer to provide a copy of their laboratory NVLAP accreditation certificate for the ASTM E-477-06a test standard with the submittals. Data from non-NVLAP accredited test facilities will not be accepted.

D. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

E. Source quality-control reports.

F. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.4 QUALITY ASSURANCE

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with AMCA 500-D testing for damper rating.

C. Silencer performance must have been substantiated by laboratory testing in a duct-to-reverberant room test facility according to ASTM E477-06a.The test facility must provide for airflow in both directions through the test silencer. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and

reverberation room absorption. The aero-acoustic laboratory must be currently NVLAP accredited for the ASTM E477-06a test standard.

D. Silencer manufacturer shall provide a written test report by a third party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

PART 2 PRODUCTS

2.1 MATERIALS

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
   1. Galvanized Coating Designation: G60.
   2. Exposed-Surface Finish: Mill phosphatized.

C. Aluminum Sheets: Comply with ASTM B 209, Alloy 3003, Temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

D. Extruded Aluminum: Comply with ASTM B 221, Alloy 6063, Temper T6.

E. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.2 FIRE DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Pottorff.
   3. Ruskin Company.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Closing rating in ducts up to 4-inch wg static pressure class and minimum 2000-fpm velocity.

D. Fire Rating: 3 hours.

E. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch thick galvanized steel; with mitered and interlocking corners.

F. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
   1. Minimum Thickness: 0.05 inch thick, as indicated, and of length to suit application.

2.3 BACKDRAFT AND PRESSURE RELIEF DAMPERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Pottorff Company.
   3. Ruskin Company.

B. Description: Gravity balanced.

C. Maximum Air Velocity: 2000 fpm.

D. Maximum System Pressure: 1-inch wg.

E. Frame: 0.052-inch thick, galvanized sheet steel, with welded corners and mounting flange.

F. Blades: Multiple single-piece blades, center-pivoted, maximum 6-inch width, 0.025-inch-thick, roll-formed aluminum with sealed edges.

G. Blade Action: Parallel.

H. Blade Seals: Neoprene, mechanically locked.

I. Blade Axles:
   1. Material: Nonferrous metal.
   2. Diameter: 0.20 inch.

J. Tie Bars and Brackets: Galvanized steel.

K. Return Spring: Adjustable tension.

L. Bearings: Steel ball or synthetic pivot bushings.

M. Accessories:
   1. Adjustment device to permit setting for varying differential static pressure.
   2. Counterweights and spring-assist kits for vertical airflow installations.
   3. Electric actuators.
   4. Chain pulls.
   5. Screen Mounting: Front mounted in sleeve.
      a. Sleeve Thickness: 20-gage minimum.
      b. Sleeve Length: 6 inches minimum.
   6. Screen Material: Galvanized steel.
   7. Screen Type: Insect.
   8. 90-degree stops.

2.4 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. McGill AirFlow LLC.
      b. Greenheck.
      c. Ruskin Company.
      d. Pottorff Company.
   2. Standard leakage rating, with linkage outside airstream.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat-shaped, galvanized-steel channels, 0.064-inch minimum thickness.
      b. Mitered and welded corners.
      c. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized-steel, 0.064 inch thick.
   6. Blade Axles: Nonferrous metal.
   7. Bearings:
      a. Oil-impregnated bronze.
      b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
   8. Tie Bars and Brackets: Galvanized steel.

B. Low-Leakage, Steel, Manual Volume Dampers:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. McGill AirFlow LLC.
      b. Greenheck.
      c. Pottorff Company.
      d. Ruskin Company.
   2. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
   3. Suitable for horizontal or vertical applications.
   4. Frames:
      a. Hat shaped.
      b. Galvanized-steel channels, 0.064 inch thick.
      c. Mitered and welded corners.
      d. Flanges for attaching to walls and flangeless frames for installing in ducts.
   5. Blades:
      a. Multiple or single blade.
      b. Parallel- or opposed-blade design.
      c. Stiffen damper blades for stability.
      d. Galvanized, roll-formed steel, 0.064 inch thick.
   6. Blade Axles: Nonferrous metal.
   7. Bearings:
      a. Oil-impregnated bronze.

b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.

8. Blade Seals: Neoprene.
9. Jamb Seals: Cambered stainless steel.
10. Tie Bars and Brackets: Galvanized steel.
11. Accessories:
    a. Include locking device to hold single-blade dampers in a fixed position without vibration.

2.5 FLANGE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Nexus PDQ; Division of Shilco Holdings Inc.
   3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.6 TURNING VANES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. SEMCO Incorporated.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.
   1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. Manufactured Turning Vanes for Nonmetal Ducts: Fabricate curved blades of resin-bonded fiberglass with acrylic polymer coating; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

D. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-3, "Vanes and Vane Runners," and 2-4, "Vane Support in Elbows."

E. Vane Construction: Double wall.

F. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger

dimensions.

2.7 DUCT-MOUNTED ACCESS DOORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Greenheck Fan Corporation.
   3. McGill AirFlow LLC.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 2-10, "Duct Access Doors and Panels," and 2-11, "Access Panels - Round Duct."
   1. Door:
      a. Double wall, rectangular.
      b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
      c. Vision panel.
      d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
      e. Fabricate doors airtight and suitable for duct pressure class.
   2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
   3. Number of Hinges and Locks:
      a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
      b. Access Doors up to 18 Inches Square: Two hinges and two sash locks.
      c. Access Doors up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
      d. Access Doors Larger Than 24 by 48 Inches: Four hinges and two compression latches with outside and inside handles.

2.8 DUCT ACCESS PANEL ASSEMBLIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Flame Gard, Inc.
   3. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0428-inch stainless steel.

D. Fasteners: Stainless steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.9 FLEXIBLE CONNECTORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Inc.
   3. Ventfabrics, Inc.
   4. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to 2 strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel or 0.032-inch thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
   1. Minimum Weight: 26 oz./sq. yd.
   2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
   3. Service Temperature: Minus 40 to plus 200 deg F.

F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.
   1. Minimum Weight: 24 oz./sq. yd.
   2. Tensile Strength: 530 lbf/inch in the warp and 440 lbf/inch in the filling.
   3. Service Temperature: Minus 50 to plus 250 deg F.

G. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.
   1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
   2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
   3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
   4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
   5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
   6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
   7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.10 FLEXIBLE DUCTS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Flexmaster U.S.A., Inc.
   2. McGill AirFlow LLC.

3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.
   1. Pressure Rating: 10-inch wg positive.
   2. Maximum Air Velocity: 4000 fpm.
   3. Temperature Range: Minus 10 to plus 160 deg F.
   4. Insulation R-value: Comply with ASHRAE/IESNA 90.1-2004.

C. Flexible Duct Connectors:
   1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action in sizes 3 through 18 inches, to suit duct size.

2.11 DUCT 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 of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

2.12 DUCT SILENCERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Dynasonics.
   2. Vibro-Acoustics.
   3. Alternate manufacturers must request and obtain written approval by the Engineer to bid the project at least 10 days prior to the bid due-date. As a condition of pre-approval, alternate manufacturers must submit to the Engineer silencer test reports. Each report shall be for a silencer tested in full accordance with the ASTM E-477-06a silencer test standard in an aero-acoustic test facility which is NVLAP accredited for the ASTM E-477-06a standard. Each test shall have been conducted within the last 12 month period. A copy of the laboratory's NVLAP accreditation certificate must be included with the submitted reports. Any changes to the specifications must be submitted and approved in writing by the Engineer at least 10 days prior to the bid due-date.

B. General Requirements:
   1. Silencers shall be of the size, configuration, capacity and acoustic performance as scheduled on the drawings. All silencers shall be factory fabricated and supplied by the same manufacturer.
   2. Silencer inlet and outlet connection dimensions must be equal to the duct sizes shown on the drawings. Duct transitions at silencers are not permitted unless shown on the contract drawings.
   3. Silencers shall be constructed in accordance with ASHRAE and SMACNA standards for the pressure and velocity classification specified for the air distribution system in which it is installed. Material gauges noted in other sections are minimums. Material gauges shall

be increased as required for the system pressure and velocity classification. The silencers shall not fail structurally when subjected to a differential air pressure of 8 inches water gauge.

4. All casing seams and joints shall be lock-formed and sealed or stitch welded and sealed except as noted in Section G below, to provide leakage-resistant construction. Airtight construction shall be achieved by use of a duct-sealing compound supplied and installed by the contractor at the jobsite.
5. All perforated steel shall be adequately stiffened to insure flatness and form. All spot welds shall be painted.
6. Fire-Performance Characteristics: Silencer assemblies, including acoustic media fill, Vibar™ film liner, sealants, and acoustical spacer, shall have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.
7. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

C. Rectangular Elbow Silencers: Outer casing shall be ASTM A 653/A 653M, G90 galvanized sheet steel, 14 gauge. All acoustical splitters shall be internally radiused and aerodynamically designed for efficient turning of the air. Half and full splitters are required as necessary to achieve the scheduled insertion loss. All elbow silencers with a turning cross-section dimension greater than 48” shall have at least two half splitters and one full splitter.

D. Inner perforated metal liner: ASTM A 653/A 653M, G90 galvanized sheet steel.
1. Rectangular Elbow Silencers: 22 gauge.

E. Principal Sound-Absorbing Mechanism:
1. Dissipative silencers:
a. Media shall be of acoustic quality, shot-free glass fiber insulation with long, resilient fibers bonded with a thermosetting resin. Glass fiber density and compression shall be as required to insure conformance with laboratory test data. Glass fiber shall be packed with a minimum of 15% compression during silencer assembly. Media shall be resilient such that it will not crumble or break, and conform to irregular surfaces. Media shall not cause or accelerate corrosion of aluminum or steel. Mineral wool will not be permitted as a substitute for glass fiber.

F. Media Protection:
1. Where indicated on the silencer schedule, media shall be encapsulated in glass fiber cloth to help prevent shedding, erosion and impregnation of the glass fiber.

G. Accessories:
1. Factory-installed end caps to prevent contamination during shipping.

H. Source Quality Control:
1. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
2. Silencer performance must have been substantiated by laboratory testing in a duct-to-reverberant room test facility according to ASTM E477-06a.The test facility must provide for airflow in both directions through the test silencer. The test set-up, procedure and facility shall eliminate all effects due to flanking, directivity, end reflection, standing waves and reverberation room absorption. The aero-acoustic laboratory must be currently

NVLAP accredited for the ASTM E477-06a test standard.

3. Silencer manufacturer shall provide a written test report by a third-party organization showing silencer assemblies have flame-spread index not exceeding 25 and smoke-developed index not exceeding 50 when tested according to ASTM E 84, NFPA 255 or UL 723.

I. Submittals.
   1. Performance Data:
      a. Submit laboratory acoustic and aerodynamic performance obtained according to ASTM E477-06a and so certified when submitted for approval. The laboratory must be currently NVLAP accredited for the ASTM E477-06a test standard. A copy of the accreditation certificate must be included with the submittals. Data from non-NVLAP accredited test facilities will not be accepted. Shop drawings submitted without proper certifications will be rejected.
         1) Submitted silencer pressure drops shall not exceed those listed in the silencer schedule. Silencer pressure drop measurements shall be made in accordance with the ASTM E-477-06a test standard. Tests shall be conducted and reported on the identical units for which acoustical data is presented.
         2) The manufacturer shall supply certified dynamic insertion loss and self-noise power level data for each scheduled silencer. The data shall match the project's air distribution system requirement for forward or reverse flow, and total system airflow. All ASTM E-477-06a tests to obtain this data shall be conducted in the same facility and shall utilize the same silencer.
         3) Silencer dynamic insertion loss shall not be less than that listed in the silencer schedule.
         4) Silencer generated noise shall not be greater than that listed in the silencer schedule.

J. INSTALLATION.
   1. Install silencer according to manufacturer's written installation instructions.

K. FIELD QUALITY CONTROL.
   1. Tests and Inspections:

L. Ensure duct silencers are installed with airflow arrows in direction.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel.
   1. Install steel volume dampers in steel ducts.
   2. Install aluminum volume dampers in aluminum ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
   1. On both sides of duct coils.
   2. Upstream and downstream from duct filters.
   3. At outdoor-air intakes and mixed-air plenums.
   4. At drain pans and seals.
   5. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
   6. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
   7. At each change in direction and at maximum 50-foot spacing.
   8. Upstream and downstream from turning vanes.
   9. Upstream or downstream from duct silencers.
   10. Control devices requiring inspection.
   11. Elsewhere as indicated.

H. Install access doors with swing against duct static pressure.

I. Access Door Sizes:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.
   3. Head and Hand Access: 18 by 10 inches.
   4. Head and Shoulders Access: 21 by 14 inches.
   5. Body Access: 25 by 14 inches.
   6. Body plus Ladder Access: 25 by 17 inches.

J. Label access doors according to Division 23 Section "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

K. Install flexible connectors to connect ducts to equipment.

L. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

M. Connect supply diffusers to ducts with maximum 60-inch lengths of flexible duct clamped or strapped in place.

N. Connect flexible ducts to metal ducts with adhesive plus sheet metal screws.

O. Install duct test holes where required for testing and balancing purposes.

P. Provide remote damper operators where ever volume dampers are installed above an inaccessible hard ceiling.

3.2 ADJUSTMENT, CALIBRATION, AND TESTING

A. Description:
1. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.
2. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.
3. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.
4. Equipment and procedures used for calibration shall meet instrument manufacturer's recommendations.
5. Provide diagnostic and test equipment for calibration and adjustment.
6. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. For example, an installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
7. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.
8. If after-calibration-indicated performance cannot be achieved, replace out-of-tolerance instruments.
9. Comply with field-testing requirements and procedures indicated by ASHRAE Guideline 11, "Field Testing of HVAC Control Components," in the absence of specific requirements, and to supplement requirements indicated.

3.3 FIELD QUALITY CONTROL

A. Tests and Inspections:
1. Operate dampers to verify full range of movement.
2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.
5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

SECTION 233423

HVAC POWER VENTILATORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Centrifugal roof ventilators.
2. In-line ceiling mounted ventilators.
3. In-line mixed-flow fans.

1.3 PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan-performance ratings on actual Project site elevations.

B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Also include the following:
1. Certified fan performance curves with system operating conditions indicated.
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.
6. Roof curbs.
7. Fan speed controllers.

B. Shop Drawings: 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. Coordination Drawings: Reflected ceiling plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Roof framing and support members relative to duct penetrations.
   2. Ceiling suspension assembly members.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including light fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

D. Field quality-control reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 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. AMCA Compliance: Fans shall have AMCA-Certified performance ratings and shall bear the AMCA-Certified Ratings Seal.

C. UL Standards: Power ventilators shall comply with UL 705. Power ventilators for use for restaurant kitchen exhaust shall also comply with UL 762.

1.6 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate sizes and locations of concrete bases with actual equipment provided.

C. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1.8 WARRANTY

A. Manufacturer shall provide, at no additional cost, a standard parts warranty that covers a period of two years from substantial completion. This warrants that all products are free from defects in material and workmanship and shall meet the capacities and ratings set forth in the equipment manufacturer's catalog and bulletins.

PART 2 PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Loren Cook Company.
   3. PennBarry.

B. Housing: Removable, spun-aluminum, dome top and outlet baffle; square, one-piece, aluminum base with venturi inlet cone.
   1. Hinged Subbase: Galvanized-steel hinged arrangement permitting service and maintenance.

C. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

D. Direct-Drive Units: Motor mounted in airstream, factory wired to disconnect switch located on outside of fan housing.

E. Accessories:
   1. Variable-Speed Controller: Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Disconnect Switch: Nonfusible type, with thermal-overload protection, factory wired through an internal aluminum conduit.
   3. Bird Screens: Removable, 1/2-inch mesh, aluminum or brass wire.
   4. Dampers: Counterbalanced, parallel-blade, backdraft dampers mounted in curb base; factory set to close when fan stops.
   5. Barometric Dampers: Parallel-blade dampers mounted in curb.

F. Roof Curbs: Galvanized steel; mitered and welded corners; 1-1/2-inch- thick, rigid, fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to suit roof opening and fan base.
   1. Configuration: Self-flashing without a cant strip, with mounting flange.
   2. Sound Curb: Curb with sound-absorbing insulation.
   3. Pitch Mounting: Manufacture curb for roof slope.
   4. Metal Liner: Galvanized steel.

2.2 CEILING-MOUNTED VENTILATORS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck.
   2. Loren Cook Company.
   3. Penn Barry.

B. Housing: Steel, lined with acoustical insulation.

C. Fan Wheel: Galvanized steel, Centrifugal wheels directly mounted on motor shaft. Fan shrouds, motor, and fan wheel shall be removable for service.

D. Grille: Plastic, louvered grille with flange on intake and thumbscrew attachment to fan housing.

E. Electrical Requirements: Junction box for electrical connection on housing and receptacle for motor plug-in.

F. Accessories:
   1. Motor Mounted Speed Dial: Solid-state control to reduce speed from 100 to less than 50 percent.
   2. Filter: Washable aluminum to fit between fan and grille.
   3. Isolation: Rubber-in-shear vibration isolators.
   4. Integral back-draft damper.

2.3 MIXED-FLOW FANS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Greenheck Fan Corporation.
   2. Loren Cook Company.
   3. Penn Barry.

B. General:
   1. The fan shall be of welded and bolted construction utilizing corrosion resistant fasteners.
   2. Housing shall be minimum 12 gauge LorenizedTM steel with integral inlet and outlet flanges.
   3. Drive components shall be isolated from the air stream with a removable bearing cover and a continuously welded belt tunnel.
   4. Adjustable motor plate shall utilize threaded studs for positive belt tensioning.
   5. Extended lube lines shall be furnished for lubrication of fan bearings.
   6. Mounting brackets shall be welded to the outer housing to accommodate universal mounting feet for vertical or horizontal installation.
   7. Unit shall bear an engraved aluminum nameplate.
   8. Nameplate shall indicate design CFM, static pressure, and maximum fan RPM.
   9. Unit shall be shipped in ISTA certified transit tested packaging.

C. Wheel.
   1. Wheel shall be centrifugal backward inclined, non-overloading flat blade type, constructed of 100% aluminum, including a precision machined cast aluminum hub.
   2. Wheel hub shall be keyed and securely attached to the fan shaft.
   3. Wheel inlet shall overlap an aerodynamically efficient aluminum inlet cone to provide maximum performance and efficiency.
   4. Wheel shall be balanced in accordance with AMCA.
   5. Standard 204-05, Balance Quality and Vibration Levels for Fans.

D. Fan Impeller:
   1. Fan impeller shall be mixed flow design. The impeller shall be electronically balanced both statically and dynamically to balance grade G6.3 per ANSI S2.19.
   2. Fan impeller shall be manufactured with continuously welded steel airfoils and coated with a minimum of 2-4 mils of Permatector (Polyester Urethane), electrostatically applied and baked. Finish color shall be RAL 7023, concrete grey.
   3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

E. Fan motors and Drives: Motor shall be NEMA design B with class B insulation rated for continuous duty and furnished at the specified voltage, phase and enclosure.

F. Belts and Drives: Belts shall be oil and heat resistant, static conducting.
   1. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts.
   2. Drives shall be sized for 150% of the installed motor horsepower.
   3. The variable pitch motor drive must be factory set to the specified fan RPM.

G. Bearings: Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be regreasable ball type in a cast iron pillow block housing selected for a minimum L10 life in excess of 80,000 hours at maximum cataloged operating speed.

H. Options and Accessories:
   1. Bolted Access Door.
   2. Belt guard.
   3. Provide AMCA Type A Spark resistant construction.

I. Factory Finishes:
   1. Sheet Metal Parts: Prime coat before final assembly.
   2. Exterior Surfaces: Baked-enamel finish coat after assembly.
   3. Coatings: Hot-dip galvanized.
      a. Apply to finished housings.
      b. Apply to fan wheels.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install power ventilators level and plumb.

B. Ceiling Units: Suspend units from structure; use steel wire or metal straps.

C. Support suspended units from structure using threaded steel rods and spring hangers with vertical-limit stops having a static deflection of 1 inch.

D. Install units with clearances for service and maintenance.

E. Label units according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Verify that shipping, blocking, and bracing are removed.
   2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
   3. Verify that cleaning and adjusting are complete.
   4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.

5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
10. Shut unit down and reconnect automatic temperature-control operators.
11. Remove and replace malfunctioning units and retest as specified above.

C. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Prepare test and inspection reports.

3.4 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Comply with requirements in Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.

D. Replace fan and motor pulleys as required to achieve design airflow.

E. Lubricate bearings.

END OF SECTION

SECTION 233713

DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Rectangular and square ceiling diffusers.
2. Grilles and registers.
3. Ceiling linear slot outlets.

D. Related Sections:
1. Section 233300 "Air Duct Accessories" for fire and smoke dampers and volume-control dampers not integral to diffusers, registers, and grilles.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:
1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

B. Samples for Initial Selection: For diffusers, registers, and grilles with factory-applied color finishes.

C. Samples for Verification: For diffusers, registers, and grilles, in manufacturer's standard sizes to verify color selected.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:
   1. Ceiling suspension assembly members.
   2. Method of attaching hangers to building structure.
   3. Size and location of initial access modules for acoustical tile.
   4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
   5. Duct access panels.

B. Source quality-control reports.

PART 2 PRODUCTS

2.1 CEILING DIFFUSERS

A. Louver Face Diffuser Tag-A:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Price.
      b. Titus.
      c. Krueger.
   2. Devices shall be specifically designed for variable-air-volume flows.
   3. Material: Steel.
   4. Finish: Baked enamel, white.
   5. Face Size: 24x24.
   6. Mounting: As required for ceiling type.
   7. Pattern: Refer to drawings.
   8. Accessories:
      a. Round to square transition.

B. Louver Face Diffuser Tag-F:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Price.
      b. Titus.
      c. Krueger.
   2. Devices shall be specifically designed for variable-air-volume flows.
   3. Material: Steel.
   4. Finish: Baked enamel, white.
   5. Face Size: 24x24.
   6. Mounting: As required for ceiling type.
   7. Pattern: Refer to drawings.
   8. Accessories:
      a. Round to square transition.
      b. Induction Vanes.

2.2 REGISTERS AND GRILLES

A. Fixed Face Grille, Tag-B:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Krueger.
      b. Price Industries.
      c. Titus.
   2. Material: Steel.
   3. Finish: Custom color chosen by the architect.
   4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart. Blades are parallel to the long dimension.
   5. Blade Deflection: 45 degrees.
   6. Frame: 1-1/4 inches wide.
   7. Mounting: Countersunk screw.

B. Adjustable Bar Grille, Tag-C:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Price.
      b. Titus.
      c. Krueger.
   2. Material: Steel.
   3. Finish: Baked enamel, in color chosen by the architect.
   4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
   5. Core Construction: Integral.
   6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
   7. Frame: 1-1/4 inches wide.
   8. Mounting: Countersunk screw.

C. Heavy Duty Fixed Face Bar Grille, Tag-D:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Price.
      b. Titus.
      c. Krueger.
   2. Material: Steel.
   3. Finish: Baked enamel. Provide in standard color chosen by architect.
   4. Face Blade Arrangement: Horizontal spaced 3/8 inch apart with 0 degree deflection.
   5. Core Construction: Integral.
   6. Frame: 1-1/4 inches wide.
   7. Mounting: Countersunk screw.

D. Adjustable Bar Register, Tag-G:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Price.
      b. Titus.
      c. Krueger.
   2. Material: Steel.

3. Finish: Baked enamel, in color chosen by the architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart.
5. Core Construction: Integral.
6. Rear-Blade Arrangement: Vertical spaced 3/4 inch apart.
7. Frame: 1-1/4 inches wide.
8. Mounting: Countersunk screw.
9. Damper Type: Adjustable opposed blade, operable from register face, where no damper is indicated in ductwork.

E. Fixed Face Register, Tag-H:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Krueger.
   b. Price Industries.
   c. Titus.
2. Material: Steel.
3. Finish: Custom color chosen by the architect.
4. Face Blade Arrangement: Horizontal spaced 3/4 inch apart. Blades are parallel to the long dimension.
5. Blade Deflection: 45 degrees.
6. Frame: 1-1/4 inches wide.
7. Mounting: Countersunk screw.
8. Damper Type: Adjustable opposed blade, operable from register face, where no damper is indicated in ductwork.

2.3 CEILING LINEAR SLOT OUTLETS

A. Linear Slot Diffuser, Tag-E:
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Price.
   b. Titus.
   c. Krueger.
2. Material - Shell: Aluminum.
3. Material - Pattern Controller and Tees: Aluminum.
4. Finish - Face and Shell: Baked enamel, black.
5. Finish - Pattern Controller: Baked enamel, black.
6. Finish - Tees: Baked enamel, in color selected by Architect.
7. Slot Width: 3/4 inch.
8. Number of Slots: Four.
9. Length: Refer to drawings.
10. Accessories:
    a. Insulated Plenum.
    b. Blank-offs for all inactive lengths.
11. Plenum: Field fabricated plenum boxes with fiber-free insulation. Refer to drawings for dimensions, location, and further details.

2.4 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

SECTION 233723

HVAC GRAVITY VENTILATORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following types of roof-mounting intake and relief ventilators:
   1. Roof hoods.

D. Related Sections include the following:
   1. Division 08 Section "Louvers and Vents" for ventilator assemblies provided as part of the general construction.
   2. Division 23 Section "HVAC Power Ventilators" for roof-mounting exhaust fans.

1.3 PERFORMANCE REQUIREMENTS

A. Structural Performance: Intake and relief ventilators shall be capable of withstanding the effects of gravity loads, wind loads and thermal movements without permanent deformation of components, noise or metal fatigue, or permanent damage to fasteners and anchors.

B. Water Entrainment: Limit water penetration through unit to comply with ASHRAE 62.1.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For intake and relief ventilators. Include plans, elevations, sections, details, and ventilator attachments to curbs and curb attachments to roof structure.

C. Coordination Drawings: Roof framing plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
   1. Structural members to which roof curbs and ventilators will be attached.
   2. Sizes and locations of roof openings.

1.5 QUALITY ASSURANCE

A. Source Limitations: Obtain ventilators through one source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

B. Product Options: Information on Drawings and in Specifications establishes requirements for system's 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.

C. Product Options: Drawings indicate size, profiles, and dimensional requirements of intake and relief ventilators and are based on the specific equipment indicated. Refer to Division 01 Section "Product Requirements."
   1. 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.

D. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.2, "Structural Welding Code--Aluminum."
   2. AWS D1.3, "Structural Welding Code--Sheet Steel."

1.6 COORDINATION

A. Coordinate installation of roof curbs and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

PART 2 PRODUCTS

2.1 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 of the manufacturers specified.

2.2 MATERIALS

A. Aluminum Extrusions: ASTM B 221, Alloy 6063-T5 or T-52.

B. Aluminum Sheet: ASTM B 209, Alloy 3003 or 5005 with temper as required for forming or as otherwise recommended by metal producer for required finish.

C. Galvanized-Steel Sheet: ASTM A 653/A 653M, G90 zinc coating, mill phosphatized.

D. Stainless-Steel Sheet: ASTM A 666, Type 304, with No. 4 finish.

E. Fasteners: Same basic metal and alloy as fastened metal or 300 Series stainless steel, unless otherwise indicated. Do not use metals that are incompatible with joined materials.
   1. Use types and sizes to suit unit installation conditions.
   2. Use hex-head or Phillips pan-head screws for exposed fasteners, unless otherwise indicated.

F. Post-Installed Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed, for masonry, as determined by testing per ASTM E 488, conducted by a qualified independent testing agency.

G. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.3 FABRICATION, GENERAL

A. Factory or shop fabricate intake and relief ventilators to minimize field splicing and assembly. Disassemble units to the minimum extent as necessary for shipping and handling. Clearly mark units for reassembly and coordinated installation.

B. Fabricate frames, including integral bases, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

C. Fabricate units with closely fitted joints and exposed connections accurately located and secured.

D. Fabricate supports, anchorages, and accessories required for complete assembly.

E. Perform shop welding by AWS-certified procedures and personnel.

2.4 ROOF HOODS

A. Manufacturers:
   1. Greenheck.
   2. Loren Cook Company.
   3. Penn Barry.

B. Factory or shop fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figures 5-6 and 5-7.

C. Materials: Aluminum sheet, minimum 0.064-inch thick base and 0.040-inch thick hood; suitably reinforced.

D. Roof Curbs: Galvanized-steel sheet; with mitered and welded corners; 1-1/2-inch thick, rigid fiberglass insulation adhered to inside walls; and 1-1/2-inch wood nailer. Size as required to fit roof opening and ventilator base.
   1. Configuration: Self-flashing without a cant strip, with mounting flange.
   2. Overall Height: 18 inches.

E. Bird Screening: Galvanized-steel, 1/2-inch square mesh, 0.041-inch wire.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install intake and relief ventilators level, plumb, and at indicated alignment with adjacent work.

B. Secure intake and relief ventilators to roof curbs with cadmium-plated hardware. Use concealed anchorages where possible. Refer to Division 07 Section "Roof Accessories" for installation of roof curbs.

C. Install intake and relief ventilators with clearances for service and maintenance.

D. Install perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Install concealed gaskets, flashings, joint fillers, and insulation as installation progresses. Comply with Division 07 Section "Joint Sealants" for sealants applied during installation.

F. Label intake and relief ventilators according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

G. Protect galvanized and nonferrous-metal surfaces from corrosion or galvanic action by applying a heavy coating of bituminous paint on surfaces that will be in contact with concrete, masonry, or dissimilar metals.

H. Repair finishes damaged by cutting, welding, soldering, and grinding. Restore finishes so no evidence remains of corrective work. Return items that cannot be refinished in the field to the factory, make required alterations, and refinish entire unit or provide new units.

3.2 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections.

Drawings indicate general arrangement of ducts and duct accessories.

3.3 ADJUSTING

A. Adjust damper linkages for proper damper operation.

END OF SECTION

SECTION 237433

ROOF TOP UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes factory-packaged outdoor rooftop units capable of supplying up to 100 percent outdoor air and providing cooling and heating.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Include rated capacities, operating characteristics, and furnished specialties and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and attachment details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Prepare the following by or under the supervision of a qualified professional engineer:
      a. Mounting Details: For securing and flashing roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
      b. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Roof-curb mounting details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Size and location of unit-mounted rails and anchor points and methods for anchoring units to roof curb.
   2. Required roof penetrations for ducts, pipes, and electrical raceways, including size and location of each penetration.

B. Startup service reports.

C. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For units to include in emergency, operation, and maintenance manuals.

1.6 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Filters: One set for each unit.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period for Compressors: Five years from date of Substantial Completion.
   2. Warranty Period for Heat Exchangers: 25 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Aaon.
   2. Valent.
   3. Daikin.
   4. Trane.
   5. Note that Engineer will review in detail submittals for this equipment and will not approve incomplete submittals that do not clearly indicate or include in detail the items indicated to be provided in the above submittal section of this specification. Engineer will not approve submittals that do not meet or exceed all performance and construction requirements indicated in the specifications and drawings for this project. Do not request a product to be accepted or submit a product that does not have a digital compressor or variable speed condenser fan with head pressure control because it will not be considered acceptable by Engineer and rejected. Manufacturers products noted above are to be provided by authorized manufacturer’s representative companies of the Contractor whom is submitting a proposal. Engineer will not approve submittals that do not come from the authorized manufacturer’s representative company for the Contractor whom is submitting a proposal. If authorized manufacturer’s representative company for the Contractor is different than authorized manufacturer’s representative company of the Engineer then

authorized manufacturer's representative company for the Contractor then that company shall contact and coordinate with authorized manufacturer's representative company of the Engineer. If contact and coordination are not performed Engineer will not approve submittals.

2.2 PERFORMANCE REQUIREMENTS

A. General Fabrication Requirements: Comply with requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment," and Section 7 - "Construction and System Start-up."
   1. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
   2. Unit and refrigeration system shall comply with ASHRAE 15, Safety Standard for Mechanical Refrigeration.
   3. Unit shall be certified in accordance with UL Standard 1995/CSA C22.2 No. 236, Safety Standard for Heating and Cooling Equipment.
   4. Unit shall be safety certified by ETL and ETL US listed. Unit nameplate shall include the ETL/ETL Canada label.

B. Cabinet Surface Condensation:
   1. Cabinet shall have additional insulation and vapor seals if required to prevent condensation on the interior and exterior of the cabinet.
   2. Portions of cabinet located downstream from the cooling coil shall have a thermal break at each thermal bridge between the exterior and interior casing to prevent condensation from occurring on the interior and exterior surfaces. The thermal break shall not compromise the structural integrity of the cabinet.

C. 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 ROOFTOP UNITS

A. General Description.
   1. Packaged rooftop unit shall include compressors, evaporator coils, filters, supply fans, dampers, air-cooled condenser coils, condenser fans, reheat coil, electric heaters, exhaust fans, energy recovery wheels, and unit controls.
   2. Unit shall be factory assembled and tested including leak testing of the DX coils, pressure testing of the refrigeration circuit, and run testing of the completed unit. Run test report shall be supplied with the unit in the service compartment's literature pocket.
   3. Unit shall have decals and tags to indicate lifting and rigging, service areas and caution areas for safety and to assist service personnel.
   4. Unit components shall be labeled, including refrigeration system components and electrical and controls components.
   5. Estimated sound power levels (dB) shall be shown on the unit schedule.
   6. Installation, Operation and Maintenance manual shall be supplied within the unit.
   7. Laminated color-coded wiring diagram shall match factory installed wiring and shall be affixed to the interior of the control compartment's hinged access door.
   8. Unit nameplate shall be provided in two locations on the unit, affixed to the exterior of the unit and affixed to the interior of the control compartment's hinged access door.

B. Construction.
   1. All cabinet walls, access doors, and roof shall be fabricated of double wall, impact resistant, rigid polyurethane foam panels.
   2. Unit insulation shall have a minimum thermal resistance R-value of 13. Foam insulation shall have a minimum density of 2 pounds/cubic foot and shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610°F.
   3. Unit construction shall be double wall with G90 galvanized steel on both sides and a thermal break. Double wall construction with a thermal break prevents moisture accumulation on the insulation, provides a cleanable interior, prevents heat transfer through the panel, and prevents exterior condensation on the panel.
   4. Unit shall be designed to reduce air leakage and infiltration through the cabinet. Cabinet leakage shall not exceed 1% of total airflow when tested at 3 times the minimum external static pressure provided in AHRI Standard 340/360. Panel deflection shall not exceed L/240 ratio at 125% of design static pressure, at a maximum 8 inches of positive or negative static pressure, to reduce air leakage. Deflection shall be measured at the midpoint of the panel height and width. Continuous sealing shall be included between panels and between access doors and openings to reduce air leakage. Piping and electrical conduit through cabinet panels shall include sealing to reduce air leakage.
   5. Roof of the air tunnel shall be sloped to provide complete drainage. Cabinet shall have rain break overhangs above access doors.
   6. Access to filters, dampers, cooling coils, reheat coil, heaters, exhaust fans, energy recovery wheels, compressors, and electrical and controls components shall be through hinged access doors with quarter turn, zinc cast, lockable handles. Full length stainless steel piano hinges shall be included on the doors.
   7. Exterior paint finish shall be capable of withstanding at least 2,500 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.
   8. Units with cooling coils shall include double sloped 304 stainless steel drain pans.
   9. Unit shall be provided with base discharge and return air openings. All openings through the base pan of the unit shall have upturned flanges of at least 1/2 inch in height around the opening.
   10. Unit shall include lifting lugs on the top of the unit.
   11. Unit base pan shall be provided with 1/2 inch thick foam insulation.

C. Electrical.
   1. Unit shall be provided with factory installed and factory wired, non-fused disconnect switch.
   2. Unit shall be provided with phase and brown out protection which shuts down all motors in the unit if the electrical phases are more than 10% out of balance on voltage, the voltage is more than 10% under design voltage or on phase reversal.
   3. Unit shall be provided with a factory installed and factory wired 115V, 13 amp GFI outlet disconnect switch in the unit control panel.

D. Supply Fans.
   1. Unit shall include direct drive, unhoused, backward curved, plenum supply fans.
   2. Blowers and motors shall be dynamically balance and mounted on rubber isolators.
   3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
   4. Variable frequency drives shall be factory wired and mounted in the unit. The VFD frequency signal control point must be able to handle a 20K ohm input impedance. Fan

motors shall be premium efficiency.

E. Exhaust Fans.
1. Exhaust dampers shall be sized for 100% relief.
2. Fans and motors shall be dynamically balanced.
3. Motors shall be premium efficiency ODP with ball bearings rated for 200,000 hours service with external lubrication points.
4. Access to exhaust fans shall be through double wall, hinged access doors with quarter turn lockable handles.
5. Unit shall include belt driven, unhoused, backward curved, plenum exhaust fans.
6. Variable frequency drives shall be factory wired and mounted in the unit. The VFD frequency signal control point must be able to handle a 20K ohm input impedance. Fan motors shall be premium efficiency.

F. Cooling Coils.
1. Evaporator Coils.
a. Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and galvanized steel end casings. Fin design shall be sine wave rippled.
b. Coils shall be 6 row high capacity.
c. Coils shall have interlaced circuitry and shall be 6 row high capacity.
d. Coils shall be helium leak tested.
e. Coils shall be furnished with factory installed thermostatic expansion valves.

G. Refrigeration System.
1. Unit shall be factory charged with R-454B refrigerant.
2. Compressors shall be scroll type with thermal overload protection and independently circuited.
3. Compressors shall be mounted in an isolated service compartment which can be accessed without affecting unit operation. Lockable hinged compressor access doors shall be fabricated of double wall, rigid polyurethane foam injected panels to prevent the transmission of noise outside the cabinet.
4. Compressors shall be isolated from the base pan with the compressor manufacturer’s recommended rubber vibration isolators, to reduce any transmission of noise from the compressors into the building area.
5. Each refrigeration circuit shall be equipped with thermostatic expansion valve type refrigerant flow control.
6. Each refrigeration circuit shall be equipped with automatic reset low pressure and manual reset high pressure refrigerant safety controls, Schrader type service fittings on both the high pressure and low pressure sides and a factory installed replaceable core liquid line filter driers.
7. Unit shall include a variable capacity scroll compressor on the refrigeration circuit which shall be capable of modulation from 10-100% of its capacity.
8. Unit shall include a variable capacity scroll compressor on the lead refrigeration circuit which shall be capable of modulation from 10-100% of its capacity where there is more than one compressor indicated.
9. Refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the

space.

10. Lead refrigeration circuit shall be provided with hot gas reheat coil, modulating valves, electronic controller, supply air temperature sensor and a control signal terminal which allow the unit to have a dehumidification mode of operation, which includes supply air temperature control to prevent supply air temperature swings and overcooling of the space where there is more than one compressor indicated.
11. Each refrigeration circuit shall be equipped with suction and discharge compressor isolation valves.
12. Each refrigeration circuit shall include adjustable compressor lockouts.
13. First capacity stage shall be provided with on/off condenser fan cycling and adjustable compressor lockout to allow cooling operation down to 35°F.
14. Reversing valve for air-source heat pump operation.

H. Condensers.
   1. Air-Cooled Condenser.
      a. Condenser fans shall be a vertical discharge, axial flow, variable speed direct drive fans.
      b. Coils shall be designed for use with R-454B refrigerant and constructed of copper tubes with aluminum fins mechanically bonded to the tubes and aluminum end casings. Fin design shall be sine wave rippled.
      c. Coils shall be designed for a minimum of 10°F of refrigerant sub-cooling.
      d. Coils shall be helium leak tested.
      e. Condenser fans shall be VFD driven variable speed for condenser head pressure control. Factory provided and factory programmed VFDs shall continuously modulate the fan air flow to maintain head pressure at acceptable levels. Cooling operation shall be allowed down to 35°F with adjustable compressor lockouts.

I. Energy Recovery.
   1. Unit shall contain a factory mounted and tested energy recovery wheels. The energy recovery wheels shall be mounted in a rigid frame containing the wheel drive motor, drive belt, wheel seals and bearings. Frame shall slide out for service and removal from the cabinet.
   2. The energy recovery component shall incorporate a rotary wheel in an insulated cassette frame complete with seals, drive motor and drive belt.
   3. Wheels shall be wound continuously with one flat and one structured layer in an ideal parallel plate geometry providing laminar flow and minimum pressure drop-to-efficiency ratios. The layers shall be effectively captured in stainless steel wheel frames or aluminum and stainless steel segment frames that provide a rigid and self-supporting matrix.
   4. Wheels shall be provided with removable energy transfer matrix. Wheel frame construction shall be a welded hub, spoke and rim assembly of stainless, plated and/or coated steel and shall be self-supporting without matrix segments in place. Segments shall be removable without the use of tools to facilitate maintenance and cleaning. Wheel bearings shall be selected to provide an L-10 life in excess of 400,000 hours. Rim shall be continuous rolled stainless steel and the wheel shall be connected to the shaft by means of taper locks.
   5. All diameter and perimeter seals shall be provided as part of the cassette assembly and shall be factory set. Drive belts of stretch urethane shall be provided for wheel rim drive without the need for external tensioners or adjustment.
   6. The energy recovery cassette shall be an Underwriters Laboratories Recognized

Component for electrical and fire safety. The wheel drive motor shall be an Underwriters Laboratory Recognized Component and shall be mounted in the cassette frame and supplied with a service connector or junction box. Thermal performance shall be certified by the manufacturer in accordance with ASHRAE Standard 84, Method of Testing Air-to-Air Heat Exchangers and AHRI Standard 1060, Rating Air-to-Air Energy Recovery Ventilation Equipment. Cassettes shall be listed in the AHRI Certified Products.

7. Energy recovery wheel cassette shall carry a 5 year non-prorated warranty, from the date of original equipment shipment from the factory. The first 12 months from the date of equipment startup, or 18 months from the date of original equipment shipment from the factory, whichever is less, shall be covered under the standard AAON limited parts warranty. The remaining period of the warranty shall be covered by Airxchange. The 5 year warranty applies to all parts and components of the cassette, with the exception of the motor, which shall carry an 18 month warranty. Warranty shall cover material and workmanship that prove defective, within the specified warranty period, provided the Airxchange written instructions for Installation, Operation, and Maintenance have been followed. Warranty excludes parts associated with routine maintenance, such as belts. Refer to the Airxchange Energy Recovery Cassette Limited Warranty Certificate.
8. Hinged service access doors shall allow access to the wheels.
9. Total energy recovery wheels shall be coated with silica gel desiccant permanently bonded by a process without the use of binders or adhesives, which may degrade desiccant performance. The substrate shall be lightweight polymer and shall not degrade nor require additional coatings for application in marine or coastal environments. Coated segments shall be washable with detergent or alkaline coil cleaner and water. Desiccant shall not dissolve nor deliquesce in the presence of water or high humidity.
10. Unit shall include energy recovery wheel defrost control which includes an adjustable temperature sensor and timer wired to periodically stop the wheel rotation, which allows the warm exhaust air to defrost the wheel.
11. Unit shall include energy recovery wheel rotation detection sensors and a set of normally open and normally closed contracts for field indication of wheel rotation.

J. Filters.
1. Unit shall include 2 inch thick, pleated panel filters with an ASHRAE MERV rating of 13, upstream of the cooling coil.
2. Unit shall include 1 inch MERV 8 pre filters upstream of the outside air opening.
3. Units shall include a Magnehelic gauge mounted in the controls compartment.

K. Outside Air/Economizer.
1. Unit shall include 100% motor operated outside air damper assembly constructed of extruded aluminum, hollow core, airfoil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 15 CFM of leakage per sq. ft. of damper area when subjected to 2 inches w.g. air pressure differential across the damper. Damper assembly shall be controlled by spring return, 2 position actuator. Unit shall include outside air opening bird screen and outside air hood with rain lip.

L. Roof Curb.
1. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.
2. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
3. Materials: ASTM C 1071, Type I or II.

4. Insulation Thickness: 1 inch.

2.4 CONTROLS

A. Control Wiring: Factory wire connection for controls' power supply.

B. Control Devices: Sensors, transmitters, relays, switches, detectors, operators, actuators, and valves shall be manufacturer's standard items to accomplish indicated control functions.

C. Control Damper:
1. Damper Location: Factory installed inside unit for ease of blade axle and bushing service. Arrange dampers located in a mixing box to achieve convergent airflow to minimize stratification.
2. Damper Leakage: Comply with requirements in AMCA 500-D. Leakage shall not exceed 6.5 cfm per sq. ft. at a static-pressure differential of 4.0 inches water column when a torque of 5 inch pounds per sq. ft. is applied to the damper jackshaft.
3. Damper Rating: Rated for close-off pressure equal to the fan shutoff pressure.
4. Damper Label: Bear the AMCA seal for both air leakage and performance.
5. Blade Configuration: Unless otherwise indicated, use parallel blade configuration for two-position control and equipment isolation service.
6. Damper Frame Material: Extruded aluminum.
7. Blade Type: Single-thickness metal reinforced with multiple V-grooves or hollow-shaped airfoil.
8. Blade Material: Extruded aluminum.
9. Blade Seals: Replaceable, continuous perimeter vinyl seals and jambs with stainless-steel compression-type seals.
10. Bearings: Thrust bearings for vertical blade axles.

D. Damper Operators:
1. Factory-installed electric operator for each damper assembly with one operator for each damper assembly mounted to the damper frame.
2. Maximum Operating Time: Open or close damper 90 degrees in 60 seconds.
3. Adjustable Stops: For both maximum and minimum positions.
4. Spring-return operator to fail-safe; either closed or open as required by application.
5. Operator Type: Direct coupled, designed for minimum 60,000 full-stroke cycles at rated torque.
6. Position feedback Signal: For remote monitoring of damper position.
7. Coupling: V-bolt and V-shaped, toothed cradle.
8. Circuitry: Electronic overload or digital rotation-sensing circuitry.

E. Refrigeration System Controls:
1. Unit-mounted enthalpy controller shall lock out refrigerant system when outdoor-air enthalpy is less than 28 Btu/lb of dry air or outdoor-air temperature is less than 60 deg F.

F. Microprocessor controller - Each RTU shall be controlled by a stand-alone microprocessor based controller with resident control logic. The controller will interface with the BAS and the inputs and outputs in the points list to accomplish the following temperature control and energy conservation strategies.
1. Occupied Mode - All unit functions will be enabled for normal heating and cooling

operation. Unit defaults to default temperature setpoints in the unit microprocessor when communication with BAS is lost.

2. Occupied Space Temperature Control - When in occupied mode as described above, the dedicated unit control shall operate stages of heating and cooling to maintain space temperature setpoint. Setpoints may be set by one of the following methods:
   a. Remotely through BAS by the system operator;
   b. Locally through the unit ROD; located in the space through the BAS system;
   c. Locally through remote mounted unit ROD.
3. Low Ambient Compressor Lockout - Compressor operation shall be disabled below a user defined outdoor air temperature.
4. Unit status report - For each OAU unit, the BAS shall provide an operating status summary of all sensed values (zone temperature, discharge temperature, etc.) setpoints and modes.
5. Supply Air Tempering - When the unit is in the heat mode, but not actively heating, outdoor air heat set point will continue heat operation at minimum fire to prevent space cycling.

G. BAS Interface: Factory-installed hardware and software to enable the BAS to monitor, control, and display unit status and alarms.
   1. ASHRAE 135 (BACnet) communication interface with the BAS shall enable the BAS operator to remotely control and monitor the unit from an operator workstation. Control features and monitoring points displayed locally at unit control panel shall be available through the BAS.

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. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.

C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.

B. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
   1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof

construction.
2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."
3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.

C. Install wall- and duct-mounted sensors furnished by manufacturer for field installation. Install control wiring and make final connections to control devices and unit control panel.

D. Install separate devices furnished by manufacturer and not factory installed.

E. Install new filters at completion of equipment installation and before testing, adjusting, and balancing.

3.3 CONNECTIONS

A. Where installing piping adjacent to units, allow space for service and maintenance.

B. Duct Connections:
1. Comply with requirements in Section 233113 "Metal Ducts."
2. Drawings indicate the general arrangement of ducts.
3. Connect ducts to units with flexible duct connectors. Comply with requirements for flexible duct connectors in Section 233300 "Air Duct Accessories."

C. Electrical Connections: Comply with requirements for power wiring, switches, and motor controls in electrical Sections.
1. Install electrical devices furnished by unit manufacturer but not factory mounted.

3.4 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.
1. Complete installation and startup checks according to manufacturer's written instructions.
2. Inspect units for visible damage to refrigerant compressor, condenser and evaporator coils, and fans.
3. Start refrigeration system when outdoor-air temperature is within normal operating limits and measure and record the following:
   a. Cooling coil leaving-air, dry- and wet-bulb temperatures.
   b. Cooling coil entering-air, dry- and wet-bulb temperatures.
   c. Condenser coil entering-air dry-bulb temperature.
   d. Condenser coil leaving-air dry-bulb temperature.
4. Simulate maximum cooling demand and inspect the following:
   a. Compressor refrigerant suction and hot-gas pressures.
   b. Short-circuiting of air through outside coil or from outside coil to outdoor-air intake.
5. Inspect casing insulation for integrity, moisture content, and adhesion.
6. Verify that clearances have been provided for servicing.
7. Verify that controls are connected and operable.
8. Verify that filters are installed.
9. Clean coils and inspect for construction debris.

10. Inspect operation of power vents.
11. Inspect and adjust vibration isolators and seismic restraints.
12. Verify bearing lubrication.
13. Clean fans and inspect fan-wheel rotation for movement in correct direction without vibration and binding.
14. Adjust fan belts to proper alignment and tension.
15. Start unit.
16. Inspect and record performance of interlocks and protective devices including response to smoke detectors by fan controls and fire alarm.
17. Operate unit for run-in period.
18. Calibrate controls.
19. Adjust and inspect high-temperature limits.
20. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
21. Verify operational sequence of controls.
22. Measure and record the following airflows. Plot fan volumes on fan curve.
    a. Supply-air volume.
    b. Return-air flow.
    c. Outdoor-air flow.

B. After startup, change filters, verify bearing lubrication, and adjust belt tension.

C. Remove and replace components that do not properly operate and repeat startup procedures as specified above.

D. Prepare written report of the results of startup services.

3.5 ADJUSTING

A. Adjust initial temperature and humidity set points.

B. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 238127

VARIABLE REFRIGERANT FLOW SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

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 SYSTEM DESCRIPTION AND GENERAL REQUIREMENTS

A. Variable Refrigerant Flow (VRF) HVAC system shall be a variable capacity, direct expansion (DX) heat recovery and heat pump engineered system. The outdoor unit shall consist of one or more cabinet(s) connected through common refrigerant piping. Each system shall have single or multiple, inverter compressor(s). Each system shall be connected to multiple indoor units (ducted, non-ducted or combination thereof) through a common refrigerant piping and integrated system controls. Each indoor unit shall be controlled individually. Additionally heat recovery system shall be capable of simultaneous heating and cooling individual zone(s).
   1. Simultaneous Cooling and Heating VRF System: Heat recovery system shall be an air cooled, system consisting of one to three outdoor unit(s) connected to Heat Recovery (HRU) unit(s) and indoor unit(s). Multi-port heat recovery units shall allow simultaneous heating and cooling of individual zone(s).

B. The manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. The Manufacturer's Representative shall provide a minimum of 8-hours of BACnet integration assistance with the owner's building automation contractor.

C. System shall be provided with all integral devices as required to meet ASHRAE 15-2022 R-32 refrigerant mitigation requirements, including but not limited to, all refrigerant leak detection devices, automatic shutoff valves and controls.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, sequence of operations and electrical characteristics.

B. Shop Drawings: 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.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

B. Warranty: Sample of special warranty.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.

1.7 QUALITY ASSURANCE

A. The units shall be manufactured in a facility registered to ISO 9001 and ISO14001 which is a set of standards applying to environmental protection set by the International Organization for Standardization (ISO).

B. All electrical power wiring shall be installed in accordance with the National Electrical Code (NEC) and all applicable state and local building codes.

C. The units shall be listed by Electrical Testing Laboratories (ETL) and bear the ETL label and comply with UL 1995 Heat and Cooling Equipment Standard for Safety.

D. All systems must be AHRI 1230 Certified and listed in the certified product directory.

E. The VRF system shall be installed by a licensed mechanical contractor trained by the VRF equipment manufacturer or certified manufacturer's agent. If contractor is not licensed by VRF equipment manufacturer as an approved installer then contractor shall provide written proof of certification prior to the start of installation.

1.8 STORAGE AND HANDLING

A. All VRF equipment shall be stored protected from weather, extreme temperature, etc. as

suggested by the manufacturer. All VRF equipment shall be moved, lifted, etc. as suggested by the manufacturer.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period:
      a. For Compressor: Five year(s) from date of Substantial Completion.
      b. For Parts: Two year(s) from date of Substantial Completion.
      c. For Labor: Two year(s) from date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Daiken VRF (Tim McGraw at TriState - 610-825-4770).
   2. LG Multi-V VRF (Casey Younkins at Energy Transfer Solutions, Inc. - 610-444-0333).
   3. Toshiba Carrier.

2.2 SIMULTANEOUS HEATING AND COOLING SYSTEM

A. SYSTEM DESCRIPTION:
   1. The variable capacity heat pump air conditioning system shall be a Daikin Variable Refrigerant Volume Series (Heat Pump or Heat Recovery model) system as specified.
   2. The system shall consist of multiple evaporators using PID control, REFNET™ joints and headers and Daikin VRV condenser unit.
   3. The condenser shall be a direct expansion (DX), air-cooled heat pump, multi-zone air-conditioning system with variable speed inverter driven compressors using R-32 refrigerant.
   4. The condensing unit may connect an indoor evaporator nominal capacity up to 200% of the condensing unit's nominal capacity. All zones can operate separately with individual temperature control.
   5. The Daikin condensing unit shall be able to connect to indoor unit models FXFA, FXMA, FXSA, FXTA, FXDA, FXZA, FXUA, FXAA, and OTHER IDUs and shall range in capacity from 5,800 Btu/h to 96,000 Btu/h in accordance with Daikin's engineering data book detailing each available indoor unit.
      a. The indoor units shall be connected to the condensing unit utilizing Daikin's REFNET™ specified piping joints and headers to ensure correct refrigerant flow and balancing. T-style joints are not acceptable for a variable refrigerant system.
   6. Operation of the system shall permit either individual cooling or heating of each indoor unit simultaneously. Each indoor unit or group of indoor units shall be able to provide set temperature independently via a local remote controller, an Intelligent Controller, an

Intelligent Manager or a BMS interface.

7. The REYA_AA condensing unit model numbers and the associated number of connectable indoor units per REYA_AA condensing unit is indicated in the following table. Each indoor unit or group of indoor units shall be independently controlled.

MODEL NUMBER	NOMINAL CAPACITY (Tons)	MAXIMUM NUMBER OF INDOOR UNITS
REYA72AATJ*	6	12
REYA96AATJ*	8	16
REYA120AATJ*	10	20
REYA144AATJ*	12	25
REYA168AATJ*	14	29
REYA192AATJ*	16	33
REYA216AATJ*	18	37
REYA240AATJ*	20	41
REYA264AATJ*	22	45
REYA288AATJ*	24	49
REYA312AATJ*	26	54
REYA336AATJ*	28	58
REYA360AATJ*	30	64
REYA384AATJ*	32	64
REYA408AATJ*	34	64
REYA432AATJ*	36	64
REYA456AATJ*	38	64
REYA480AATJ*	40	64

B. VRV EMERION FEATURES.

1. Voltage Platform - Heat Pump condensing units shall be available with a 208-230V/3ph/60 Hz power supply.
2. Single-module outdoor units shall be available from 6 to 20 T in nominal cooling capacity and can be combined to offer up to 40 T in a dual-module configuration, which helps minimize the overall space required for mechanical equipment and optimize total project costs.
3. The condensing unit shall feature a sealed E-box with a minimum IP55 rating to provide high dust and moisture protection for reliability.
4. Each system shall be able to enlarge from single to dual module without the need for installed main pipe size changes. The manufacturer shall provide predefined pipe sizes and design rules ensuring reliable system operation and offering design flexibility in phased installation applications.
5. Stable Operation - System shall provide stable inverter operation at varied ambient conditions.
6. No Drain Pan Heater - System shall be capable of heating operation without the need for

a drain pan heater. If an alternate manufacturer is chosen, an additional drain pan heater shall be provided by the manufacturer.

7. Auto Changeover - System shall, below the field selected outdoor ambient temperature provide signal to initiate auxiliary or back up heat.
8. Advanced Zoning - A single system shall provide up to 64 zones.
9. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve with up to 2000 positions for independent control.
10. VFD Inverter Control and Smart Variable Refrigerant Temperature - Each condensing unit shall use high efficiency, variable speed all "inverter" based flash vapor injection compressor(s) coupled with inverter fan motors to optimize part load performance. The system capacity and refrigerant temperatures shall be modulated automatically to set suction and condensing pressures while varying the refrigerant volume for the needs of the cooling or heating loads. The control will be automatic and customizable depending on load and weather conditions.
    a. Indoor shall use PID to control superheat to deliver a comfortable room temperature condition and optimize efficiency.
11. Configurator software - Each system shall be available with configurator software package to allow for remote configuration of operational settings and for assessment of operational data and error codes.
    a. If this software is not provided by an alternate manufacturer, for each individual outdoor unit the contractor shall do the settings manually and keep detailed records for future maintenance purposes.
12. Each system shall include a built-in data recorder that can store up to 40 minutes of operational data which can help identify the issue in case of a product failure.
13. Heating during Defrost and Oil Return. Reverse cycle (cooling mode) in these modes shall not be permitted due to the potential reduction in space temperature.
14. Low Ambient Cooling - Each system shall be capable of low ambient cooling operation to -4°FDB (-20°CDB) with the use of a Safety Shut off Valve.
15. Independent Control - Each indoor unit shall use a dedicated electronic expansion valve for independent control.
16. Flexible Design -.
    a. Systems shall be capable of up to 540ft (165m)[623 ft. (190m) equivalent] of linear piping between the condensing unit and furthest located indoor unit.
    b. Systems shall be capable of up to 3,280ft (1,000m) total "one-way" piping in the piping network.
    c. Systems shall have a vertical (height) separation of up to 361 ft between the condensing unit and the indoor units.
    d. Systems shall be capable of up to 295ft (90m) from the first REFNET™ / branch point.
    e. The condensing unit shall have the ability to connect an indoor unit evaporator capacity of up to 200% of the condensing unit nominal capacity.
    f. Systems shall be capable of 98ft (30m) vertical separation between indoor units.
    g. Condensing units shall be supported with a fan motor ESP up to 0.32" WG as standard to allow connection of discharge ductwork and to prevent discharge air short circuiting.
17. Oil return - Each system shall be furnished with a centrifugal oil separator and active oil recovery cycle.
18. Simple wiring - Systems shall use 16/18 AWG, 2 wire, stranded, non-shielded and non-polarized daisy chain control wiring.

19. Space saving - Each system shall not exceed the dimensions shown below

MODEL NUMBER	Dimensions in Inch (H x W x D)
REYA72AATJ*	65-3/8 x 36-5/8 x 30-1/8
REYA96AATJ*	65-3/8 x 48-13/16 x 30-1/8
REYA120AATJ*	
REYA144AATJ*	
REYA168AATJ*	
REYA192AATJ*	65-3/8 x 68-7/8 x 30-1/8
REYA216AATJ*	
REYA240AATJ*	
REYA264AATJ*	(65-3/8 x 48-13/16 x 30-1/8) + (65-3/8 x 48-13/16 x 30-1/8)
REYA288AATJ*	
REYA312AATJ*	
REYA336AATJ*	
REYA360AATJ*	(65-3/8 x 48-13/16 x 30-1/8) + (65-3/8 x 68-7/8 x 30-1/8)
REYA384AATJ*	(65-3/8 x 68-7/8 x 30-1/8) + (65-3/8 x 68-7/8 x 30-1/8)
REYA408AATJ*	
REYA432AATJ*	
REYA456AATJ*	
REYA480AATJ*	

20. Each condensing unit shall include a multi-functional digital display that can provide system operation status such as operating refrigerant temperatures, pressures, outdoor electronic expansion valve opening and compressor operation time.
21. Each condensing unit shall include a service window that can provide easy access to system field settings and operation status without completely removing the condensing unit panel.
22. Advanced diagnostics - Systems shall include a self-diagnostic, auto-check function to detect a malfunction and display the type and location.
23. Each condensing unit shall incorporate contacts for electrical demand shedding with optional 3 stage demand control with 12 customizable demand settings.
24. Advanced controls - Each system shall have at least one remote controller capable of controlling up to 16 indoor units.
25. Each system shall be capable of integrating with open protocol BACnet, LonWorks and Modbus building management systems.
26. Low sound levels - Each system shall use indoor and condensing units with quiet operation as low as 27 dB(A).
27. The system shall be certified and listed in the OSHPD directory for seismic certification.
28. The condensing unit can be installed up to 200 ft above the ground without requiring any additional field modifications to the unit to comply with the Florida Miami Dade Wind code requirements.
29. The condensing unit shall be factory equipped with a Schrader valve for connection to a

pressure relief kit for compliance with the City of Chicago Pressure relief code.

2.3 EQUIPMENT

A. PERFORMANCE:
1. The VRV REYA_AA system shall perform as indicated below:

MODEL NUMBER	SYSTEM IEER (Ducted)	SYSTEM IEER (Non-Ducted)
REYA72AATJ*	21.20	23.60
REYA96AATJ*	21.20	24.20
REYA120AATJ*	20.20	23.00
REYA144AATJ*	19.70	22.70
REYA168AATJ*	19.00	21.70
REYA192AATJ*	19.80	22.20
REYA216AATJ*	18.70	21.80
REYA240AATJ*	18.00	20.40
REYA264AATJ*	18.40	21.60
REYA288AATJ*	18.40	21.00
REYA312AATJ*	18.00	20.60
REYA336AATJ*	17.70	19.80
REYA360AATJ*	17.40	18.90
REYA384AATJ*	18.00	20.70
REYA408AATJ*	17.20	19.90
REYA432AATJ*	16.80	18.80
REYA456AATJ*	16.20	18.30
REYA480AATJ*	15.80	18.00

MODEL NUMBER	SYSTEM EER (Ducted)	SYSTEM EER (Non-Ducted)
REYA72AATJ*	12.40	12.50
REYA96AATJ*	12.00	12.20
REYA120AATJ*	11.10	11.10
REYA144AATJ*	11.00	11.20
REYA168AATJ*	10.70	10.70
REYA192AATJ*	11.30	11.40
REYA216AATJ*	11.00	10.90
REYA240AATJ*	10.70	10.70
REYA264AATJ*	10.20	11.20
REYA288AATJ*	10.40	11.40
REYA312AATJ*	10.20	10.90
REYA336AATJ*	10.00	9.80
REYA360AATJ*	9.70	10.50
REYA384AATJ*	9.90	10.50
REYA408AATJ*	9.70	10.00
REYA432AATJ*	9.30	9.80
REYA456AATJ*	9.00	9.40
REYA480AATJ*	9.00	8.90

MODEL NUMBER	SYSTEM COP@47°F (Ducted)	SYSTEM COP@47°F (Non-Ducted)
REYA72AATJ*	3.60	3.80
REYA96AATJ*	3.60	3.80
REYA120AATJ*	3.50	3.50
REYA144AATJ*	3.35	3.30
REYA168AATJ*	3.30	3.30
REYA192AATJ*	3.40	3.48
REYA216AATJ*	3.35	3.35
REYA240AATJ*	3.30	3.30
REYA264AATJ*	3.25	3.70
REYA288AATJ*	3.25	3.45
REYA312AATJ*	3.20	3.40
REYA336AATJ*	3.20	3.40
REYA360AATJ*	3.20	3.40
REYA384AATJ*	3.20	3.35
REYA408AATJ*	3.20	3.35
REYA432AATJ*	3.20	3.30
REYA456AATJ*	3.20	3.30
REYA480AATJ*	3.20	3.30

MODEL NUMBER	SYSTEM COP@17°F (Ducted)	SYSTEM COP@17°F (Non-Ducted)
REYA72AATJ*	2.40	2.40
REYA96AATJ*	2.25	2.30
REYA120AATJ*	2.25	2.25
REYA144AATJ*	2.10	2.10
REYA168AATJ*	2.10	2.10
REYA192AATJ*	2.25	2.25
REYA216AATJ*	2.20	2.20
REYA240AATJ*	2.20	2.20
REYA264AATJ*	2.20	2.20
REYA288AATJ*	2.10	2.20
REYA312AATJ*	2.10	2.20
REYA336AATJ*	2.10	2.10
REYA360AATJ*	2.10	2.10
REYA384AATJ*	2.10	2.10
REYA408AATJ*	2.10	2.10
REYA432AATJ*	2.10	2.10
REYA456AATJ*	2.10	2.10
REYA480AATJ*	2.10	2.10

MODEL NUMBER	SYSTEM COP@5°F (Ducted)	SYSTEM COP@5°F (Non-Ducted)
REYA72AATJ*	1.64	1.75
REYA96AATJ*	1.75	1.81
REYA120AATJ*	1.64	1.75
REYA144AATJ*	1.91	1.96
REYA168AATJ*	1.85	1.85
REYA192AATJ*	1.84	1.77
REYA216AATJ*	1.68	1.66
REYA240AATJ*	1.55	1.59
REYA264AATJ*	1.75	1.81
REYA288AATJ*	1.75	1.81
REYA312AATJ*	1.75	1.76
REYA336AATJ*	1.65	1.75
REYA360AATJ*	1.75	1.81
REYA384AATJ*	1.78	1.82
REYA408AATJ*	1.76	1.75
REYA432AATJ*	1.68	1.75
REYA456AATJ*	1.66	1.62
REYA480AATJ*	1.61	1.55

2. Performance Conditions:
    a. Cooling: Indoor temperature of 80°FDB (26.7°CDB), 67°FWB (19.5°CWB) and outdoor temperature of 95°FDB (35°CDB).
    b. Heating: Indoor temperature of 70°FDB (21.1°CDB) and outdoor temperature of 47°FDB (8.3°CDB), 43°FWB (6.1°CDB).
    c. Equivalent piping length: 25ft (7.5m).
3. Cooling Operation:
    a. The standard operating range in cooling will be 23°FDB (-5°CDB) ~ 122°FDB (50°CDB).
    b. Cooling mode indoor room temperature range will be 57-77°FWB (13.9 - 25°CWB).
4. Heating Operation:
    a. The standard operating range in heating will be -22° - 60°FWB (-30 - 15.6°CWB).
        1) If an alternate equipment manufacturer is selected, the mechanical contractor shall provide, at their own risk and cost, all additional material and labor to meet low ambient operating condition and performance.
    b. Heating mode indoor room temperature range will be 59°FDB - 80°F DB (15°CDB - 26.7°CDB).

B. ELECTRICAL:
1. The power supply to the condensing unit shall be as indicate on equipment schedules.

C. WIRING:
1. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded, stranded 2 conductor cable.
2. The control wiring shall be a two-wire multiplex transmission system, making it possible to connect multiple indoor units to one condensing unit with one 2-cable wire, thus simplifying the wiring installation.
3. The control wiring maximum lengths shall be as shown below:

	CONDENSER TO INDOOR UNIT	CENTRAL CONTROLLER TO FIRST ODU	INDOOR UNIT TO REMOTE CONTROL
CONTROL WIRING LENGTH	6,560ft (2,000m)	656FT (200m)	1640 ft. (500m)
WIRE TYPE	16/18 AWG, 2 wire, non-polarity, non-shielded, stranded		

D. REFRIGERANT PIPING:
1. The system shall be capable of refrigerant piping up to 540ft (165m) actual or 623ft (190m) equivalent from the condensing unit to the furthest indoor unit, a total combined liquid line length of 3,280ft (1,000m) of piping between the condensing and indoor units, without any oil traps or additional components.
2. REFNET™ piping joints and headers shall be used to ensure proper refrigerant balance and flow for optimum system capacity and performance.
   a. T-style joints shall not be acceptable as this will negatively impact proper refrigerant balance and flow for optimum system capacity and performance.

E. PAINT/CORROSION RESISTANCE:
1. Paint and corrosion resistance shall be at a minimum per the table below:

COMPONENT	VRV EMERION		
	BASE MATERIAL	SURFACE TREATMENT	COATING THICKNESS
			External & Internal Surface
EXTERNAL PANEL BASE	Galvanized steel	POLYESTER	≧1.5 mils
EXTERNAL FRONT PANEL	Galvanized steel	POLYESTER	≧1.5 mils
PILLAR	Galvanized steel	POLYESTER	≧1.5 mils
COMPRESSOR COVER	ASTM material	Resin Paint	≧0. 78 mils
FIN GUARD	Iron wire	Resin Paint	≧0. 79 mils
FAN GUARD AND DRUM	Polypropylene	No treatment required	N/A
FAN	Acrylonitrile - glass	No treatment required	N/A
FAN MOTOR FRAME	Resin	No treatment required	N/A
FAN MOTOR SHAFT	Carbon steel	No treatment required	N/A
FAN MOTOR SUPPORT	Galvanized steel	POLYESTER	≧1.5 mils
HEAT EXCHANGERS (FIN ONLY)	Aluminum	Polymer Anti-corrosion surface treatment	Salt Spray 1000 hours, blister rating 10
ELECTRICAL PARTS BOX	Hot-dip zinc-coated steel	No treatment required	N/A
ELECTRICAL PARTS BOARD	Glass cloth / Glass nonwoven cloth material	Insulation Varnish	No specific thickness
SCREWS	Carbon steel wire rods	High corrosion resistance treatment	≧0. 28 mils

2.4 OUTDOOR/CONDENSING UNIT

A. GENERAL:
1. The condensing unit is designed specifically for use with R-32 VRV EMERION series components.
2. The refrigeration circuit of the condensing unit shall consist of Daikin inverter scroll compressors, motors, fans, condenser coil, electronic expansion valves, solenoid valves, 4-way valve, distribution headers, capillaries, filters, shut off valves, oil separators, service ports, liquid receiver, and suction accumulator.
3. Liquid and suction lines must be individually insulated between the condensing and indoor units.

4. The condensing unit can be wired and piped with access from the left, right, rear or bottom.
5. The connection ratio of indoor units to condensing unit shall be permitted up to 200% of nominal capacity.
6. Each condensing system shall be able to support the connection of up to 64 indoor units dependent on the model of the condensing unit.
7. The sound pressure level standard shall be that value as listed in the Daikin engineering manual for the specified models at 3 feet from the front of the unit. The condensing unit shall be capable of operating automatically at further reduced noise during nighttime or via an external input.
8. The system will automatically restart operation after a power failure and will not cause any settings to be lost, thus eliminating the need for reprogramming.
9. The condensing unit shall be modular in design and should allow for side-by-side installation.
10. The following safety devices shall be included on the condensing unit, high pressure sensor and switch, low pressure sensor low pressure switch control circuit fuses, crankcase heaters, fusible plug, overload relay, inverter overload protector, thermal protectors for compressor and fan motors, over current protection for the inverter and anti-recycling timers.
11. To ensure the liquid refrigerant does not flash when supplying to the various indoor units, the circuit shall be provided with a sub-cooling feature.
12. Oil recovery cycle shall be automatic occurring 2 hours after start of operation and then every 8 hours of operation.
13. The condensing unit shall be capable of heating operation at -22°F (-30°C) wet bulb ambient temperature without additional low ambient controls or an auxiliary heat source.

B. UNIT CABINET:
1. The condensing unit shall be completely weatherproof and corrosion resistant. The unit shall be constructed from rust-proof galvanized steel panels coated with a baked enamel finish.
2. Each condensing unit shall have a three-segment panel design which allows for direct access to outdoor fans, critical mechanical, and electrical components separately for ease of installation and service.
3. Each outdoor unit shall have separate knockouts for both refrigerant piping and wiring on the bottom panel.
4. The condensing unit fan motor shall have multiple speed operation of the DC (digitally commutating) inverter type, and be of high external static pressure and shall be factory set as standard at 0.12 in. WG. A field setting switch to a maximum 0.32 in. WG pressure is available to accommodate field applied duct for indoor mounting of condensing units.
5. The condensing unit shall have configurable settings for intermittent fan operation to help minimize snow accumulation on fan blades when the system is off.
6. Each outdoor unit fan shall be a vertical discharge configuration, and the nominal airflow rate for each module will range from 6,210 CFM to 14,505 CFM dependent on the model specified.
7. The fan motor shall have inherent protection and permanently lubricated bearings and be mounted.
8. The fan motor shall be provided with a fan guard to prevent contact with moving parts.

C. SOUND:
1. Nominal sound pressure levels shall be as shown below.

MODEL NUMBER	SOUND PRESSURE LEVEL dB(A)
REYA72AATJ*	58
REYA96AATJ*	61
REYA120AATJ*	61
REYA144AATJ*	65
REYA168AATJ*	65
REYA192AATJ*	67
REYA216AATJ*	68
REYA240AATJ*	69
REYA264AATJ*	67
REYA288AATJ*	69
REYA312AATJ*	69
REYA336AATJ*	69
REYA360AATJ*	70
REYA384AATJ*	71
REYA408AATJ*	71
REYA432AATJ*	72
REYA456AATJ*	72
REYA480AATJ*	73

2. Night setback control of the fan motor for low noise operation by way of automatically limiting the maximum speed shall be a standard feature. Operation sound level shall be selectable from 3 steps.

OPERATION SOUND dB(A)	NIGHT MODE SOUND PRESSURE LEVEL dB(A) APPROX.
Level 1	55
Level 2	50
Level 3	45

D. CONDENSER COIL:
1. The condenser coil shall be manufactured from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The heat exchanger coil shall be of a waffle louver fin and rifled bore tube design to ensure high efficiency performance.

3. The heat exchanger on the condensing units shall be manufactured from Hi-X seamless copper tube with N-shape internal grooves mechanically bonded on to aluminum fins to an e-Pass Design.
4. The fins shall be coated with an anti-corrosion hydrophilic blue coating as standard from factory with a salt spray test rating of 1000hr per ASTM B117 test standards.
5. The outdoor coil shall have three-circuit heat exchanger design eliminating the need for a drain pan heater. The lower part of the coil shall be used for inverter cooling and be on or off during operation enhancing the defrost operation.
    a. An alternate manufacturer must provide a drain pan heater to enable adequate defrosting of the unit in defrost operation.
6. The condensing unit shall be factory equipped with condenser coil guards on all sides.

E. COMPRESSOR:
1. The Daikin inverter scroll compressors shall be variable speed (PVM inverter) controlled which is capable of changing the speed to follow the variations in total cooling and heating load as determined by the suction gas pressure as measured in the condensing unit.
    a. In addition, samplings of evaporator and condenser temperatures shall be made so that the high/low pressures detected are read every 20 seconds and calculated. With each reading, the compressor capacity (INV frequency) shall be controlled to eliminate deviation from target value.
        1) Non-inverter-driven compressors, which may cause starting motor current to exceed the nominal motor current (RLA) and require larger wire sizing, shall not be allowed.
2. The inverter driven compressors in the condensing unit shall be of highly efficient reluctance DC (digitally commutating), hermetically sealed scroll "P-type."
3. Neodymium magnets shall be adopted in the rotor construction to yield a higher torque and efficiency in the compressor instead of the normal ferrite magnet type.
    a. At complete stop of the compressor, the neodymium magnets will position the rotor into the optimum position for a low torque start.
4. The capacity control range shall be as low as 1% to 100%.
5. The compressor's motor shall have a cooling system using discharge gas, to avoid sudden changes in temperature resulting in significant stresses on winding and bearings.
6. Each compressor shall be equipped with a crankcase heater, high pressure safety switch, and internal thermal overload protector.
7. Oil separators shall be standard with the equipment together with an intelligent oil management system.
8. The compressor shall be mounted on vibration dampening rubber grommets to minimize the transmission of vibration, eliminating the standard need for external spring isolation.
9. In the event of compressor failure, the remaining compressors, if applicable, shall continue to operate and provide heating or cooling as required at a proportionally reduced capacity. The microprocessor and associated controls shall be manually activated to specifically address this condition for single module and manifold systems.
10. In the case of multiple condenser modules, combined operation hours of the compressors shall be balanced by means of the Duty Cycling Function, ensuring sequential starting of each module at each start/stop cycle, completion of oil return, completion of defrost or every 8 hours. When connected to a central control system, sequential start is activated for all systems on each D4 network.

2.5 BRANCH SELECTOR UNITS

A. GENERAL:
1. SINGLE-PORT BRANCH SELECTOR BOX.
   a. The BSA36AAVJ, BSA60AAVJ, and BSA96AAVJ, are designed specifically for use with R32 VRV EMERION, R32 VRV AURORA, and R32 Water Cooled heat recovery system components.
   b. The single port branch selector boxes BSA_A shall provide individual control and changeover for one group of indoor units.
   c. These BSA_A branch controllers shall support low ambient cooling down to −4F° to connected indoor units.
   d. These selector boxes shall be factory assembled, wired, and piped.
   e. These branch selector boxes shall have a heat-by-pass control loop inside the units to prevent overheating of space during heating cycles.
   f. These selector boxes must be mounted indoors.
   g. When simultaneously heating and cooling, the units in heating mode shall energize their subcooling electronic expansion valve.
2. MULTI-PORT FLEX BRANCH SELECTOR BOX SERIES.
   a. The BSF4A54AAVJ, BSF6A54AAVJ, and BSF8A54AAVJ are designed specifically for use with R32 VRV EMERION, R32 VRV AURORA, and R32 Water Cooled heat recovery system components.
   b. These branch selector boxes shall provide individual control and changeover for multiple groups of indoor units.
   c. These branch selector boxes shall allow for Field selectable LEFT/RIGHT/PASS THROUGH piping configuration.
   d. These branch selector boxes shall allow multiple branch selector boxes to be connected downstream of the first Branch selector box in series.
   e. These Branch selector boxes, when connected in series, shall be able to support a total indoor load of up to 230MBH.
   f. The EEV heads and motors used in the branch selector box shall be accessible via a quick access panel without disassembly of the electrical box.
   g. The electrical box of the 4-port branch selector box shall be field re-locatable to left, right, and back side of the main cabinet.
   h. These branch selector boxes shall allow connected indoor units to operate in cooling mode down to -4F without any additional field installed accessories.
   i. Labels shall be displayed close to the incoming 3 pipes to facilitate clear identification and eliminate cross piping.
   j. The branch selector boxes shall employ EEV with the ability to control up to 6000 pulses.
   k. These selector boxes shall be factory assembled, wired, and piped.
   l. These selector boxes must be mounted indoors.
   m. When simultaneously heating and cooling, the units in heating mode shall energize their sub cooling electronic expansion valve.

3. The number of connectable indoor units shall be in accordance with the table below:

BRANCH SELECTOR TYPE	MODEL NUMBER	MAXIMUM CONNECTABLE COOLING CAPACITY	MAXIMUM NUMBER OF CONNECTABLE INDOOR UNITS PER BRANCH
SINGLE-PORT	BSA36AAVJ	36,000 Btu/h	4
	BSA60AAVJ	60,000 Btu/h	8
	BSA96AAVJ	96,000 Btu/h	8
MULTI-PORT FLEX-SERIES	BSF4A54AAVJ	144,000 Btu/h*	5
	BSF6A54AAVJ	216,000 Btu/h*	5
	BSF8A54AAVJ	290,000 Btu/h*	5
* For multiple branch selector box connected in series, refer to the engineering manual for details.			

B. UNIT CABINET.
1. These units shall have a galvanized steel plate casing.
2. Each cabinet shall house 3 electronic expansion valves for refrigerant control per branch as well as shut off valves for refrigerant mitigation.
3. The cabinet shall contain one subcooling heat exchanger per branch.
4. The unit shall have sound absorption thermal insulation material made of flame- and heat-resistant foamed polyethylene.
5. Nominal sound pressure levels shall be measured and published in the submittals by the manufacturer. The sound levels must not exceed the values below.
   a. If an alternative manufacturer is selected, the mechanical contractor shall provide, at their own cost and expense, any additional material and labor to meet the below published sound levels

BRANCH SELECTOR TYPE	MODEL NUMBER	SOUND LEVEL dB(A) OPERATION	SOUND LEVEL dB(A) MAX
SINGLE PORT	BSA36AAVJ	35	40
	BSA60AAVJ	41	45
	BSA96AAVJ	41	45
MULTI-PORT FLEX-SERIES	BSF4A54AAVJ	36	43
	BSF6A54AAVJ	37.5	46
	BSF8A54AAVJ	37.5	46

6. DIMENSIONS:

a. The branch selector units shall not exceed the dimensions stated in the table below.

BRANCH SELECTOR TYPE	MODEL NUMBER	HEIGHT Inches (mm)	WIDTH Inches (mm)	DEPTH Inches (mm)
SINGLE PORT	BSA36AAVJ	8-1/8 (207)	15-1/4 (388)	16-3/4 (426)
	BSA60AAVJ	8-1/8 (207)	15-1/4 (388)	16-3/4 (426)
	BSA96AAVJ	8-1/8 (207)	15-1/4 (388)	16-3/4 (426)
MULTI-PORT FLEX-SERIES	BSF4A54AAVJ	9 -1/2 (241)	19-15/16 (490)	28-3/16 (716)
	BSF6A54AAVJ	9 -1/2 (241)	33-7/16 (849)	28-3/16 (716)
	BSF8A54AAVJ	9 -1/2 (241)	33-7/16 (849)	28-3/16 (716)

7. REFRIGERANT VALVES:
   a. The unit shall be furnished with 3 electronic expansion valves per branch to control the direction of refrigerant flow. The use of solenoid valves for changeover and pressure equalization shall not be acceptable due to refrigerant noise.
   b. The refrigerant connections must be of the braze type.
   c. In multi-port units, each port shall have its own electronic expansion valves. If common expansion/solenoid valves are used, redundancy must be provided.
   d. Multiple indoor units may be connected to a branch selector box with the use of a REFNET™ joint provided they are within the capacity range of the branch selector.
   e. These branch selector boxes shall support up to the maximum capacity per port shown in the table below

BRANCH SELECTOR TYPE	MODEL NUMBER	MAXIMUM CAPACITY PER PORT
SINGLE PORT	BSA36AAVJ	36,000 Btu/h
	BSA60AAVJ	60,000 Btu/h
	BSA96AAVJ	96,000 Btu/h
MULTI-PORT FLEX-SERIES	BSF4A54AAVJ	54,000 Btu/h
	BSF6A54AAVJ	54,000 Btu/h
	BSF8A54AAVJ	54,000 Btu/h

8. CONDENSATE REMOVAL:
   a. The unit shall be hermetically sealed to prevent condensation build up inside the unit and not require use of a secondary condensate collection pan. A safety device or secondary drain pan shall be installed by the mechanical contractor to comply with the applicable mechanical code if an alternate manufacturer is selected.
9. INTEGRATED SAFETY SHUT OFF VALVES:
   a. The branch selector box shall have valves that close to limit the releasable charge in the event of a leak detection.
   b. The safety shut off valves shall close in the event that the indoor unit detects a leak.
10. VENTILATED ENCLOSURE.

a. The branch selector box shall be compatible with the ventilated branch box enclosures which can be assembled around the boxes and ventilated to a larger space or to the exterior. See applicable models on the table below.

Enclosure Model	Applicable Branch Selector Model
BS-EBF04-AA	BSF4A54AAVJ
BS-EBF07-AA	BSF6A54AAVJ
	BSF8A54AAVJ
BS-EBSVA-AA	BSA36AAVJ
	BSA60AAVJ
	BSA96AAVJ

b. The enclosure shall have a leak sensor which once triggered, closes the valves and the system.

11. ELECTRICAL:
    a. The unit electrical power shall be 230 volts, 1 phase, 60 hertz.
    b. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
    c. The minimum circuit amps (MCA) shall be 0.1, and the maximum overcurrent protection amps (MOP) shall be 15.
    d. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

2.6 HEAT PUMP SAFETY SHUTOFF VALVE BOXES

A. GENERAL:
1. The SVA60AAVJ and SVA96AAVJ are designed specifically for use with R32 VRV EMERION, R32 VRV AURORA, and R32 Water Cooled heat pump system components.
2. These boxes shall be factory assembled, wired, and piped.
3. These boxes must be mounted indoors.
4. The number of connectable indoor units shall be in accordance with the table below:

SAFETY SHUT OFF VALVE TYPE	MODEL NUMBER	MAXIMUM CONNECTABLE COOLING CAPACITY	MAXIMUM NUMBER OF CONNECTABLE INDOOR UNITS PER BRANCH
SINGLE-PORT	SVA60AAVJ	60,000 Btu/h	16
	SVA96AAVJ	96,000 Btu/h	16

B. UNIT CABINET.
1. These units shall have a galvanized steel plate casing.
2. Each cabinet shall house 2 electronic expansion valves to limit releasable charge.
3. The cabinet shall contain one subcooling heat exchanger per branch.
4. The unit shall have sound absorption thermal insulation material made of flame- and heat-resistant foamed polyethylene.
5. Nominal sound pressure levels shall be measured and published in the submittals by the

manufacturer. The sound levels must not exceed the values below.

a. If an alternative manufacturer is selected, the mechanical contractor shall provide, at their own cost and expense, any additional material and labor to meet the below published sound levels

SAFETY SHUT OFF VALVE TYPE	MODEL NUMBER	SOUND LEVEL dB(A) OPERATION	SOUND LEVEL dB(A) MAX
SINGLE PORT	SVA60AAVJ	35	40
	SVA96AAVJ	41	45

6. DIMENSIONS:
   a. The branch selector units shall not exceed the dimensions stated in the table below.

SAFETY SHUT OFF VALVE TYPE	MODEL NUMBER	HEIGHT Inches (mm)	WIDTH Inches (mm)	DEPTH Inches (mm)
SINGLE PORT	SVA60AAVJ	8-1/8 (207)	15-1/4 (388)	16-3/4 (426)
	SVA96AAVJ	8-1/8 (207)	15-1/4 (388)	16-3/4 (426)

7. REFRIGERANT VALVES:
   a. The refrigerant connections must be of the braze type.
   b. The safety shut off valve box shall have valves that close to limit the releasable charge in the event of a leak detection.
   c. The safety shut off valves shall close in the event that the indoor unit detects a leak.
   d. These safety shut off valves shall support up to the maximum capacity per port shown in the table below

BRANCH SELECTOR TYPE	MODEL NUMBER	MAXIMUM CAPACITY PER PORT
SINGLE PORT	SVA60AAVJ	60,000 Btu/h
	SVA96AAVJ	96,000 Btu/h

8. CONDENSATE REMOVAL:
   a. The unit shall be hermetically sealed to prevent condensation build up inside the unit and not require use of a secondary condensate collection pan. A safety device or secondary drain pan shall be installed by the mechanical contractor to comply with the applicable mechanical code if an alternate manufacturer is selected.
9. VENTILATED ENCLOSURE OPTION.
   a. The valve box shall be compatible with the ventilated branch box enclosures which can be assembled around the boxes and ventilated to a larger space or to the exterior. See applicable models on the table below.

Enclosure Model	Applicable Safety Shut Off Valve Model
BS-EBSVA-AA	SVA60AAVJ
	SVA96AAVJ

   b. The enclosure shall have a leak sensor which once triggered, closes the valves and the system.

10. ELECTRICAL:
    a. The unit electrical power shall be 230 volts, 1 phase, 60 hertz.
    b. The unit shall be capable of operation within the limits of 187 volts to 255 volts.
    c. The minimum circuit amps (MCA) shall be 0.1, and the maximum overcurrent protection amps (MOP) shall be 15.
    d. The control voltage between the indoor and condensing unit shall be 16VDC non-shielded 2 conductor cable.

2.7 ROUND FLOW 3X3 CEILING CASSETTE INDOOR UNIT

A. General:
1. Daikin indoor unit model FXFA shall be a round flow ceiling cassette fan coil unit, operable with R32 refrigerant, equipped with an electronic expansion valve, refrigerant leak sensor, direct drive DC (ECM) type fan, for installation into the ceiling cavity equipped with an air panel grill.
2. It shall be available in capacities from 7,200 Btu/h to 54,000 Btu/h. Model numbers are FXFA07AAVJU, FXFA09AAVJU, FXFA12AAVJU, FXFA15AAVJU, FXFA18AAVJU, FXFA24AAVJU, FXFA30AAVJU, FXFA36AAVJU, FXFA48AAVJU, FXFA54AAVJU to be connected to outdoor unit models RXTA, RXYA, RXLA Heat Pumps and REYA and RELA Heat Recovery and RWEA Water Cooled Units.
3. Shall be a round flow air distribution type, fresh white, impact resistant decoration panel, or optional self-cleaning filter panel.
4. The supply air is distributed via four individually motorized louvers.
5. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition.
6. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1NRV71.
7. The indoor units sound pressure shall range from 30 dB(A) to 45 dB(A) at High speed measured at 5 feet below the unit.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	Cooling (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	Heating (Indoor 70°F DB Outdoor 47F / 43F, 25 ft pipe length)
FXFA07AAVJU	7,200	8,500
FXFA09AAVJU	9,500	10,500
FXFA12AAVJU	12,000	13,500
FXFA15AAVJU	14,400	17,000
FXFA18AAVJU	18,000	20,000
FXFA24AAVJU	23,000	27,000
FXFA30AAVJU	30,000	34,000
FXFA36AAVJU	36,000	40,000
FXFA48AAVJU	48,000	54,000
FXFA54AAVJU	54,000	60,000

C. Indoor Unit:
1. The Daikin indoor unit FXFA shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. The indoor unit shall have a factory installed refrigerant leak sensor built in. If a leak is detected, the unit shall go into circulation mode and provide full airflow. The unit shall have signal output in event of leak to connect to external ventilation, damper, alarm etc.
3. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
4. Both refrigerant lines shall be insulated from the outdoor unit.
5. The round flow supply air flow can be field modified to 18 different airflow patterns to accommodate various installation configurations including corner installations.
6. Return air shall be through the concentric panel, which includes a resin net, mold resistant, antibacterial filter.
7. The indoor units shall be equipped with a condensate pan with antibacterial treatment and condensate pump. The condensate pump provides up to 33-1/2 lift from bottom of unit to top of drain piping and has a built-in safety shutoff and alarm.
8. The indoor units shall be equipped with a return air thermistor.
9. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
10. The voltage range will be 253 volts maximum and 187 volts minimum.
11. To save energy and optimize occupancy comfort, the indoor unit shall be equipped with built in occupancy sensor and surface temperature sensor.
12. Supplied air shall be directed automatically by four individually controlled louvers.

D. Unit Cabinet:
1. The cabinet shall be space-saving and shall be located onto the ceiling.

2. Four auto-adjusted louvers shall be available to choose, which include standard, draft prevention, and ceiling stain prevention.
3. The air flow of the unit shall have the ability to shut down outlets with multiple patterns allowing for simpler installation in irregular spaces.
4. Fresh air intake shall be possible by way of Daikin's optional fresh air intake kit.
5. A branch duct knockout shall exist for branch ducting of supply air.
6. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.
7. Optional high-efficiency air filters are available for each model unit.

E. Fan:
1. The fan shall be direct-drive DC (ECM) type fan, statically and dynamically balanced impeller with three fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range from 0.08 to 0.16 HP.
3. The airflow rate shall be available in three manual settings.
4. The DC fan shall be able to automatically adjust the fan speed in 5 speeds based on the space load.
5. The fan motor shall be equipped as standard with adjustable external static pressure (ESP) settings to allow operation with the high efficiency air filter options.
6. The fan motor shall be thermally protected.

F. Filter:
1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin and antibacterial treatment.
2. Optional high efficiency disposable air filters shall be available.
3. Optional Self-Cleaning Filter Panel, which performs automatic filter cleaning up to once a day, with dust collection box that indicates when to be emptied.

G. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The coil shall be a 2, or 3-row cross fin copper evaporator coil with up to 21 FPI design completely factory tested.
4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/4 inch outside diameter PVC.
5. A condensate pan with antibacterial treatment shall be located under the coil.
6. A thermistor will be located on the liquid and gas line.

H. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

I. Control:
   1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
   2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
   3. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.
   4. For the Sensing functions and the optional Self-Cleaning Filter functions, Remote controller BRC1NRV71 shall be used. Consult with Daikin prior to applying controls.

J. Optional Accessories Available:
   1. A high efficiency disposable air filter kit.
   2. Air intake kit.
   3. Self-Cleaning Filter Panel, which performs automatic filter cleaning up to once a day, with dust collection box that indicates when to be emptied.
   4. Remote "in-room" sensor kit (KRCS01-6B).
      a. The Daikin wall mounted, hard wired remote sensor kit is recommended for when a NAV controller is not used or when the NAV controller is not located in the space that is being controlled. The sensor for detecting the temperature can be placed away from the indoor unit (branch wiring is included in the kit).

2.8 2X2 CASSETTE UNIT

A. General:
   1. Daikin indoor unit model FXZA-AAVJU shall be a ceiling cassette fan coil unit, operable with R32 refrigerant, equipped with an electronic expansion valve, for installation into the ceiling cavity equipped with a decoration panel grille.
   2. It shall be available in capacities from 5,800 Btu/h to 18,000 Btu/h. Model numbers are FXZA05AAVJU, FXZA07AAVJU, FXZA09AAVJU, FXZA12AAVJU, FXZA15AAVJU, FXZA18AAVJU to be connected to outdoor unit model RXYA / RWEA / RXLA heat pump and REYQ / RELA / RWEA heat recovery model.
   3. The decoration panel shall be a four-way air distribution type, impact resistant with a washable decoration panel. The supply air is distributed via motorized louvers which can be horizontally and vertically adjusted from 0° to 90°. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition.
   4. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote controls.
   5. The indoor units sound pressure shall range from 25.5 dB(A) to 33 dB(A) at low speed measured at 5 feet below the unit.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	Cooling (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	Heating (Indoor 70°F DB / 60°F WB, Outdoor 47°F DB, 25 ft pipe length)
FXZA05AAVJU	5,800	6,500
FXZA07AAVJU	7,500	8,500
FXZA09AAVJU	9,500	10,500
FXZA12AAVJU	12,000	13,500
FXZA15AAVJU	15,000	17,000
FXZA18AAVJU	18,000	20,000

C. Indoor Unit:
1. The Daikin indoor unit FXZA-AAVJU shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, flare connections, condensate drain pan, condensate drain pump, condensate safety shutoff and alarm, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch.
2. The indoor unit shall have a factory installed refrigerant leak sensor built in. If a leak is detected, the unit shall go into circulation mode and provide full airflow. Signal will be sent to shut compressor and close safety shut off valve in BS Box or Dedicated SSOV as needed. The unit shall have signal output directly or through an accessory PCB in event of leak to connect to external ventilation, damper, alarm etc.
3. Both refrigerant lines shall be fully insulated from the outdoor unit or nearest branch connection into the refrigerant network.
4. The 4-way supply air flow can be field modified to 3-way and 2-way airflow to accommodate various installation configurations including corner installations.
5. Return air shall be through the concentric panel, which includes a resin net mold-resistant filter.
6. The indoor units shall be equipped with a condensate pan and condensate pump. The condensate pump provides up to 24-13/16" of lift, measured from the drain outlet, and has a built-in safety shutoff and alarm.
7. The indoor units shall be equipped with a return air thermistor.
8. The indoor unit will be powered with 208~230V/1-phase/60Hz.
9. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:
1. The cabinet shall be space-saving and shall be located onto the ceiling.
2. Three auto-swing positions shall be available to choose from via field setting.
3. The airflow of the unit shall have the ability to shut down one or two sides allowing for simpler corner installation.
4. Fresh air intake shall be possible by way of direct duct installation to the side of the indoor unit cabinet.
5. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Decoration Panel:
   1. The FXZA-AAVJU series shall be compatible with the following decoration panel - VISTA Decoration panel.
      a. The decoration panel shall be a four-way air distribution type and constructed of impact resistant polymer.
      b. The decoration panel dimensions shall measure 24-7/16" x 24-7/16" and shall fit into a standard 2x2 ceiling grid with no overlap of adjacent tiles.
      c. The four air discharge outlet louvers shall be independently motorized and controllable. Each louver shall have a visual indicator to easily identify the louver and simplify the airflow configuration.
      d. The louver outlets shall be capable of closure to allow for 3-way and 2-way air distribution.
      e. The decoration panel shall be a low-profile design, extending 5/16" below the ceiling.
      f. The decoration panel shall be compatible with the optional space and presence sensor kit.

F. Optional Space and Presence sensor kit:
   1. The space and presence sensor shall be color matched to the decoration panel.
   2. The sensor kit shall be capable of sensing occupancy within the space and automatically controlling the indoor unit set point in response to the detection of occupancy.
   3. The sensor kit shall be capable of automatically adjusting the direction of individual air discharge outlet louvers in response to the detection of occupants in the vicinity of the unit.
   4. The sensor kit shall be capable of automatically adjusting the direction of individual air discharge outlet louvers in response to the sensed floor temperature.

G. Fan:
   1. The fan shall be driven by a direct-drive DC motor with statically and dynamically balanced impeller and shall have three user-selectable speeds available: high, medium, and low. The power input required at the three field selectable speeds shall be made available as standard.
   2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output of 50W.
   3. The airflow rate shall be available in high, medium, and low settings.
   4. When FXZA-AAVJU is connected with either the Navigation Remote Controller or the I-Touch Manager/Daikin Hero central controller, the Auto fan mode shall be selectable.

H. Filter:
   1. The return air shall be filtered by means of a washable long-life filter with mildew proof resin.

I. Coil:
   1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
   2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
   3. The coil shall be a 2-row cross fin copper evaporator coil with 22 FPI design completely factory tested.
   4. The refrigerant connections shall be flare connections and the condensate will be 1 -1/32

inch outside diameter PVC.
5. A condensate pan shall be located under the coil.
6. A condensate pump with a 24-13/16" lift, measured from the drain outlet, shall be located below the coil in the condensate pan with a built-in safety alarm.
7. A thermistor will be located on the liquid and gas line.

J. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

K. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with a Daikin Intelligent Touch Manager advanced multi-zone controller.

2.9 WALL MOUNTED UNITS

A. General:
1. Daikin indoor unit FXAA shall be a wall mounted fan coil unit, operable with refrigerant R-32, equipped with an electronic expansion valve, for installation onto a wall within a conditioned space.
2. This compact design with finished white casing shall be available in capacities from 5,400 Btu/h to 24,000 Btu/h. Model numbers are FXAA05AAVJU, FXAA07AAVJU, FXAA09AAVJU, FXAA12AAVJU, FXAA18AAVJU and FXAA24AAVJU to be connected to outdoor unit model RXYA/RXTA Heat Pump and REYA Heat Recovery model as well as other ODU units.
3. Computerized PID control shall be used to control superheat to deliver a comfortable room temperature condition. The unit shall be equipped with a programmed drying mechanism that dehumidifies while limiting changes in room temperature when used with Daikin remote control BRC1NRV71.
4. A mildew-proof, polystyrene condensate drain pan, and resin net mold resistant filter shall be included as standard equipment.
5. The indoor units sound pressure shall range from 51 dB(A) to 63 dB(A) at low speed measured at 3.3 feet below and from the unit.

B. Performance: Each unit's performance is based on nominal operating conditions:

Model Number	Cooling (Indoor 80°F DB / 67°F WB, Outdoor 95°F DB, 25 ft pipe length)	Heating (Indoor 70°F DB Outdoor 47F / 43F, 25 ft pipe length)
FXAA05AAVJU	5,400	6,100
FXAA07AAVJU	7,500	8,500
FXAA09AAVJU	9,500	10,500
FXAA12AAVJU	12,000	13,500
FXAA18AAVJU	18,000	20,000
FXAA24AAVJU	24,000	26,500

C. Indoor Unit:
1. The Daikin indoor unit FXAA shall be completely factory assembled and tested. Included in the unit is factory wiring, piping, electronic proportional expansion valve, control circuit board, fan motor thermal protector, flare connections, condensate drain pan, self-diagnostics, auto-restart function, 3-minute fused time delay, and test run switch. The unit shall have an auto-swing louver which ensures efficient air distribution, which closes automatically when the unit stops. The front grille shall be easily removed for washing. The discharge angle shall automatically set at the same angle as the previous operation upon restart. The drainpipe can be fitted to from either left or right sides.
2. The indoor unit shall have a factory installed refrigerant leak sensor built in. If a leak is detected, the unit shall go into circulation mode and provide full airflow. The unit shall have signal output directly or through an accessory PCB in event of leak to connect to external ventilation, damper, alarm etc.,
3. Indoor unit and refrigerant pipes will be charged with dehydrated air prior to shipment from the factory.
4. Both refrigerant lines shall be insulated from the outdoor unit.
5. Return air shall be through a resin net mold resistant filter.
6. The indoor units shall be equipped with a condensate pan.
7. The indoor units shall be equipped with a return air thermistor.
8. The indoor unit will be separately powered with 208~230V/1-phase/60Hz.
9. The voltage range will be 253 volts maximum and 187 volts minimum.

D. Unit Cabinet:
1. The cabinet shall be affixed to a factory supplied wall mounting template and located in the conditioned space.
2. The cabinet shall be constructed with sound absorbing foamed polystyrene and polyethylene insulation.

E. Fan:
1. The fan shall be a direct-drive crossflow fan, statically and dynamically balanced impeller with high and low fan speeds available.
2. The fan motor shall operate on 208/230 volts, 1 phase, 60 hertz with a motor output range 28W - 58W.
3. The airflow rate shall be available in high and low settings.

4. The fan motor shall be thermally protected.

F. Coil:
1. Coils shall be of the direct expansion type constructed from copper tubes expanded into aluminum fins to form a mechanical bond.
2. The coil shall be of a waffle louver fin and high heat exchange, rifled bore tube design to ensure highly efficient performance.
3. The refrigerant connections shall be flare connections and the condensate will be 5/8 inch outside diameter PVC.
4. A thermistor will be located on the liquid and gas line.
5. A condensate pan shall be located in the unit.

G. Electrical:
1. A separate power supply will be required of 208/230 volts, 1 phase, 60 hertz. The acceptable voltage range shall be 187 to 253 volts.
2. Transmission (control) wiring between the indoor and outdoor unit shall be a maximum of 3,280 feet (total 6,560 feet).
3. Transmission (control) wiring between the indoor unit and remote controller shall be a maximum distance of 1,640 feet.

H. Control:
1. The unit shall have controls provided by Daikin to perform input functions necessary to operate the system.
2. The unit shall be compatible with interfacing with a BMS system via optional LonWorks or BACnet gateways.
3. The unit shall be compatible with a Daikin Hero System advanced multi-zone controller.

2.10 LOCAL CONTROLLERS

A. GENERAL.
1. The local remote control shall be made from plastic materials with a neutral color. Each controller shall have a LCD (Liquid Crystal Display) that shows set point, room temperature, mode of operation (on/off/cool/heat), and fan speed.

B. Electrical characteristics.
1. General:Each indoor unit control circuit board shall supply 16 volts DC to the local remote controller. The voltage may rise or fall in relation to the transmission packets that are sent and received.
2. Wiring: The remote controller wiring shall run from the indoor unit control board terminal block to the remote controller connected to that indoor unit. The Maximum wiring length shall be 1640 feet.
3. Wiring size: Wiring shall be non-shielded, 2-conductor sheathed vinyl cord or cable, and 18 AWG stranded copper wire.

C. VRV Controls Network.
1. The VRV Controls Network is comprised of local remote controllers, multi-zone controllers, advanced multi-zone controllers, and open protocol software devices that transmit information via the high-speed communication bus and may also be controlled via a network PC. The VRV Controls Network supports operation monitoring,

scheduling, error e-mail distribution, general user software, tenant billing, maintenance support, and integration with Building Management Systems (BMS) using open protocol via Modbus® BACnet® or Lonworks® interfaces; all of which blend to provide the optimal control strategy for the best HVAC comfort solution.

D. Remote Controllers.
   1. The remote controller wiring consists of a non-polar two-wire connection to the indoor unit. The local remote controllers may be wall-mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s). Temperature setpoint can be adjusted in increments of 1°F/°C. In the cases where a system or unit error may occur, the VRV controllers will display a alphanumeric error code and the unit address. The local remote controllers do not need to be addressed.
   2. Navigation Remote Controller:
      a. BRC1NRV71.

E. BRC1NRV71: Remote Controller can provide control for all R-32 VRV indoor units. The remote controller wiring consists of a non-polar two-wire connection to the indoor unit at terminals P1/P2. The NAV Remote Controller is wall mounted and can be adjusted to maintain the optimal operation of the connected indoor unit(s). The NAV Remote Controller does not need to be addressed.

F. The NAV Remote Controller (BRC1NRV71) can be used in conjunction another NAV Remote Controller (BRC1NRV71) to control the same indoor unit group. No more than 2 remote controllers can be placed in the same group.
   1. Mounting:
      a. The NAV Remote Controller shall be mounted into a standard 2" x 4" junction box.
   2. Display Features:
      a. The NAV Remote Controller shall be approximately 4.75" x 4.75" in size with a 2.75" x 1.75" LCD display.
      b. Backlit LCD display with contrast adjustment and auto off after 30 seconds.
      c. Display language shall be selectable from English, French or Spanish.
      d. Selectable display - Detailed, Standard and Simple.
         1) Detailed display.
      e. Shall display Operation Mode, Cool, Heat and Setback setpoints, Fan Speed, Louver position, Room Temperature, Time, and Day of the Week.
         1) Standard display.
      f. Shall display Operation Mode, Cool, Heat and Setback setpoints and Fan Speed.
         1) Simple display.
      g. Shall display Operation Mode, Cool, Heat and Setback setpoints, Fan Speed and Room Temperature.
      h. The room temperature shall be displayed with a large 11/16" font.
      i. All displayed items configurable.
         1) Configure "Off" to be displayed when unit is turned off (field setting required).
      j. Prevents mode adjustment.
         1) Setpoint can be removed from display when unit is turned Off (field setting required).
      k. Prevents setpoint adjustment.
         1) Fan speed display removable (field setting required).
      l. Prevents fan speed adjustment.
      m. System Status icons.

n. The controller shall display temperature setpoint in one degree increments with a range of 60-90oF (16-32oC).
o. Detailed and Simple display will reflect room temperature (0-176oF/-18-80oC range in one degree increments).
    1) Display of temperature information shall be configurable for Fahrenheit or Celsius.
p. On/Off status shall be displayed with an LED.
q. Error codes will be displayed with a alpha numeric code in the event of system abnormality/error.
    1) A blinking LED will also signal system abnormality/error.
r. The following system temperatures can be displayed to assist service personnel in troubleshooting:
    1) Return Air Temperature.
    2) Liquid Line Temperature.
    3) Gas Line Temperature.
    4) Discharge Air Temperature (depending on unit),
    5) Remote Controller Sensor Temperature.
    6) Temperature used for Indoor Unit Control.

3. Basic Operation:
    a. Capable of controlling a group of up to 16 indoor units.
    b. Controller shall control the following group operations:
    c. On/Off, Operation Mode (Cool, Heat, Fan, Dry and Auto* (*with VRV Heat Recovery & Heat Pump Systems)).
    d. Configure only the essential modes to be selectable - remove unnecessary mode selection(s) from display.
    e. Independent Cooling and Heating setpoints in the occupied mode.
    f. Dual setpoints (individual Cool and Heat setpoints with minimum setpoint differential 0 - 7oF (0 - 4oC) default 2oF (1oC)) or Single setpoint.
    g. Independent Cooling Setup and Heating Setback setpoints in the unoccupied mode.
    h. Fan Speed.
    i. Up to 5 speeds (dependent on indoor unit type).
    j. Vane direction and oscillation (dependent on indoor unit type).
    k. Airflow direction.
4. Up to 5 louver positions and auto swing.
    a. Individual airflow.
5. Provides individual control of up to four (4) louvers on an indoor unit.
    a. Dual airflow.
6. Provides control of both internal and external louver positions.
    a. Automatic draft protection.
7. Automatically prevents air flow from blowing directly on occupants.
    a. The controller shall be able to limit the user adjustable setpoint ranges individually for cooling and heating in the occupied period.
    b. Function button lockout (On/Off, Mode, Fan Speed, Up/Down, Left, Right Arrows).
    c. Optional Controller Face Decal (BRC1E72RM, BRC1E72RF, BRC1E72RMF, BRC1E72RM2, BRC1E72RF2, BRC1E72RMF2) to hide unnecessary (locked out) buttons.
    d. Indoor Unit group assignment.
    e. Filter indicator.
        1) Filter service indicator shall be displayed after 100, 1250 or 2500 (default)

hours of run time configurable via field setting.

f. Clock (12/24 hour) and Day display.
g. Automatic adjustment for Daylight Savings Time (DST).
    1) Set changeover period (second Sunday in March / first Sunday in November).

8. Programmability:
    a. Controller shall support schedule settings with selectable weekly pattern options.
    b. 7-day.
    c. Weekday + Weekend.
    d. Weekday + Saturday + Sunday.
    e. Everyday.
    f. The schedule shall support unit On/Off.
    g. Independent settings for Cooling and/or Heating setpoints when unit is on (occupied).
    h. Independent Setup (Cooling) and Setback (Heating) setpoints when unit is off (unoccupied).
    i. A maximum of 5 operations can be schedulable per day.
    j. Time setting in 1-minute increments.
    k. The Controller shall support Auto-changeover mode for both Heat Pump and Heat Recovery systems, therefore, allowing the optimal room temperature to be maintained by automatically switching the indoor unit's mode between Cool and Heat according to the room temperature and temperature setpoint.
    l. Changeover to cooling mode shall occur at cooling setpoint + 1oF (0.5oC) as the primary changeover deadband and takes the guard timer into consideration.
        1) Configurable from 1 - 4oF (0.5 - 2oC).
    m. Changeover to cooling mode shall occur at the primary changeover deadband to cooling + 1oF (0.5oC) as the secondary changeover deadband.
        1) Configurable from 1 - 4oF (0.5 - 2oC).
    n. Changeover to heating mode shall occur at heating setpoint - 1oF (0.5oC) as the primary changeover deadband and takes the guard timer into consideration.
        1) Configurable from 1 - 4oF (0.5 - 2oC).
    o. Changeover to heating mode shall occur at the primary changeover deadband to heating - 1oF (0.5oC) as the secondary changeover deadband.
        1) Configurable from 1 - 4oF (0.5 - 2oC).
    p. 1 hour guard timer.
        1) Upon changeover, guard timer will prevent another changeover during this period.
        2) Guard timer is ignored by a change of setpoint manually from either the Multi-zone Controller, Remote Controller, or by schedule.
        3) The Guard timer is also ignored if the space temperature reaches the secondary changeover deadband (configurable from 1 - 4oF (0.5 - 2oC)) from the primary changeover deadband, and the guard timer has been activated.
        4) 60 minutes as default, configurable to 15, 30, or 90 minutes.
    q. The controller shall support the Auto-setback by sensor function (dependent on indoor unit type).
    r. The cooling and heating setpoints shall gradually relax (configurable) internally when the room is determined to be unoccupied.
        1) The internal setpoint shall return to the original setpoint when room occupancy is detected.
    s. The controller shall support the Auto-off by sensor function (dependent on indoor

unit type).

t. The indoor unit shall turn off when it is determined that the room is unoccupied after a specified time has elapsed.
   1) The indoor unit shall be turned on manually when occupancy is detected.
u. The controller shall support the Filter Auto Clean function to be performed once a day (dependent on indoor unit type).
v. Eight (8) time periods (00:00-03-00, 03:00-06:00, 06:00-09:00, 09:00-12:00, 12:00-15:00, 15:00-18:00, 18:00-21:00, 21:00-00:00) shall be available to select from to enable the automatic filter cleaning function.
   1) Default time period (00:00 to 3:00) shall be used if the period for filter auto cleaning is not specified.
w. The indoor unit shall be stopped during auto filter cleaning function operation.
x. The Controller shall support an afterhours override Timer for temporarily enabling indoor unit operation during the unoccupied period.
y. When the Off Timer is enabled and when the unit is manually turned on at the remote controller.
z. The controller shall shut off the unit after a set time period.
aa. The time period shall be configurable in the controller menu with a range of 10 minutes - 10 hours in 10 minute increments.
bb. The room temperature shall be capable of being sensed at either the NAV Remote Controller, the indoor unit return air temperature sensor (default), or Remote Temperature Sensor (KRCS01-6B/KRCSH2018-01) configured through the field settings.
cc. The controller shall support room temperature offset range of -5.4oF (-3.0oC) to 5.4oF (3.0oC) during Cool, Heat and Auto modes configured through the field settings.

2.11 CENTRAL CONTROLLERS

A. DAIKIN HERO SIMPLE EDGE: The Daikin HERO Simple Edge provides a connection of a Daikin VRV* system to the HERO Cloud Services network for remote monitoring. The HERO Simple Edge is mounted onto the outdoor unit, and the built-in SIM card provides wireless connectivity.

B. DAIKIN INTELLIGENT TOUCH MANAGER: The intelligent Touch Manager (iTM) is an advanced multi-zone controller that controls and monitors the Daikin VRV system as well as third-party equipment. The iTM can provide a cost-effective mini Building Management System (BMS) solution to integrate and control third-party devices through optional software and hardware. If a BMS already exists, the iTM can be used as a BACnet gateway for BMS integration with the iTM BACnet Server Gateway Option.
   1. Operation and Configuration.
      a. Intuitive user interface with 10.4" LCD touchscreen.
      b. Flexible screen views include the icon view, list view, and layout view for system configurations.
      c. Easy engineering with the use of the Preset Tool and USB port.
   2. Advanced VRV Control Logic.
   3.
      a. Independent Cool and Heat setpoints or Single setpoint in the occupied period.
      b. Independent Setback setpoints in the unoccupied period.

c. Weekly Schedule with Optimum Start and Timed Override.
d. Auto Changeover with configurable methods.

4. Facility Management and Billing.
5.
   a. Remote web access.
   b. Automatic error and alert emails.
   c. Tenant Billing with iTM PPD option.
   d. Provide indoor unit and outdoor unit operation data for up to five days.
6. Mini BMS Solution with Software and Hardware Options.
   a. Interlock and Emergency Stop for facility management.
   b. DI, DO, AI, AO points integrated via the WAGO I/O System.
   c. BACnet points (AI, AO, AV. BI, BO. BV, MSI, MSO, MSV) integrated with the iTM BACnet Client Option.
7. BACnet Server Gateway Option.
   a. Direct connection to the VRV system using the iTM as a gateway.
   b. Individual device ID assigned to each indoor unit and outdoor unit management point.
   c. Seamless control logic integration between the iTM and BMS.
   d. Greatly reduces the need for BMS integrator programming.
8. Built-in Service Tool with remote access.
   a. Operation data are stored in the iTM for the last 5 days:
      1) Indoor unit and outdoor unit operation data.
      2) BACnet Client objects.
      3) WAGO I/O system data.
   b. Operation data can be exported through a USB drive or via the iTM web browser remotely.
   c. The BMS can monitor the BACnet objects of the indoor unit, and outdoor unit operation data with the BACnet Server Gateway Option activated.
9. Web function and remote monitoring.
   a. The Web function enables remote management for the Daikin VRV system with other general equipment integrated into the iTM so they can be accessed from a PC using a browser compatible with a flash player. Four administrators and sixty general users can be registered to access the iTM. Screens and operation accessible to general users can be restricted using the menu functions.

PART 3 EXECUTION

3.1 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Equipment Mounting:
   1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).

D. Install all controls and control wiring noted above and required for a complete fully correctly functioning VRF system. This to include time required for programming of the system to provide a system manufacturer sequence of operation to be submitted and approved by Engineer.

3.2 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized and factory-employed service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.
   1. Manufacturer's Field Service: Engage a factory-authorized and factory-employed service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Tests and Inspections:
   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.3 STARTUP SERVICE

A. Engage a factory-authorized and factory-employed service representative to perform startup service.
   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Manufacturer shall provide the services of a Factory Authorized Service Engineer to provide complete start-up supervision. The Manufacturer's Representative shall provide a minimum of 16-hours of BACnet integration assistance with the owner's building automation contractor.

3.4 DEMONSTRATION

A. Engage a factory-authorized and factory-employed service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION

SECTION 238228

RADIANT CEILING PANELS

PART 1 GENERAL

1.1 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.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes electric radiant ceiling panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings:
   1. Include plans, elevations, sections, and details.
   2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Indicate location and size of each field connection.
   4. Indicate location and arrangement of integral controls and other accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
   1. Structural members to which radiant panels will be attached.
   2. Method of attaching radiant panels to building structure.
   3. Penetrations of fire-rated wall and floor assemblies.

B. Field quality-control reports.

1.5 WARRANTY

A. Special Warranty: Manufacturer agrees to replace components of units that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: Five years from date of Substantial Completion.

1.6 QUALITY ASSURANCE

A. Heating output of panel is in accordance with EN 14037.

B. Acoustic performance is in accordance with DIN EN ISO 354.

PART 2 PRODUCTS

2.1 HOT WATER ELECTRIC RADIANT CEILING PANELS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Berko.
   2. Qmark.
   3. Ritting.

B. General: Description: Sheet-metal-enclosed panel with heating element suitable for lay-in installation flush with T-bar ceiling grid. Comply with UL 2021.
   1. Panel: Minimum 0.0276-inch-thick, galvanized sheet steel back panel riveted to minimum 0.0396-inch-thick, galvanized sheet steel front panel with fused-on crystalline surface.
   2. Heating Element: Powdered graphite sandwiched between sheets of electric insulation.
   3. Heating Element: Insulated resistive wires.
   4. Electrical Connections: Nonheating, high-temperature, insulated-copper leads, factory connected to heating element.
   5. Mounting: T-bar or recessed mounting frame as required.
   6. Exposed-Side Panel Finish: Apply silk-screened finish to match appearance of Architect-selected acoustical ceiling tiles.
   7. Wall Thermostat: Bimetal, sensing elements calibrated from 55 to 90 deg F with contacts suitable for line-voltage circuit, and manually operated on-off switch with contactors, relays, and control transformers.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive radiant panels 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

A. Install units level and plumb.

B. Install expansion compensation hoses.

C. Install piping covers.

3.3 CONNECTIONS

A. Install piping adjacent to radiant panels to allow service and maintenance.

END OF SECTION

SECTION 238236

ELECTRIC BASEBOARD HEATERS

PART 1 GENERAL

1.1 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.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes electric baseboard heaters.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Field quality-control reports.

PART 2 PRODUCTS

2.1 ELECTRIC BASEBOARD HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Brasch.
   2. Sterling.
   3. Vulcan.

B. Description: Factory-packaged units constructed according to UL 499, UL 1030, and UL 2021.
   1. 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.

C. Heating Elements: Nickel-chromium-wire heating element enclosed in metallic sheath mechanically bonded to fins, with high-temperature cutout and sensor running the full length of element. Element supports shall eliminate thermal expansion noise.

D. Front, Back and Top Panel: Minimum 12 gauge thick steel with exposed corners rounded; removable front panels with tamper-resistant fasteners braced and reinforced for stiffness.

E. Floor-Mounted Pedestals: Conceal conduit for power and control wiring at maximum 36-inch spacing. Pedestal-mounted back panel shall be solid panel matching front panel.

F. Support Brackets: Locate at maximum 36-inch spacing to support front panel and element.

G. Finish: Baked-enamel finish in manufacturer's standard color as selected by Architect.

H. Access Doors: Factory made, permanently hinged with tamper-resistant fastener, integral with enclosure.

I. Enclosure Style: Flat top.
   1. Bottom Inlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.
      a. Mill-finish aluminum.
      b. Anodized finish, color as selected by Architect from manufacturer's standard colors.
      c. Painted to match enclosure.
   2. Top Outlet Grille: Extruded-aluminum linear bar grille; pencil-proof bar spacing.
      a. Mill-finish aluminum.
      b. Anodized finish, color as selected by Architect from manufacturer's standard colors.
      c. Painted to match enclosure.

J. Unit Controls: Provide an integral tamper-proof double pole thermostat and disconnect switch in minimum 12” control section.

K. Accessories: Integral disconnect switch, floor mounting pedestals, blank sections, splice plates and end caps.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive convectors for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for electrical connections to verify actual locations before installation of convector.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install convectors level and plumb.

3.3 CONNECTIONS

A. Ground electric convectors according to Section 260526 "Grounding and Bonding for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections:
   1. Operational Test: After electrical circuitry has been energized, start convectors to confirm proper operation.
   2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Convectors will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 238239

UNIT HEATERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Wall heaters with propeller fans and electric-resistance heating coils.
2. Cabinet unit heaters with centrifugal fans and electric-resistance heating coils.
3. Propeller unit heaters with electric-resistance coils.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Details of anchorages and attachments to structure and to supported equipment.
4. Equipment schedules to include rated capacities, operating characteristics, furnished

specialties, and accessories.
5. Location and arrangement of piping valves and specialties.
6. Location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

C. Samples for Initial Selection: Finish colors for units with factory-applied color finishes.

D. Samples for Verification: Finish colors for each type of cabinet unit heater and wall and ceiling heaters indicated with factory-applied color finishes.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

A. 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.

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Cabinet Unit Heater Filters: Furnish two spare filter(s) for each filter installed.

PART 2 PRODUCTS

2.1 WALL HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Berko Electric Heating; a division of Marley Engineered Products.
2. Chromalox, Inc.; a division of Emerson Electric Company.
3. Marley Electric Heating; a division of Marley Engineered Products.
4. QMark Electric Heating; a division of Marley Engineered Products.

B. Description: An assembly including chassis, electric heating coil, fan, motor, and controls. Comply with UL 2021.

C. Cabinet:
   1. Front Panel: Stamped-steel louver, with removable panels fastened with tamperproof fasteners, and tamperproof thermostat.
   2. Finish: Baked enamel over baked-on primer with manufacturer's standard color selected by Architect, applied to factory-assembled and -tested wall and ceiling heaters before shipping.
   3. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Surface-Mounting Cabinet Enclosure: Steel with finish to match cabinet.

E. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high temperature protection. Provide integral circuit breaker for overcurrent protection.

F. Fan: Aluminum propeller directly connected to motor.
   1. Motor: Permanently lubricated, multispeed. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

G. Controls: Unit-mounted tamper resistant thermostat.

H. Electrical Connection: Factory wire motors and controls for a single field connection with disconnect switch.

2.2 ELECTRIC CABINET UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Sigma.
   2. Berko.
   3. Vulcan.

B. Description: A factory-assembled and -tested unit complying with ARI 440.
   1. Comply with UL 2021.

C. Coil Section Insulation: ASTM C 1071; surfaces exposed to airstream shall be aluminum-foil facing to prevent erosion of glass fibers.
   1. Thickness: 1 inch.
   2. Thermal Conductivity (k-Value): 0.26 Btu x in./h x sq. ft. at 75 deg F mean temperature.
   3. Fire-Hazard Classification: Maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
   4. Adhesive: Comply with ASTM C 916 and with NFPA 90A or NFPA 90B.
   5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Cabinet: Steel with baked-enamel finish with manufacturer's custom paint, in color selected by Architect.
   1. Vertical Unit, Exposed Front Panels: Minimum 0.0528-inch- thick, galvanized, sheet steel, removable panels with channel-formed edges secured with tamperproof cam fasteners.
   2. Horizontal Unit, Exposed Bottom Panels: Minimum 0.0528-inch- thick, galvanized, sheet steel, removable panels secured with tamperproof cam fasteners and safety chain.
   3. Recessing Flanges: Steel, finished to match cabinet.
   4. Control Access Door: Key operated.
   5. Base: Minimum 0.0528-inch- thick steel, finished to match cabinet, 6 inches high with leveling bolts.
   6. Extended Piping Compartment: 8-inch- wide piping end pocket.
   7. False Back: Minimum 0.0428-inch- thick steel, finished to match cabinet.

E. Filters: One inch throwaway.

F. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

G. Fan and Motor Board: Removable.
   1. Fan: Forward curved, high static, double width, centrifugal; directly connected to motor. Thermoplastic or painted-steel wheels, and aluminum, painted-steel, or galvanized-steel fan scrolls.
   2. Motor: Permanently lubricated, multispeed; resiliently mounted on motor board. Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   3. Wiring Terminations: Connect motor to chassis wiring with plug connection.

H. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Refer to these sections for additional requirements for unit manufacturer provided controls and ATC contractor provided controls.

2.3 PROPELLER UNIT HEATERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Berko.
   2. Markel Products Company.
   3. Sigma.

B. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers.

C. Comply with UL 2021.

D. Comply with UL 823.

E. Cabinet: Removable panels for maintenance access to controls.

F. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

G. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

H. Discharge Louver: Adjustable fin diffuser for horizontal units and conical diffuser for vertical units.

I. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.

J. Electric-Resistance Heating Coil: Nickel-chromium heating wire, free from expansion noise and hum, mounted in ceramic inserts in galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

K. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

L. Fan Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
   1. Motor Type: Permanently lubricated.

M. Control devices and operational sequences are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Refer to these sections for additional requirements for unit manufacturer provided controls and ATC contractor provided controls.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install wall boxes in finished wall assembly; seal and weatherproof. Joint-sealant materials and applications are specified in Division 07 Section "Joint Sealants."

B. Install cabinet unit heaters to comply with NFPA 90A.

C. Install propeller unit heaters level and plumb.

D. Suspend cabinet unit heaters from structure with elastomeric hangers. Vibration isolators are specified in Division 23 Section "Vibration and Controls for HVAC Piping and Equipment."

E. Suspend propeller unit heaters from structure with all-thread hanger rods and spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Division 23 Section "Vibration and Controls for HVAC Piping and Equipment."

F. Install wall-mounting thermostats and switch controls in electrical outlet boxes at heights to match lighting controls. Verify location of thermostats and other exposed control sensors with Drawings and room details before installation.

G. Install new filters in each unit within two weeks of Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Connect supply and return ducts to cabinet unit heaters with flexible duct connectors specified in Division 23 Section "Air Duct Accessories."

D. Comply with safety requirements in UL 1995.

E. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections, and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:
   1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
   2. Operate electric heating elements through each stage to verify proper operation and electrical connections.
   3. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION

SECTION 260000

ELECTRICAL

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and other Divisions Specification Sections, apply to this Section.

B. The requirements of all other sections of Division 26 apply to this section.

1.3 WARRANTY FOR PROJECT

A. The Contractor shall provide the Owner with a 2-year warranty on all materials, labor and systems from the date of Substantial Completion for each Phase. The date of Substantial completion will be as set in a letter issued by the Architect.

1.4 DEFINITIONS

A. For a complete list of definitions for this contract refer to the Division 1 specifications.

B. Provide: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

C. Install: Means to provide, install and make the equipment/system completely functional and operational with testing, commissioning and training.

1.5 SCOPE OF WORK

A. Work Included: It is the intent of these specifications and the accompanying drawings that the Contractor shall, unless otherwise specified herein, furnish all labor, materials, tools, and equipment necessary, together with the necessary accessories to constitute a satisfactory and complete installation, to complete the installation of the electrical work, as indicated on the drawings and described hereinafter. The Contractor shall properly install, equip, adjust and put in perfect condition, the respective portions of the work specified, and to so interconnect the various items or sections of the work to form a complete and properly operating whole. The work shall consist of, but shall not necessarily be limited to the following:
   1. General:
      a. Demolish electrical conduit, wiring and equipment as shown on the drawings, as required in these specifications and as required to accommodate the new construction activities and the required construction phasing to allow the Owner to occupy the site during construction. Remove wiring back to the respective source for all associated equipment indicated to be demolished and maintain the electrical circuit integrity as required for equipment to remain.
      b. Demolish all electrical connections to all architectural, plumbing and mechanical equipment being demolished. Refer to those drawings for locations of the equipment.
      c. For detailed scope of work for each electrical system, refer to the respective Division 26 specification sections.
   2. Construction phasing and sequencing:
      a. Working hours and dates: Refer to the Division 0 and 1 specifications and the contract drawings for all details and requirements.
      b. Where new circuit breakers are being retrofitted into existing panels, all power outage work shall be performed during summers or weekends during school year: Saturday or Sunday. Coordinate with Owner and provide a minimum of 14 days of notification of proposed weekend work.
      c. Contractor shall include all required overtime in his bid; the Owner will not provide additional compensation to the Contractor for work performed outside of normal working hours in order to complete the project per schedule and per the required construction phasing and sequencing requirements.
      d. Refer to Architectural Phasing plans and specifications for requirements related to construction phasing.
   3. Provide and install temporary electrical power to the site, for construction activities in accordance with Division 0 & 1 specifications and/or as required for construction activities for all contractors.
   4. The electrical contractor is responsible for all wall, ceiling and floor patching and painting of demolished and new electrical systems.
   5. Provide and install wiring and conduits for lighting and power.
   6. Provide and install lighting fixtures and controls, including digital controllers and programming of the controllers and wall switches. Provide and install associated low-voltage and branch circuit wiring to each associated fixture.
   7. Provide and install new emergency lighting, including UL924 relays.
   8. Install new exterior site lighting, including concrete foundations, conduit, and handholes.
   9. Provide and install new diesel generator with sub-base tank and sound-attenuating enclosure on a concrete foundation.
   10. Provide and install new automatic transfer switches and temporary generator connection equipment.

11. Provide and install new panelboards and feeders, including feeders and conduits.
12. Provide new circuit breaker in the existing panelboards to match the existing types, ratings, etc. as indicated on the drawings.
13. Provide and install new panelboards to replace existing panelboards. Modify conduits branch and feeders wiring and terminate them on new panel as indicated on plans. Splice and extend wiring as necessary.
14. Provide new wiring devices, including faceplates.
15. Provide and install new branch wiring for all architectural, plumbing, and mechanical equipment shown on those drawings. Provide and install NEC required disconnecting means for all required equipment and locations.
16. Provide and install new grounding systems.
17. Provide and install a complete mass notification fire alarm system with all new devices, equipment, and wiring. Fire alarm system shall be programmed, tested, and approved by AHJ prior to removal of existing fire alarm system in existing portions of building.
18. Provide and install new data, telephone, and wireless access structured cabling systems, including jacks, faceplates, patch panels and all terminations at the jack and IDF/MDF.
19. Install new back boxes and raceway for all low-voltage and communication systems as documented on the plans and specifications.
20. Contractor shall hire communications vendor to provide and install new Bogen public address (PA) system headend and expansion of existing PA system.
21. Contractor shall hire communications vendor to provide and install new master clock system with new headend and all new wireless 120V powered clocks throughout existing building and new addition.
22. Provide and install new structured cabling, backboxes and RJ-45 data jacks. Route surface metallic raceway (Wiremold) where cables cannot be concealed in walls and loose above finished ceilings. Properly support all cabling as per code.
23. Provide and install fused or non-fused disconnect switches, or circuit breakers at the various pieces of equipment as required by the N.E.C. Code.
24. Adjust connections to electrical motors to insure proper rotation.
25. Provide and install new grounding per 2020 NEC.
26. Testing and balancing of Electrical system.
27. All necessary rigging.
28. Removal of trash and general clean-up.
29. All necessary permits, approvals, fees, etc.
30. Instruction to the Owner.
31. Provide Operation and Maintenance Manuals.
32. Provide As-Built drawings.
33. Cutting, patching and clean-up.

B. It will be the responsibility of the Contractor to examine all Drawings to determine the full extent of the work. All field measurements and verifications of conditions and materials will be the obligation of the Contractor. The submission of a Proposal by the Contractor will be considered an indication that all work has been included in the Proposal. It will also be considered an indication that a thorough review of conditions, materials, and all related specifications have been investigated by the Contractor, and the results of such investigations have been included in the Contractor's Proposal.

C. Coordination Between Mechanical and Electrical Contractors:
   1. The Electrical Contractor shall:
      a. Receive and set the motor starters as provide by the Mechanical and Plumbing

Contractors.
   b. Provide power wiring, including final connection of same, from source to starters or contactors to motors.
   c. Receive and install the wall-mounted electrical control devices, thermal switches, etc., and provide all wiring for same.
   d. Provide all fused or unfused disconnect switches and circuit breakers not supplied as part of the HVAC system and as required by the National Electrical Code, or as shown on the drawings, or as specified.
   e. Adjust connections to electrical motors to insure proper rotation.
   f. Provide duct detectors and tubes to the MC for installation in the ductwork. EC shall wire and program the duct detectors and remote test stations into the fire alarm system.
   g. Provide 120V to junction boxes for the MC to install 120-24V transformers for all VAV's. EC to receive the transformer from the MC and install & wire up the 120V side of the transformer. MC shall provide all 24V wiring.
2. The Mechanical Contractor will:
   a. Furnish and set all motors for mechanical equipment.
   b. Furnish all motor starters, starter/disconnects, HVAC unit mounted disconnects, contactors, pushbuttons and switches for local and remote control of all HVAC equipment and turn over to the Electrical Contractor for installation.
   c. Provide pre-wired control panels, including relays, switches, pilot lights, etc., all as shown and/or specified, complete with wiring to numbered terminal strips.
   d. Furnish and install duct and pipe-mounted control devices, such as freezestats, aquastats, flow switches, etc.
   e. Furnish wiring diagrams for the systems, in sufficient time to allow roughing-in of conduit in accordance with the proposed work schedule.
   f. Provide all control wiring including 120V controls, 120V power and 120/24V control power transformers as required for a complete and fully functional HVAC DDC control system.
   g. Provide 120V-24V transformers for all VAV's to the EC for mounting and wiring.
   h. Receive duct detectors from the EC and install in the ductwork. MC shall provide and install all shut-down and system activation wiring from the smoke detectors to the respective units.
3. The Plumbing Contractor will:
   a. Furnish and set all motors for plumbing equipment.
   b. Coordinate locations of all equipment with both the Mechanical and Electrical Contractors.
   c. Provide the Electrical Contractor with information and instructions for connection of electrical service to water coolers, domestic hot water heater, etc.
4. The Electrical Contractor shall examine the drawings and read the specifications for the mechanical trades, and shall note all motor-driven equipment, starters and control apparatus noted, shown or specified herein.

D. Architectural Equipment Wiring and Connections:
1. All equipment for will be furnished and set by the Equipment Contractor.
2. The Electrical Contractor shall run all electrical conduit and wiring to each piece of equipment requiring electrical service and shall make all final connections to the equipment.
3. The equipment and required wiring connections are shown on the drawings.
4. This Electrical Contractor shall furnish disconnect switches at the various pieces of

equipment as required by the NEC.

1.6 WARRANTY

A. Contractors shall note that all equipment warranties, as described in the various sections of the Specifications, will begin after Substantial Completion. It will not make any difference when equipment is ordered, delivered or installed, warranties will commence after the Architect issues his letter of "Substantial Completion.".

B. All equipment is to include factory start-up unless the Contractor receives written permission, from the Owner, for Contractor start-up. Copies of the start-up report must be included with the Request for Final Payment, otherwise final payment will be withheld until the factory reports are submitted.

C. All equipment furnished for this Project shall include a minimum two-year warranty on parts and labor.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION - NOT USED

END OF SECTION

SECTION 260500

COMMON WORK RESULTS FOR ELECTRICAL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
1. Electrical equipment coordination and installation.
2. Sleeves for raceways and cables.
3. Sleeve seals.
4. Grout.
5. Common electrical installation requirements.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For sleeve seals.

1.5 COORDINATION

A. Coordinate arrangement, mounting, and support of electrical equipment:
1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
3. To allow right of way for piping and conduit installed at required slope.
4. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.

B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

C. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping.".

PART 2 PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel.
   1. Minimum Metal Thickness:
      a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side more than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
      b. For sleeve cross-section rectangle perimeter equal to, or more than, 50 inches (1270 mm) and 1 or more sides equal to, or more than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
      d. Pipeline Seal and Insulator, Inc.
   2. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
   3. Pressure Plates: Stainless steel. Include two for each sealing element.
   4. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

A. Comply with NECA 1.

B. Measure indicated mounting heights to bottom of unit for suspended items and to center of unit for wall-mounting items.

C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.

D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

E. Right of Way: Give to piping systems installed at a required slope.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

E. Cut sleeves to length for mounting flush with both surfaces of walls.

F. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

G. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable, unless indicated otherwise.

H. Seal space outside of sleeves with grout for penetrations of concrete and masonry.
   1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.

I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealants."

J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Penetration Firestopping."

K. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

L. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

M. Underground, Exterior-Wall Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

A. Install to seal exterior wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

END OF SECTION

SECTION 260519

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Building wires and cables rated 600 V and less.
   2. Connectors, splices, and terminations rated 600 V and less.
   3. Fire resistive cable.
   4. Sleeves and sleeve seals for cables.

1.3 DEFINITIONS

A. EPDM: Ethylene-propylene-diene terpolymer rubber.

1.4 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Qualification Data: For testing agency.

C. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. 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.

C. Comply with NFPA 70.

1.6 COORDINATION

A. Set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
1. American Insulated Wire Corp.; a Leviton Company.
2. General Cable Corporation.
3. Senator Wire & Cable Company.
4. Southwire Company.

B. Copper Conductors: Comply with NEMA WC 70.

C. Conductor Insulation: Comply with NEMA WC 70 for Types THHN-THWN-2. Conductor sizes #12 and #10 shall be solid and #8 and larger shall be stranded.

D. Multiconductor Cable: Comply with NEMA WC 70 for galvanized steel metal-clad cable, Type MC with ground wire.

E. Fire resistive cable in conduit for life safety and engine start circuit wiring:
1. Type RHW-2RHH/R90 fire resistive cables UL 2196 certified and FHIT 28F and FHIT7 28F for installation in EMT conduit.
2. Connectors, junction boxes and splices as per the manufacturer’s written instructions to comply with the UL certification.
3. Listed to UL 44, Thermoset Insulated Wires and Cables, as the following type: RHW-2, 600 Volt, Rated 90oC Dry/90oC Wet.
4. Classified to UL 2196, Standard for Tests for Fire Resistive Cables, for two-hours.
5. Electrical Circuit Integrity System (FHIT) of the UL Fire Resistance Directory for horizontal and vertical installations in EMT conduit.
6. Sunlight Resistant.
7. FT4 Rated.
8. ST1.
9. IEEE 1202.
10. NFPA 70, NFPA 101, NFPA 130. NFPA 502 (when approved by AHJ).

11. Design Parameters.
    a. CONDUCTORS: Bare stranded copper, 8 AWG through 750kcmil.
    b. INSULATION: High Temperature Mica Tapes layer. Ceramifiable silicone, Low Smoke Zero Halogen (LSZH).
    c. JACKET: Cross-linked polyolefin (XLPO), Low Smoke Zero Halogen.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
   1. AFC Cable Systems, Inc.
   2. Hubbell Power Systems, Inc.
   3. O-Z/Gedney; EGS Electrical Group LLC.
   4. 3M; Electrical Products Division.
   5. Tyco Electronics Corp.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SLEEVES FOR CABLES

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.4 SLEEVE SEALS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
   1. Advance Products & Systems, Inc.
   2. Calpico, Inc.
   3. Metraflex Co.
   4. Pipeline Seal and Insulator, Inc.

B. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and cable.
   1. Sealing Elements: EPDM interlocking links shaped to fit surface of cable or conduit.

Include type and number required for material and size of raceway or cable.

2. Pressure Plates: Stainless steel. Include two for each sealing element.
3. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements. Include one for each sealing element.

PART 3 EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Exposed Feeders: Type THHN-THWN-2, single conductors in raceway.

B. Feeders Concealed in Ceilings, Walls, Partitions, and Crawlspaces: Type THHN-THWN-2, single conductors in raceway.

C. Emergency life-safety feeders and engine start circuits: UL 2196 RHH/R90 2-hour rated cables in EMT conduit, as per manufacturer’s installation instructions.

D. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-THWN-2, single conductors in raceway or surface metal raceway.

E. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Type THHN-THWN-2, single conductors in raceway or type MC Cable.

F. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-THWN-2, single conductors in raceway.

G. Class 1 Control Circuits: Type THHN-THWN-2, in raceway.

H. Class 2 Control Circuits: Type THHN-THWN-2, in raceway.

I. Fire Alarm Circuits: Single conductors in raceway or metal-clad type MC-FPLP cabling. Types as required by the Manufacturer.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors, unless otherwise indicated.

B. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

C. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

D. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

E. Support cables according to Division 26 Section "Hangers and Supports for Electrical Systems."

F. Identify and color-code conductors and cables according to Division 26 Section "Identification for Electrical Systems."

3.4 CONNECTIONS

A. 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 and UL 486B.

B. Make splices and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than unspliced conductors.
   1. Use oxide inhibitor in each splice and tap conductor for aluminum conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 12 inches (300 mm) of slack.

3.5 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:
   1. For sleeve rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   2. For sleeve rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of

floor or wall.

F. Cut sleeves to length for mounting flush with both wall surfaces.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and cable unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and cable, using joint sealant appropriate for size, depth, and location of joint according to Division 07 Section "Joint Sealants."

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at cable penetrations. Install sleeves and seal with firestop materials according to Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual cables with flexible boot-type flashing units applied in coordination with roofing work.

M. Aboveground Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeves to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between cable and sleeve for installing mechanical sleeve seals.

3.6 SLEEVE-SEAL INSTALLATION

A. Install to seal underground exterior-wall penetrations.

B. Use type and number of sealing elements recommended by manufacturer for cable material and size. Position cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.7 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Division 07 Section "Penetration Firestopping."

3.8 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.

B. Perform tests and inspections and prepare test reports.

C. Tests and Inspections:
   1. After installing conductors and cables and before electrical circuitry has been energized, test feeder conductors for compliance with requirements.
      a. Megger testing for 600V feeder conductors.
   2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

D. Test Reports: Prepare a written report to record the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

E. Remove and replace malfunctioning units and retest as specified above.

END OF SECTION

SECTION 260526

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes methods and materials for grounding systems and equipment, plus the following special applications:
   1. Building grounding.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Other Informational Submittals: Plans showing dimensioned as-built locations of grounding features specified in Part 3 "Field Quality Control" Article, including the following:
   1. Ground rods.
   2. Ground rings.
   3. Grounding arrangements and connections for separately derived systems.
   4. Grounding for sensitive electronic equipment.

C. Qualification Data: For testing agency and testing agency's field supervisor.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For grounding to include the following in emergency, operation, and maintenance manuals:
   1. Instructions for periodic testing and inspection of grounding features at grounding connections for separately derived systems, sports lighting pole connections and bleacher steel connections based on NETA MTS.
      a. Tests shall be to determine if ground resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if they do not.

b. Include recommended testing intervals.

1.4 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association to supervise on-site testing specified in Part 3.

B. 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.

C. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:
   1. Stranded Conductors: ASTM B 8.
   2. Bonding Conductor: No. 4 AWG, stranded conductor or as noted on the drawings.
   3. Bonding Jumper: Copper tape, braided conductors, terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.2 CONNECTORS

A. Listed and labeled by a nationally recognized testing laboratory acceptable to authorities having jurisdiction for applications in which used, and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, bolted pressure-type, with at least two bolts.
   1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet (19 mm by 3 m in diameter).
   1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
   2. Backfill Material: Electrode manufacturer's recommended material.

PART 3 EXECUTION

3.1 APPLICATIONS

A. Conductors: Install stranded conductors for No. 8 AWG and larger, unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper conductor, No. 3/0 AWG minimum.
   1. Bury at least 24 inches (600 mm) below grade.
   2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Conductor Terminations and Connections:
   1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
   2. Underground Connections: Welded connectors.
   3. Connections to Ground Rods: Bolted connectors.
   4. Connections to Structural Steel and Poles: Welded connectors.
   5. Connections to Structural Rebar: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   4. Single-phase motor and appliance branch circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.

3.3 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 12 inches (50 mm) below finished floor or final grade, unless otherwise indicated.
   1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating, if any.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance, except where routed through short lengths of conduit.
   1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
   2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install so vibration is not transmitted to rigidly mounted equipment.
   3. Use exothermic-welded connectors for outdoor locations.

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

B. Perform the following tests and inspections and prepare test reports:
   1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.
   2. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal at individual ground rods. Make tests at ground rods before any conductors are connected.
      a. Measure ground resistance not less than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.
      b. Perform tests by fall-of-potential method according to IEEE 81.
   3. Prepare dimensioned drawings locating each test well, ground rod and ground rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

C. Report measured ground resistances that exceed the following values:
   1. Power and Lighting Equipment or System with Capacity 500 kVA and Less: 10 ohms.
   2. Structural Steel / Lightning Protection Grounds: 25 ohms.

D. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Engineer promptly and include recommendations to reduce ground resistance.

END OF SECTION

SECTION 260529

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following:
1. Hangers and supports for electrical equipment and systems.
2. Construction requirements for concrete bases.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit (galvanized).

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of five times

the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:
   1. Steel slotted support systems.
   2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:
   1. Trapeze hangers. Include Product Data for components.
   2. Steel slotted channel systems. Include Product Data for components.
   3. Nonmetallic slotted channel systems. Include Product Data for components.
   4. Equipment supports.

C. Welding certificates.

1.6 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Comply with NFPA 70.

1.7 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

PART 2 PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
      a. Allied Tube & Conduit.
      b. Cooper B-Line, Inc.; a division of Cooper Industries.
      c. ERICO International Corporation.
      d. GS Metals Corp.
      e. Thomas & Betts Corporation.
      f. Unistrut; Tyco International, Ltd.
      g. Wesanco, Inc.
   2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to

MFMA-4.

3. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.
4. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Galvanized Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

D. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; galvanized.

F. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
         1) Hilti Inc.
         2) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         3) MKT Fastening, LLC.
         4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.
   2. Mechanical-Expansion Anchors: Insert-wedge-type, stainless steel, for use in hardened portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.
      a. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
         1) Cooper B-Line, Inc.; a division of Cooper Industries.
         2) Empire Tool and Manufacturing Co., Inc.
         3) Hilti Inc.
         4) ITW Ramset/Red Head; a division of Illinois Tool Works, Inc.
         5) MKT Fastening, LLC.
   3. Concrete Inserts: Stainless Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.
   4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.
   6. Hanger Rods: Threaded steel.

PART 3 EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as scheduled in NECA 1, where its Table 1 lists maximum spacings less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with galvanized steel slotted support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.
   1. Secure raceways and cables to these supports with two-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1, EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
   1. To Wood: Fasten with lag screws or through bolts.
   2. To New Concrete: Bolt to concrete inserts.
   3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
   4. To Existing Concrete: Expansion anchor fasteners.
   5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.
   6. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
   7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
   1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Division 09 painting Sections for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 260533

RACEWAY AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. EPDM: Ethylene-propylene-diene terpolymer rubber.

C. FMC: Flexible metal conduit.

D. LFMC: Liquidtight flexible metal conduit.

E. LFNC: Liquidtight flexible nonmetallic conduit.

F. RMC or GRS: Galvanized rigid metal conduit.

1.4 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For the following raceway components. Include plans, elevations, sections, details, and attachments to other work.
   1. Custom enclosures and cabinets.
   2. For handholes and boxes for underground wiring, including the following:
      a. Duct entry provisions, including locations and duct sizes.

b. Frame and cover design.
c. Grounding details.
d. Dimensioned locations of cable rack inserts, and pulling-in and lifting irons.
e. Joint details.

C. Coordination Drawings: Conduit routing plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
1. Structural members in the paths of conduit groups with common supports.
2. HVAC and plumbing items and architectural features in the paths of conduit groups with common supports.

1.5 QUALITY ASSURANCE

A. 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.

B. Comply with NFPA 70.

PART 2 PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
1. AFC Cable Systems, Inc.
2. Alflex Inc.
3. Allied Tube & Conduit; a Tyco International Ltd. Co.
4. Maverick Tube Corporation.
5. O-Z Gedney; a unit of General Signal.
6. Wheatland Tube Company.

B. Rigid Steel Conduit: ANSI C80.1 with threaded fittings.

C. IMC: ANSI C80.6.

D. EMT: ANSI C80.3, with compression fittings.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings for Conduit (Including all Types and Flexible and Liquidtight), EMT, and Cable: NEMA FB 1; listed for type and size raceway with which used, and for application and environment in which installed.
1. Fittings for EMT: Die-cast, compression type.
2. Fittings for RGS: Threaded type.

G. Joint Compound for Rigid Steel Conduit or IMC: Listed for use in cable connector assemblies, and compounded for use to lubricate and protect threaded raceway joints from corrosion and enhance their conductivity.

2.2 NONMETALLIC CONDUIT AND TUBING

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
   1. AFC Cable Systems, Inc.
   2. CANTEX Inc.
   3. CertainTeed Corp.; Pipe & Plastics Group.
   4. Condux International, Inc.
   5. ElecSYS, Inc.
   6. Electri-Flex Co.
   7. Lamson & Sessions; Carlon Electrical Products.
   8. Manhattan/CDT/Cole-Flex.
   9. RACO; a Hubbell Company.
   10. Thomas & Betts Corporation.

B. ENT: NEMA TC 13.

C. RNC: NEMA TC 2, Type PVC Schedule 40, unless otherwise indicated.

D. LFNC: UL 1660.

E. Fittings for ENT and RNC: NEMA TC 3; match to conduit or tubing type and material.

F. Fittings for LFNC: UL 514B.

2.3 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. EGS/Appleton Electric.
   3. Erickson Electrical Equipment Company.
   4. Hoffman.
   5. Hubbell Incorporated; Killark Electric Manufacturing Co. Division.
   6. O-Z/Gedney; a unit of General Signal.
   7. RACO; a Hubbell Company.
   8. Spring City Electrical Manufacturing Company.
   9. Thomas & Betts Corporation.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Nonmetallic Outlet and Device Boxes: NEMA OS 2.

E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

F. Cast-Metal Access, Pull, and Junction Boxes: NEMA FB 1, galvanized with gasketed cover.

G. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous-hinge cover with flush latch, unless otherwise indicated.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

H. Cabinets:
   1. NEMA 250, Type 1, galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.
   2. Hinged door in front cover with flush latch and concealed hinge.
   3. Key latch to match panelboards.
   4. Metal barriers to separate wiring of different systems and voltage.
   5. Accessory feet where required for freestanding equipment.

2.4 SLEEVES FOR RACEWAYS

A. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, galvanized steel, plain ends.

B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

C. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch (1.3- or 3.5-mm) thickness as indicated and of length to suit application.

D. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

2.5 SURFACE RACEWAYS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
   1. Wiremold.
   2. Hubbell.
   3. Panduit.
   4. Approved equal by the Engineer.

B. General.
   1. System: Provide surface raceway systems for branch circuit and data network voice, video and other low-voltage wiring. Surface raceway system shall consist of raceway bases, covers, appropriate fittings and device mounting plates necessary for a complete installation.
   2. Configuration: Raceways shall be one- or two-piece design with base and snap-on cover,

or three-piece design with base and two snap-on covers which snap side by side on a common base. Base shall be dividable with a fixed barrier for up to 4 compartments. Raceway shall be available in widths of 3/4 inch to 10 inch and depths of 17/32 inch to 5 inch. Provide raceways from a company which can provide custom sizes if required. Raceway covers shall be available in tamper-resistant form with screws on access plates and covers of fittings, but not on standard cover lengths.

3. Fittings: Fittings shall include flat, internal and external elbows, couplings for joining raceway sections, wire clips, blank end fittings, and device mounting brackets and plates as applicable. Where required, provide tamper-resistant form, dividable with barriers and matching the size of the accompanying raceway base. Provide full capacity corner elbows and tee fittings to maintain a controlled 2 inch cable bend radius, meeting the specification for Fiber Optic and UTP cabling and exceeding the TIA/EIA-569-A requirements for communications pathways.
4. Device Brackets and Plates: Provide in sizes to match the raceway width and with mounting holes located to ensure proper mounting of devices in up to 4 compartments. Device plates shall be available in any length from 6 inch to 60 inch, with cutouts to accommodate various combinations of power and communications devices in up to 4 compartments. Provide 6 inch and 12 inch long device plates with a flange to overlap the joint of adjacent cover as applicable.
5. Communications Devices and Accessories: Raceway shall accommodate a complete line of connectivity outlets and modular inserts for UTP (including Category 5, 5e, 6) STP (150 ohm) fiber optic, coaxial, and other cabling types with matching faceplates and bezels to facilitate mounting. Where indicated, provide connectivity outlets and modular inserts by Ortronics or approved equal.

C. Classification.
1. Raceway and system components shall be UL and CUL listed.
2. Surface raceways shall be suitable for use in dry interior locations only, as covered in Article 386 (Surface Metal Raceways) 388 (Surface Nonmetallic Raceways) of the National Electrical Code.
3. Surface metal raceways and fittings shall be listed by Underwriters Laboratories under File Number E4376, Listing and Classification Number RJBT and File Number E41751, Listing and Classification Number RJPR respectively.
4. Systems shall comply with UL Standard UL5 for Surface Metal Raceways.
5. Larger 2 and 3 channel non-metallic raceways shall be UL Listed under File Nos. E90378 Guide RJTX and E90377 Guide RJYT, respectively.

D. Surface steel divided raceways:
1. Trade Reference (Basis of Design): Surface Mounted Metallic Raceways by The Wiremold Company; 4000 Series Steel Raceway or approved equal.
2. Material: Galvanized steel, minimum thickness 0.040 inches.
3. Finish: Manufacturer's custom ScuffCoat™, or approved equal, color as selected by Architect (ivory or gray).
4. Device Cover Plates: Suitable to mount commercially available duplex devices, single 1.40 inch and 1.59 inch diameter receptacles, GFCI, surge receptacles and other rectangular faced devices, and voice and data jacks. Devices shall be mounted to cover plates held in place by extruded protrusions. Cover plates shall be removable using standard screwdriver without marring the finish.

E. Surface metal raceways:
   1. Trade Reference (Basis of Design): Surface Mounted Steel Raceways by The Wiremold Company; Series V500 and V700 or approved equal.
   2. Material: Galvanized steel, minimum thickness 0.040 inches.
   3. Finish: Color as selected by Architect (ivory or white).
   4. Steel Device Brackets and Plates: Steel overlap device plate for horizontal installation of devices. Plate shall overlap cover to conceal seam.
   5. Plastic Overlapping Cover Bracket and Faceplate: Plastic device mounting bracket and trim plate for horizontal installation of devices. Plate shall overlap cover to conceal seam. Faceplate shall accept a variety of power and data/communication devices. Plastic shall be compatible with UL 94 for Plastic.

PART 3 EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below, unless otherwise indicated:
   1. Exposed Conduit: Rigid steel conduit.
   2. Concealed Conduit, Aboveground: Rigid steel conduit.
   3. Underground Conduit: RNC, Type EPC-40-PVC, direct buried or concrete encased ductbank as indicated on the drawings.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): LFNC.
   5. Boxes and Enclosures, Aboveground: NEMA 250, Type 4X.

B. Comply with the following indoor applications, unless otherwise indicated:
   1. Exposed in non-public areas (electrical rooms, storage rooms, mechanicals rooms, attics, etc.), Not Subject to Physical Damage: EMT.
   2. Exposed in public areas (classrooms, offices, corridors, etc.), Not Subject to Physical Damage: Surface Metallic Raceway.
   3. Concealed in Ceilings and Interior Walls and Partitions: EMT.
   4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
   5. Damp or Wet Locations: Rigid steel conduit.
   6. Raceways for Optical Fiber or Communications Cable in Spaces Used for Environmental Air: EMT.
   7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4, stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings, unless otherwise indicated.
   2. Electrical Metallic Tubing: Use die-cast compression fittings.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits in contact with concrete.

3.2 INSTALLATION

A. Comply with NECA 1 for installation requirements applicable to products specified in Part 2 except where requirements on Drawings or in this Article are stricter.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Support raceways as specified in Division 26 Section "Hangers and Supports for Electrical Systems."

E. Arrange stub-ups so curved portions of bends are not visible above the finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications conduits, for which fewer bends are allowed.

G. Conceal conduit and EMT within finished walls, ceilings, and floors, unless otherwise indicated.

H. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

I. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors, including conductors smaller than No. 4 AWG.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire.

K. Raceways for Optical Fiber and Communications Cable: Install raceways, metallic, as follows:
   1. Install with a maximum of two 90-degree bends or equivalent for each length of raceway unless Drawings show stricter requirements. Separate lengths with pull or junction boxes or terminations at distribution frames or cabinets where necessary to comply with these requirements.

L. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points:
   1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
   2. Where otherwise required by NFPA 70.

M. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall.

3.3 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Coordinate sleeve selection and application with selection and application of firestopping specified in Division 07 Section "Penetration Firestopping."

B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.

C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

D. Rectangular Sleeve Minimum Metal Thickness:
   1. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and no side greater than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).
   2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches (1270 mm) and 1 or more sides equal to, or greater than, 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

E. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.

F. Cut sleeves to length for mounting flush with both surfaces of walls.

G. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level.

H. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway unless sleeve seal is to be installed.

I. Seal space outside of sleeves with grout for penetrations of concrete and masonry.

J. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway, using joint sealant appropriate for size, depth, and location of joint. Refer to Division 07 Section "Joint Sealants" for materials and installation.

K. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway penetrations. Install sleeves and seal with firestop materials. Comply with Division 07 Section "Penetration Firestopping."

L. Roof-Penetration Sleeves: Seal penetration of individual raceways with flexible, boot-type flashing units applied in coordination with roofing work.

M. Aboveground, Exterior-Wall Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

N. Underground, Exterior-Wall Penetrations: Install cast-iron "wall pipes" for sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway and sleeve for installing mechanical sleeve seals.

3.4 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Penetration Firestopping."

3.5 PROTECTION

A. Provide final protection and maintain conditions that ensure coatings, finishes, and cabinets are without damage or deterioration at time of Substantial Completion.
   1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
   2. Repair damage to PVC or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 260553

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following:
1. Identification for raceway and metal-clad cable.
2. Identification for conductors and communication and control cable.
3. Warning labels and signs.
4. Instruction signs.
5. Equipment identification labels.
6. Miscellaneous identification products.

1.3 SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

C. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and ANSI C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.145.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in the Contract Documents, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual, and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 PRODUCTS

2.1 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 and cable size.

B. Color for Printed Legend:
   1. Power Circuits: Black letters on an orange field.
   2. Emergency Circuits: Black letters on a red field.
   3. Legend: Indicate system or service and voltage, if applicable.

C. 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.

D. Snap-Around Labels: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeves, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.2 CONDUCTOR AND COMMUNICATION- AND CONTROL-CABLE IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.3 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. Baked-Enamel Warning Signs: Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application. 1/4-inch (6.4-mm) grommets in corners for mounting. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:
   1. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.4 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. in. (129 sq. cm) and 1/8 inch (3.2 mm) 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.

2.5 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm). Overlay shall provide a weatherproof and ultraviolet-resistant seal for label.

2.6 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
   1. Minimum Width: 3/16 inch (5 mm).
   2. Tensile Strength: 50 lb (22.6 kg), minimum.

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).
4. Color: Black, except where used for color-coding.

B. 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

3.1 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service and Feeders: 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 or snap-around, color-coding bands:
1. Fire Alarm System: Red.
2. Fire-Suppression Supervisory and Control System: Red and yellow.
3. Combined Fire Alarm and Security System: Red and blue.
4. Security System: Blue and yellow.
5. Mechanical and Electrical Supervisory System: Green and blue.
6. Telecommunication System: Green and yellow.
7. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1 AWG and larger in vaults, pull and junction boxes, manholes, and handholes use color-coding conductor tape and aluminum wraparound marker labels. Identify source and circuit number of each set of conductors. For all conductor cables, identify phase in addition to the above.

D. Branch-Circuit Conductor Identification: Where there are conductors for more than three branch circuits in same junction or pull box, use color-coding conductor tape. For all conditions (more than one conductor in a box), identify each ungrounded conductor according to source and circuit number.

E. Conductors to Be Extended in the Future: Attach write-on tags to conductors and list source and circuit number.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, signal, sound, intercommunications, voice, and data 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 Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply baked-enamel warning signs. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment Requiring Workspace Clearance According to NFPA 70: Unless otherwise indicated, apply to door or cover of equipment but not on flush panelboards and similar equipment in finished spaces.

I. Instruction Signs:
   1. Operating Instructions: 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.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and 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: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-) high letters on 1-1/2-inch- (38-mm-) high label; where 2 lines of text are required, use labels 2 inches (50 mm) high.
      b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
      c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
   2. Equipment to Be Labeled:
      a. Panelboards, electrical cabinets, and enclosures.
      b. Access doors and panels for concealed electrical items.
      c. Electrical switchgear and switchboards.
      d. Transformers.
      e. Electrical substations.
      f. Emergency system boxes and enclosures.
      g. Motor-control centers.
      h. Disconnect switches.
      i. Enclosed circuit breakers.
      j. Motor starters.
      k. Push-button stations.
      l. Power transfer equipment.
      m. Contactors.
      n. Remote-controlled switches, dimmer modules, and control devices.
      o. Battery inverter units.
      p. Battery racks.
      q. Power-generating units.
      r. Voice and data cable terminal equipment.
      s. Master clock and program equipment.
      t. Intercommunication and call system master and staff stations.
      u. Television/audio components, racks, and controls.
      v. Fire-alarm control panel and annunciators.

w. Security and intrusion-detection control stations, control panels, terminal cabinets, and racks.
x. Monitoring and control equipment.
y. Uninterruptible power supply equipment.
z. Terminals, racks, and patch panels for voice and data communication and for signal and control functions.
aa. Panelboards.
bb. Receptacles and switches, including panel source and circuit number. Minimum 10 pt black font on a clear, self-adhesive label.

3.2 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach nonadhesive signs and plastic labels with screws and auxiliary hardware appropriate to the location and substrate.

F. System Identification Color Banding for Raceways and Cables: Each color 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 (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

G. Color-Coding for Phase and Voltage Level Identification, 600 V and Less: Use the colors listed below for ungrounded service, feeder, and branch-circuit conductors.
1. Color shall be factory applied or, for sizes larger than No. 10 AWG if authorities having jurisdiction permit, field applied.
2. Colors for 208/120-V Circuits:
   a. Phase A: Black.
   b. Phase B: Red.
   c. Phase C: Blue.
3. Colors for 480/277-V Circuits:
   a. Phase A: Brown.
   b. Phase B: Orange.
   c. Phase C: Yellow.
4. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches (150 mm) 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.

H. Aluminum Wraparound Marker Labels and Metal Tags: Secure tight to surface of conductor or

cable at a location with high visibility and accessibility.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench or concrete envelope exceeds 16 inches (400 mm) overall.

J. Painted Identification: Prepare surface and apply paint according to Division 09 painting Sections.

K. For all receptacles and switches, provide the following labeling: Provide clear, self adhesive label with minimum 10 pt black lettering identifying the panel source and circuit number.

END OF SECTION

SECTION 260923

DISTRIBUTED DIGITAL LIGHTING CONTROL SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Digital Lighting Controls.
2. Emergency Lighting Control.

D. Related Sections:
1. Section 265119 -LED Interior and Exterior Lighting.
2. Drawings and general provision of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections apply to this Section.
3. Electrical Sections, including wiring devices, apply to the work of this Section.

E. Control Intent - Control Intent includes, but is not limited to:
1. Defaults and initial calibration settings for such items as time delay, sensitivity, fade rates, etc.
2. Initial sensor and switching zones.
3. Initial time switch settings.

1.2 SYSTEM DESCRIPTION & OPERATION

A. The Lighting Control and Automation system as defined under this section covers the following equipment:
1. Digital relay panels.
2. Digital Room Controllers - Self-configuring, one or two relay plenum-rated controllers for on/off control. Selected models include 0-10 volt dimming outputs.
3. Digital Switches - Self-configuring, digitally addressable pushbutton on/off, dimming, and scene.
4. 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.
5. Emergency Lighting Control Unit- Allows a standard lighting control device to control emergency lighting in conjunction with normal lighting in any area within a building.

1.3 LIGHTING CONTROL APPLICATIONS

A. Unless relevant provisions of the applicable local energy codes are more stringent, provide a minimum application of lighting controls as follows:
   1. Space Control Requirements - Provide occupancy/vacancy sensors with Manual- or Partial-ON functionality 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 where indicated on plans.

1.4 SUBMITTALS

A. Submittals Package: Submit the shop drawings, and the product data specified below at the same time as a package.

B. Shop Drawings:
   1. Composite wiring and/or schematic diagram of each control circuit as proposed to be installed.
   2. Show exact location of all digital devices, including at minimum sensors, room controllers, and switches for each area on reflected ceiling plans. (Contractor must provide AutoCAD format 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 and end-of-line termination details, if required. Illustrate points of connection to integrated systems. Coordinate integration with mechanical and/or other trades.

C. Product Data: Catalog sheets, specifications and installation instructions.

D. Include data for each device which:
   1. Indicates where sensor is proposed to be installed.
   2. Prove that the sensor is suitable for the proposed application.

1.5 QUALITY ASSURANCE

1.6 MANUFACTURER: MINIMUM 10 YEARS EXPERIENCE IN MANUFACTURE OF LIGHTING CONTROLS.

1.7 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 0° to 40° C (32° to 104° F).
   2. Relative humidity: Maximum 90 percent, non-condensing.

1.8 WARRANTY

A. Provide a five year limited manufacturer's warranty on all room control devices and panels.

1.9 MAINTENANCE

A. Spare Parts:
   1. (4) Room Controllers.
   2. (4) UL924 Listed Room Controller or devices.
   3. (4) Occupancy/Vacancy Sensors.
   4. (4) 4-Button Digital Switch.
   5. (2) Daylight Sensors.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer (Basis of Design) or approved equal:
   1. Current Lighting (Previously Hubbell Building Systems).
      a. System: NX Series.
   2. Basis of design product: Current Lighting (Hubbell) NX Series or subject to compliance and prior approval with specified requirements of this section, one of the following or approved equal:
      a. Cooper Lighting Controls.
      b. Acuity Brands Lighting Controls.
      c. Wattstopper Digital Lighting Management (DLM).
   3. Substitutions:
   4. All proposed substitutions (clearly delineated as such) must be submitted in writing for approval as stipulated in the Project Manual. Proposed substitutes must be accompanied by a review of the specification noting compliance on a line-by-line basis.
   5. By considering substitutions, the contractor accepts responsibility and associated costs for all required modifications to circuitry, devices, and wiring. The contractor shall provide complete engineered shop drawings (including power and control wiring) with deviations from the original design highlighted for review and approval prior to rough-in.

2.2 DIGITAL RELAY CONTROL PANEL

A. As indicated and where shown on the plans, install Current Lighting (Hubbell) NXP2-RL2 series Lighting Control Panel.

B. Provide quantity and type of relays (single pole, double pole) as indicated on drawings.

C. Provide with NX Radio Bridge with Real Time Clock for programming and scheduling.

2.3 DIGITAL ROOM CONTROLLER

A. As indicated and where shown on the plans, install Current Lighting (Hubbell) NXRCFX series Room Controller(s), or approved equal, to control the quantity of lighting and plug loads required.

B. Where indicated, the room controller shall provide 0 - 10 volt dimming capability for the required number of dimmable lighting loads.

C. The room controller shall integrate the functionality of connected control components including wall switch stations, occupancy sensors and daylight sensors to provide the required sequence of operation for the space.

D. Room controllers and associated room control components shall operate in a totally stand alone mode and not require the use of a network, software, computer or server for local control functions.

E. Provide room controller with timeclock feature.

F. Mechanical:
   1. The room controller housing shall measure 5.75" X 3.85" X 1.3" and be constructed of GSM UL rated 94 HB plastic approved for use in a return air plenum.
   2. The housing and shall include an integral 1/2" chase nipple for external mounting to standard junction box knockout.
   3. Four RJ45 Smart Port connectors shall be accessible on the side of the enclosure for connection of room control devices.
   4. Two recessed push buttons and associated LED indicators shall be accessible on the top of the enclosure to provide override, status, set-up and testing functions.

G. Electrical:
   1. The room controller shall have a single power feed and shall be capable of operation at voltages between 120 and 347 volts AC, 50/60 Hz.
   2. One or two output relays (model specific) shall provide a total combined power switching capacity of 20 amps per unit.
   3. Where indicated provide one or two independent 0 - 10 volt dimming channels (model specific) for full range dimming control of fixtures equipped with compatible dimmable ballast or driver.
   4. Each dimming output shall have a current sinking capacity of at least 30 mA.

5. The room controller shall be capable of supplying 150 mA of Class 2 auxiliary DC power for use by wall switch stations, occupancy sensors, and daylight sensors connected to the room controller's four RJ45 Smart Port connectors.
6. Where indicated, room controllers shall be equipped with power monitoring circuitry capable of measuring and reporting the total connected load for each room controller.

H. Functional:
1. Provide an integral pushbutton and LED indicator for each load for status and to allow operation of the relays and dimmers for testing and verification without requiring other control devices to be connected.
2. The room controller shall have a default operation providing an automatic logical sequence of operation for each load as the room control devices are plugged into the Smart Port connectors.
3. Default operation for occupancy sensors shall be automatic on, automatic off for all loads.
4. Upon connection of a switch, the operation shall automatically change to manual on, automatic off (vacancy) mode for all loads.
5. Provide capability to convert each load independently to automatic on or vacancy mode using only the integral push buttons and LED indicators on the room controller.
6. When in vacancy mode, provide a 30 second grace period after an off during which automatic on shall be temporarily enabled.
7. It shall be possible to connect up to eight (8) room controllers together using Cat5 patch cables to provide configurations up to 16 switched and dimmed loads operating as a single zone.
8. Provide the following set up and configuration functions without the need for additional devices or software:
    a. Assign/reassign relays for control by wall switch station buttons.
    b. Configure relays for occupancy or vacancy operation.
    c. Assign/reassign dimmers to raise/lower switches.
    d. Assign dimming channels for response to daylight sensor control.
    e. Auto calibrate default daylight sensor sequence of operation.
    f. Save preset scenes.
9. The NXBTR Bluetooth® radio module and smart phone app from Basis of Design manufacturer or approved equal, shall allow wireless setup and configuration of the room controller and connected devices through a user-supplied smart phone or tablet of any type and with any operating system. The application shall provide as a minimum:
    a. Configure wall switch button types. At a minimum, button types shall include toggle on/off with pilot, preset, on only and off only.
    b. Configure up to six zones of daylight harvesting per room with independent set points and time delays.
    c. Include or exclude loads from occupancy sensor control.
    d. Configure up to 16 load groups per room.
    e. Configure up to 16 preset scenes per room with independent fade times.
    f. Set independent power up conditions for relays and dimmers.
    g. Set independent occupied and unoccupied conditions for each relay and dimmer.
    h. Adjust dimmer high and low trim points.
    i. Manually control loads allowing use of the phone or tablet as a personal control for the room.

2.4 LOW VOLTAGE SWITCH STATIONS

A. Low voltage digital wall switch stations shall be of the programmable type using standard Cat5 cabling for connection to system smart port.

B. Stations shall have one to six buttons and provide lighting control functions as called out and shown on the plans.

C. All switches shall be single gang and be of the generic decorator style allowing easy ganging and use of a wide array of standard wall switch plate options.

D. Provide two RJ-45 ports per switch to allow for daisy chain connection of up to eight switches to each smart port.

E. Switch station color shall be white, ivory, light almond, grey, or black as indicated.

F. Switches shall be provided with custom engraving, with final engraving approved by Owner.

2.5 OCCUPANCY SENSORS

A. Occupancy sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared), ultrasonic and/or passive infrared (model specific) sensing technology as indicated.

B. Sensors shall be Class 2 and connect to any room controller smart port using a wiring adaptor and standard Cat5 patch cable.

C. Occupancy sensors shall be self adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically make adjustments to the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is installed.

D. Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.

E. Up to four occupancy sensors may be connected to one room controller.

F. Occupancy sensors shall be ceiling or wall mounted and use dual technology (ultrasonic and passive infrared), ultrasonic and/or passive infrared (model specific) sensing technology as indicated.

G. Sensors shall be Class 2 and connect to any room controller smart port using a wiring adaptor and standard Cat5 patch cable.

H. Occupancy sensors shall be self adaptive and not require manual calibration after installation. Digital circuitry and logic shall automatically make adjustments to the sensitivity and time delay based on learned occupancy patterns and the environment in which the sensor is

installed.

I. Sensors using both ultrasonic and passive infrared (dual technology) shall operate such that detection by both technologies is required to initiate occupancy and continued detection by either technology will maintain occupancy.
   1. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
      a. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
      b. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
      c. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.
   2. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
      a. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
      b. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
      c. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
      d. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
      e. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
   3. Dual-Technology Type: Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on-off functions shall be selectable in the field by operating controls on unit.
      a. Sensitivity Adjustment: Separate for each sensing technology.
      b. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
      c. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch- (2440-mm-) high ceiling.
   4. Provide the following detectors for each specific room type by Basis of Design manufacturer and product specified or approved equal:
      a. Storage Rooms, Classrooms, and General Rooms: Provide quantity as indicated on the drawings, Current Lighting (Hubbell) OMNI-DT2000-RP ceiling mounted dual technology sensors with (1) Current Lighting (Hubbell) UVPP power pack for each sensor.
      b. Small Offices and Small Storage Rooms: Provide quantity as indicated on the

drawings, Current Lighting (Hubbell)-DT500-RP ceiling mounted dual technology sensors with (1) Hubbell UVPP power pack for each sensor.

c. Corridors and Gang Toilet Rooms: Provide quantity as indicated on drawings, Current Lighting (Hubbell) OMNI-US2000-RP ceiling mounted ultrasonic sensors with (1) UVPP power pack for each sensor.

2.6 DAYLIGHT SENSORS

A. The NX daylight sensor shall provide ambient light level information to the room controller allowing daylight responsive lighting control.

B. The system shall operate in an open loop sequence of operation reducing the amount of electric light as the quantity of daylight entering the room increases.

C. It shall be possible to configure up to six daylight zones in a room. Each zone shall be programmable to proportionally respond to the light level provided by the daylight sensor.

D. The daylight sensor shall be mounted and positioned to provide an unobstructed view of the windows per the manufacturer's directions.

2.7 EMERGENCY LIGHTING INTERFACE

A. Where emergency lighting is to be controlled by the lighting control system, provide UL924 listed load control relays, equal to LVS model EPC-1-D, as necessary to insure that emergency lights are automatically turned full on upon loss of normal power to the area.

PART 3 EXECUTION

3.1 PRE-INSTALLATION MEETING

A. A factory authorized manufacturer's representative shall provide the electrical contractor a functional overview of the lighting control system prior to installation. The contractor shall schedule the pre-installation site visit after receipt of approved submittals to review the following:
   1. Confirm the location and mounting of all digital devices, with special attention to placement of occupancy and daylighting 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.

3.2 CONTRACTOR INSTALLATION AND SERVICES

A. Contractor to install all devices and wiring in a professional manner. All line voltage

connections to be tagged to indicate circuit and switched legs.

B. Contractor to install all room/area devices using manufacturer's factory-tested Cat 5e cable with pre-terminated RJ-45 connectors. If pre-terminated cable is not used for room/area wiring, the contractor is responsible for testing each field-terminated cable following installation, and shall supply the lighting controls manufacturer with test results. Low voltage wiring topology must comply with manufacturer's specifications. Contractor shall route network wiring as shown in submittal drawings as closely as possible, and shall document final wiring location, routing and topology on as built drawings.

C. Install the work of this Section in accordance with manufacturer's printed instructions unless otherwise indicated. Before start up, contractor shall test all devices to ensure proper communication.

D. Calibrate all sensor time delays and sensitivity to guarantee proper detection of occupants and energy savings.
   1. Adjust time delay so that controlled area remains lighted while occupied.

E. 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.).

F. Post start-up tuning - After 30 days from occupancy contractor shall adjust sensor time delays and sensitivities to meet the Owner's requirements. Provide a detailed report to the Architect / Owner of post start-up activities.

3.3 STARTUP AND PROGRAMMING

A. The system manufacturer shall provide a factory authorized field engineer to the project site after installation has been completed and prior to system energization for the purpose of testing and adjustment of the system. Factory field engineer shall test and verify all system functions and ensure proper operation of the system components in accordance with the specifications and on-site conditions. The installing contractor shall notify the system manufacturer in writing that the system is completely wired and ready to be energized and tested 2 weeks prior to scheduling a field engineer for start-up of the system. Should the field engineer arrive on the job site and find the installation incomplete, the installing contractor shall pay the cost of any future visits by the field engineer required to complete the system start-up.

B. During the start-up procedure, the factory field engineer shall provide programming assistance and guidance to the building operating personnel in order to program the systems for initial operation.

C. Allow for up to 4 hours of on-site training on the use and maintenance of the lighting control system to be scheduled at the completion of startup and programming of the system.

3.4 TECHNICAL SUPPORT

A. The lighting controls manufacturer shall provide reasonable access to factory direct telephone technical support during normal business hours.

END OF SECTION

SECTION 262416

PANELBOARDS

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

1.2 RELATED DOCUMENTS:

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

B. Requirements specified in all other sections of Division 26 apply to this Section.

1.3 SUMMARY:

A. Extent of panelboard, load-center and enclosure work, including cabinets and cutout boxes, is indicated by drawings and schedules, and as specified herein.

B. Contractor is responsible to include any expediting costs for switchboards or panelboards as necessary to meet project schedule.

C. Types of panelboards and enclosures required for the project include the following:
   1. Power-distribution panelboards.
   2. Lighting and appliance panelboards.
   3. Retrofit panelboards inside existing backboxes.

D. Refer to other Division-26 sections for wires/cables, electrical boxes and fittings, and raceway work required in conjunction with installation of panelboards and enclosures.

E. Wires/cables, electrical boxes and fittings, and raceways required in conjunction with the installation of panelboards and enclosures are specified in other Division-26 sections.

1.4 SUBMITTALS:

A. Product Data: Submit manufacturer's data on panelboards and enclosures.

B. Wiring Diagrams: Submit wiring diagrams for panelboards showing connections to electrical power feeders and distribution branches.

1.5 QUALITY ASSURANCE:

A. Installer's Qualifications: A firm with at least 3 years of successful installation experience on projects utilizing panelboards similar to those required for this project.

B. Codes and Standards:
1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC Article 408 as applicable to installation, and construction of electrical panelboards and enclosures.
2. UL Compliance: Comply with applicable requirements of UL 67, "Electric Panelboards," and UL's 50, 869, 486A, 486B, and 1053 pertaining to panelboards, accessories and enclosures. Provide panelboard units which are UL-listed and labeled.
3. Special-Use Markings: Provide panelboards, constructed for special-use, with appropriate UL markings which indicate that they are suitable for special type of use/application.
4. NEMA Compliance: Comply with NEMA Stds Pub/No. 250, "Enclosures for Electrical Equipment (1000 Volts Maximum)," Pub/No. PB 1, "Panelboards," and Pub/No. PB 1.1,"Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less."

C. Federal Specification Compliance: Comply with FS W-P-115, "Power Distribution Panel", pertaining to panelboards and accessories.

1.6 SEQUENCING AND SCHEDULING:

A. Coordinate installation of panelboards and enclosures with installation of wires/cables, electrical boxes and fittings, and raceway work.

PART 2 PRODUCTS

2.1 MANUFACTURERS:

A. Manufacturers: Subject to compliance with requirements, provide panelboard products manufactured by or approved equal:
1. Square D Co.
2. General Electric Co.
3. Cutler- Hammer / Eaton Electrical.

2.2 PANELBOARDS:

A. General: Except as otherwise indicated, provide panelboards, enclosures and ancillary components, of types, sizes, and ratings indicated, which comply with manufacturer's standard materials; with the design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes, or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

B. Overcurrent Protective Devices (OCPDs): Provide type, rating, and features as indicated. Comply with Division 26 Section "Overcurrent Protective Devices," with OCPDs adapted to panelboard installation. Tandem circuit breakers shall not be used. Multipole breakers shall have common trip.

C. Equipment Ground Bus: Adequate for feeder and branch-circuit equipment ground conductors. Bonded to box.

D. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances, for the OCPD ampere ratings indicated for future installation of devices.

E. Feed-Through Lugs: Sized to accommodate feeders indicated.

F. Double-Main Lugs: Sized to accommodate feeders indicated. Provide custom sizes separate from the integral main circuit breakers with internal factory wiring from the double main lugs to the integral main circuit breaker.

G. Special Features: Provide the following features for panelboards as indicated.
   1. All Panelboards and distribution boards: Provide both enclosure fronts and doors with full piano type hinges.
   2. For retrofit panels, provide custom hinged panel cover for existing backbox and new panelboard interior.
   3. Arc-Flash labels: Provide an arc-flash label for the exterior of each panelboard.
   4. Provide phase label color code chart for each panelboard to comply with the NEC.
   5. Provide surge protection as indicated on plans.

2.3 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Branch OCPDs: Bolt-on circuit breakers, replaceable without disturbing adjacent units.

B. Lighting and Appliance Panelboards General: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-burn solderless pressure type lug connectors approved for use with copper conductors; construct unit for connecting feeders at top of panel; equip with copper bus bars, full-sized neutral bar, with bolt-in type heavy-duty, quick-make, quick-break, single-pole circuit-breakers, with toggle handles that indicate when tripped. Provide suitable lugs on neutral bus for each outgoing feeder required; and provide bare uninsulated grounding bars suitable for bolting to enclosures. Select enclosures fabricated by same manufacturer as panelboards, which mate and match properly with panelboards.
   1. Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, in sizes and NEMA types as indicated, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with piano hinge, and doors with piano hinge, flush locks and keys, all panelboard enclosures keyed alike, with concealed piano door hinges and door swings as indicated. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed mounting. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate and match properly with panelboards to be enclosed. Provide enclosure fronts and doors with full piano type hinges.

C. Double-Width Panels: Where more than 42 poles are indicated or where otherwise indicated, provide two panelboards connected by feed-thru lugs. Contractor shall provide wire and conduit between panels equal to the main incoming feeders.

D. Doors: In panel front, with concealed hinges. Secure with flush catch and tumbler lock, all keyed alike.

E. Molded-Case Circuit Breakers: Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings indicated. Select breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated. Construct with overcenter, trip-free, toggle-type operating mechanisms with quick-make, quick-break action and positive handle trip indication. Construct breakers for mounting and operating in any physical position, and operating in an ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated.

F. Panelboards shall be made by Square D Co., General Electric Co., Cutler Hammer, or approved equal. Panelboards shall be rated at the minimum R.M.S. Symmetrical as shown on the drawings, for the 277/480 Volt panelboards and for the 120/208 volt panelboards.

G. All single pole circuit breakers installed in kitchen panels with the exception of breakers feeding refrigeration equipment and lighting shall be equipped with ground fault protection. All circuits in the kitchen supplying equipment located under / associated with the hood shall have circuit breakers equipped with shunt trip coils.

H. Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, time-delay type fuses, ground-fault protection units, etc., as recommended by panelboard manufacturer for ratings and applications indicated.

I. Special Features:
   1. Provide enclosure fronts with full piano hinges and doors within the fronts with full piano hinges. Secure fronts with standard manufacturer fastening devices.
   2. Arc-Flash labels: Provide an arc-flash label for the exterior of each panelboard.
   3. Where shown on the drawings, provide each 120/208V panelboard with integral or separately mounted 120kA surge protection device.

PART 3 EXECUTION

3.1 EXAMINATION:

A. Examine areas and conditions under which panelboards and enclosures are to be installed, and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF PANELBOARDS:

A. Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC standards and NECA's "Standards of Installation," and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Ground Fault Protection: Install panelboard ground fault circuit interrupter devices in accordance with installation guidelines of NEMA 289, "Application Guide for Ground Fault Circuit Interrupters."

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Stds 486A and B.

D. Fasten enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically anchored.

E. Provide properly wired electrical connections for panelboards within enclosures.

F. Fill out panelboard's circuit directory card upon completion of installation work.

G. Provision for Future Circuits at Flush Panelboards: Stub four 1-inch empty conduits from panel into accessible ceiling space.

3.3 GROUNDING:

A. Provide equipment grounding connections for panelboard enclosures as indicated. Tighten connections to comply with tightening torques specified in UL 486A to assure permanent and effective grounds.

3.4 FIELD QUALITY CONTROL:

A. Prior to energization of electrical circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energization, check panelboards for electrical continuity of circuits, and for short-circuits.

3.5 ADJUSTING AND CLEANING:

A. Adjust operating mechanisms for free mechanical movement.

B. Touch-up scratched or marred surfaces to match original finishes.

3.6 DEMONSTRATION:

A. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

END OF SECTION

SECTION 262726

WIRING DEVICES

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

1.2 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. Requirements specified in all other sections of Division 26 apply to this Section.

C. This Section includes the following:
1. Receptacles.
2. Plugs and Plug Connectors.
3. Snap Switches.
4. Ground Fault Circuit Interrupter Receptacles.
5. USB Charger Receptacles.
6. Isolated Ground Receptacles.
7. Recessed Clock Receptacles.
8. Wall Plates.

D. Related Sections: The following sections contain requirements that relate to this section:
1. Division 26 Section "Electrical Identification" for requirements for legends to be engraved on wall plates.

1.3 SUBMITTALS

A. Product data for each type of product specified.

B. Samples of those products indicated for sample submission in Architect's comments on product data submittal. Include color and finish samples of device plates and other items per Architect's request.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with provisions of the following codes.

B. NFPA 70 "National Electrical Code".
   1. UL and NEMA Compliance: Provide wiring devices which are listed and labeled by UL and comply with applicable UL and NEMA standards.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal:
   1. Hubbell Inc.
   2. Leviton.
   3. Pass and Seymour Inc.

2.2 WIRING DEVICES:

A. General: Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Verify color selections with Architect.

B. Receptacles: Comply with UL 498 and NEMA WD 1. Where not otherwise indicated, provide 20A heavy duty, tamper-resistant, commercial/industrial grade receptacles. Provide receptacles equal to Hubbell Wiring Devices HBL5362TRXX series or approved equal. Verify color selections with Architect.

C. Where receptacles are wired to normal/emergency or emergency only circuits, provide red colored receptacles, with ratings equal to above.

D. Ground-Fault Interrupter (GFI) Receptacles: Provide weather-resistant, tamper-resistant, "feed-thru" type ground-fault circuit interrupter, with integral commercial heavy-duty NEMA 5-20R duplex receptacles arranged to protect connected downstream receptacles on same circuit. Provide unit designed for installation in a 2-3/4 inch deep outlet box without adapter, grounding type, Class A, Group 1, per UL Standard 943. Provide receptacles equal to Hubbell Wiring Devices GFRTW20 series, which comply with UL 943 for self-testing requirements. Verify color selections with Architect.

E. USB Charger Receptacles: Provide specification grade tamper-resistant NEMA 5-20R duplex receptacle with (2) integral USB ports; (1) USB Type A, providing 3 Amp, 5VDC, 2.0, complying with battery charging specification USB BC1.2, and (1) USB Type C, 5 Amp, 5VDC, 3.0 power delivery. USB charging shall be compatible with USB 2.0/3.0/3.1 devices, including Apple products. Provide receptacle equal to Hubbell Wiring Device-Kellems USB20AC5 or approved equal. Verify color selections with Architect.

F. Isolated Ground Receptacles: Provide extra heavy duty NEMA 5-20R isolated ground, tamper-resistant receptacles. Provide receptacles equal to Legrand-Pass & Seymour TRIG5362 or approved equal. Verify color selections with Architect.

G. Recessed clock receptacle: Provide clock hanger/recessed receptacle, 20A rated, tamper-resistant, 2 pole, 3 wire, grounding, with side wire terminations. Provide receptacles equal to Hubbell Wiring Device-Kellems RR201CHSSTR or approved equal. Verify color selections with Architect.

H. Plugs: 15-amperes, 125-volts, 3-wire, grounding, armored cap plugs, parallel blades with cord clamp, and 0.4 inch cord hole; match NEMA configuration with power source's.

I. Plug Connectors: 15-amperes, 125-volts, bakelite-body armored connectors, 3-wire, grounding, parallel blades, double wipe contact, with cord clamp, and 0.4 inch cord hole, match NEMA configuration to mating plug's. Arrange as indicated.

J. Snap Switches: Comply with UL 20 and NEMA WD1. Where not otherwise indicated, provide 20A industrial/institutional heavy duty grade switches. Provide switches equal to Hubbell Wiring Devices 1221 and 1223 series or approved equal. Verify color selections with Architect.

K. Plug-in strips: shall be of prewired, multi-outlet assembly, housed in steel enclosure, as shown on drawings. Outlets shall be of the grounding type as specified for receptacles and spaced and circuited as shown on drawings. Housing shall have a satin gray finish. Plug-in strips shall be Wiremold-Plugmold-series 2000 or approved equal, except otherwise noted on the drawings.

2.3 WIRING DEVICE ACCESSORIES

A. Wall plates: single and combination, of types, sizes, and with ganging and cutouts as indicated. Provide plates which mate and match with wiring devices to which attached. Provide metal screws for securing plates to devices with screw heads colored to match finish of plates. Provide wall plate color to match wiring devices except as otherwise indicated. Provide wall plates with engraved legend where indicated. Conform to requirements of Section "Electrical Identification." Provide plates possessing the following additional construction features:
   1. Material and Finish: 0.04 inch thick, type 302 satin finished stainless steel, typical for all power, computer, telephone, CATV, etc. jacks in the project, except those mounted in surface divided raceway provide standard divided raceway covers.
   2. Material for Wet Locations: Cast Aluminum with spring-loaded lift cover, and listed and labeled for use in "wet locations." Provide aluminum while-in-use cover WP26E by Hubbell Wiring Devices or approved equal.

PART 3 EXECUTION

3.1 INSTALLATION OF WIRING DEVICES AND ACCESSORIES:

A. Install wiring devices and accessories as indicated, in accordance with manufacturer's written

instructions, applicable requirements of NEC and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other Work, including painting, electrical boxes and wiring installations, as necessary to interface installation of wiring devices with other Work.

C. Install wiring devices only in electrical boxes which are clean; free from building materials, dirt, and debris.

D. Install wiring devices after wiring work is completed.

E. Install wall plates after painting work is completed.

F. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A. Use properly scaled torque indicating hand tool.

3.2 PROTECTION

A. Protect installed components from damage. Replace damaged items prior to final acceptance.

3.3 FIELD QUALITY CONTROL

A. Testing: Prior to energizing circuits, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

B. Test ground fault interrupter operation with both local and remote fault simulations in accordance with manufacturer recommendations.

END OF SECTION

SECTION 262816

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes individually mounted enclosed switches and circuit breakers used for the following:
   1. Feeder and branch-circuit protection.
   2. Motor and equipment disconnecting means.

D. Related Sections include the following:
   1. Division 26 Section "Wiring Devices" for attachment plugs, receptacles, and toggle switches used for disconnecting means.

1.3 DEFINITIONS

A. GFCI: Ground-fault circuit interrupter.

B. RMS: Root mean square.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of switch, circuit breaker, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

B. Shop Drawings: For each switch and circuit breaker.
   1. Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Show tabulations of installed devices, equipment features, and ratings. Include the following:
      a. Enclosure types and details for types other than NEMA 250, Type 1.
      b. Current and voltage ratings.
      c. Short-circuit current rating.
      d. UL listing for series rating of installed devices.
      e. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
   2. Wiring Diagrams: Power, signal, and control wiring. Differentiate between manufacturer-installed and field-installed wiring.

C. Qualification Data: Submit data for testing agencies indicating that they comply with qualifications specified in "Quality Assurance" Article.

D. Field Test Reports: Submit written test reports and include the following:
   1. Test procedures used.
   2. Test results that comply with requirements.
   3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.

E. Manufacturer's field service report.

F. Maintenance Data: For enclosed switches and circuit breakers and for components to include in maintenance manuals specified in Division 01. In addition to requirements specified in Division 01 Section "Closeout Procedures," include the following:
   1. Routine maintenance requirements for components.
   2. Manufacturer's written instructions for testing and adjusting switches and circuit breakers.
   3. Time-current curves, including selectable ranges for each type of circuit breaker.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Testing agency that is a member company of the InterNational Electrical Testing Association and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

B. 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.

C. Comply with NEMA AB 1 and NEMA KS 1.

D. Comply with NFPA 70.

E. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions, unless otherwise indicated:
   1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).
   2. Altitude: Not exceeding 6600 feet (2000 m).

1.7 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with other construction, including conduit, piping, equipment, and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

1.8 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Spares: For the following:
      a. Potential Transformer Fuses: One for every 10 installed; minimum of 3.
      b. Control-Power Fuses: One for every 10 installed; minimum of 3.
      c. Fuses and Fusible Devices for Fused Circuit Breakers: One for every 10 installed; minimum of 3.
      d. Fuses for Fused Switches: One for every 10 installed; minimum of 3.
      e. Fuses for Fused Power-Circuit Devices: One for every 10 installed; minimum of 3.
   2. Spare Indicating Lights: Six of each type installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Fusible Switches:
      a. Eaton Corp.; Cutler-Hammer Products.
      b. General Electric Co.; Electrical Distribution & Control Division.
      c. Square D Co.
   2. Molded-Case Circuit Breakers:
      a. Eaton Corp.; Cutler-Hammer Products.
      b. General Electric Co.; Electrical Distribution & Control Division.

c. Square D Co.

3. Combination Circuit Breaker and Ground-Fault Trip:
   a. Eaton Corp.; Cutler-Hammer Products.
   b. General Electric Co.; Electrical Distribution & Control Division.
   c. Square D Co.

2.2 ENCLOSED SWITCHES

A. Enclosed, Nonfusible Switch: NEMA KS 1, Type HD, with lockable handle.

B. Enclosed, Fusible Switch, 800 A and Smaller: NEMA KS 1, Type HD, with clips to accommodate specified fuses, lockable handle with two padlocks, and interlocked with cover in closed position.

C. Elevators: Provide (2) NO/NC contacts where indicated and for all disconnects associated with an elevator.

2.3 ENCLOSED CIRCUIT BREAKERS

A. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
   1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
   2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field-adjustable trip setting.
   3. Electronic Trip Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
      a. Instantaneous trip.
      b. Long- and short-time pickup levels.
      c. Long- and short-time time adjustments.
      d. Ground-fault pickup level, time delay, and I2t response.
   4. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
   5. Molded-Case Switch: Molded-case circuit breaker without trip units.
   6. Shunt-Trip: Integral shunt-trip module within the Molded-case circuit breaker.

B. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
   1. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
   2. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Ground-Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings, push-to-test feature, and ground-fault indicator.

2.4 ENCLOSURES

A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
   1. Outdoor Locations: NEMA 250, Type 3R.
   2. Kitchen Areas: NEMA 250, Type 4X, stainless steel.
   3. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   4. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

2.5 FACTORY FINISHES

A. Manufacturer's standard prime-coat finish ready for field painting.

B. Finish: Manufacturer's standard grey paint applied to factory-assembled and -tested enclosures before shipping.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.3 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 26 Section “Identification for Electrical Systems."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.

3.4 CONNECTIONS

A. Install equipment grounding connections for switches and circuit breakers with ground continuity to main electrical ground bus.

B. Install power wiring. Install wiring between switches and circuit breakers, and control and indication devices.

C. 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 and UL 486B.

3.5 FIELD QUALITY CONTROL

A. Prepare for acceptance tests as follows:
   1. Test insulation resistance for each enclosed switch, circuit breaker, component, and control circuit.
   2. Test continuity of each line- and load-side circuit.

B. Testing Agency: Engage a qualified independent testing agency to perform specified testing.

C. Testing: After installing enclosed switches and circuit breakers and after electrical circuitry has been energized, demonstrate product capability and compliance with requirements.
   1. Procedures: Perform each visual and mechanical inspection and electrical test indicated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
   2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3.6 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.7 CLEANING

A. On completion of installation, inspect interior and exterior of enclosures. Remove paint splatters and other spots. Vacuum dirt and debris; do not use compressed air to assist in cleaning. Repair exposed surfaces to match original finish.

END OF SECTION

SECTION 263213

ENGINE GENERATORS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes packaged engine-generator sets for standby power supply with the following features:
   1. Diesel engine.
   2. Unit-mounted cooling system.
   3. Unit-mounted control and monitoring.
   4. Remote annunciator.
   5. Remote E-Stop.
   6. Performance requirements for sensitive loads.
   7. Outdoor sound attenuating enclosure.
   8. Sub-base diesel tank.

D. Related Sections include the following:
   1. Division 26 Section "Transfer Switches" for transfer switches including sensors and relays to initiate automatic-starting and -stopping signals for engine-generator sets.

1.3 DEFINITIONS

A. Operational Bandwidth: The total variation from the lowest to highest value of a parameter over the range of conditions indicated, expressed as a percentage of the nominal value of the parameter.

1.4 SUBMITTALS

A. Product Data: For each type of packaged engine generator indicated. Include rated capacities, operating characteristics, and furnished specialties and accessories. In addition, include the following:
   1. Thermal damage curve for generator.
   2. Time-current characteristic curves for generator protective device.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   1. Dimensioned outline plan and elevation drawings of engine-generator set and other components specified.
   2. Design Calculations: Signed and sealed by a qualified professional engineer in the State of Pennsylvania. Calculate wind loading in accordance with the 2018 IBC considering generator base concrete slab, anchorage to the slab, and generator/sub-base tank/housing.
   3. Wiring Diagrams: Power, signal, and control wiring.

C. Qualification Data: For installer and manufacturer.

D. Source quality-control test reports.
   1. Certified summary of prototype-unit test report.
   2. Certified Test Reports: For components and accessories that are equivalent, but not identical, to those tested on prototype unit.
   3. Certified Summary of Performance Tests: Certify compliance with specified requirement to meet performance criteria for sensitive loads.
   4. Report of factory test on units to be shipped for this Project, showing evidence of compliance with specified requirements.
   5. Report of sound generation.
   6. Report of exhaust emissions showing compliance with applicable regulations.
   7. Certified Torsional Vibration Compatibility: Comply with NFPA 110.

E. Field quality-control test reports.

F. Operation and Maintenance Data: For packaged engine generators to include in emergency, operation, and maintenance manuals. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
   1. List of tools and replacement items recommended to be stored at Project for ready access. Include part and drawing numbers, current unit prices, and source of supply.

G. Warranty: Special warranty specified in this Section.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation of units required for this Project.
   1. Maintenance Proximity: Not more than two hours' normal travel time from Installer's place of business to Project site.

B. Manufacturer Qualifications: A qualified manufacturer. Maintain, within 200 miles (321 km) of Project site, a service center capable of providing training, parts, and emergency maintenance repairs.

C. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL), and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

D. Source Limitations: Obtain packaged generator sets and auxiliary components through one source from a single manufacturer.

E. 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.

F. Comply with ASME B15.1.

G. Comply with NFPA 37.

H. Comply with NFPA 70.

I. Comply with NFPA 110 requirements for Level 1 emergency power supply system.

J. Comply with UL 2200.

K. Engine Exhaust Emissions: Comply with applicable state and local government requirements.

L. Noise Emission: Comply with applicable state and local government requirements for maximum noise level at adjacent property boundaries due to sound emitted by generator set including engine, engine exhaust, engine cooling-air intake and discharge, and other components of installation.

1.6 PROJECT CONDITIONS

A. Environmental Conditions: Engine-generator system shall withstand the following environmental conditions without mechanical or electrical damage or degradation of performance capability:
   1. Ambient Temperature: Minus 15 to plus 40 deg C.
   2. Relative Humidity: 0 to 95 percent.
   3. Altitude: Sea level to 500 feet (300 m).

1.7 COORDINATION

A. Coordinate size and location of concrete bases for package engine generators. Cast anchor-bolt

inserts into bases.

1.8 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of packaged engine generators and associated auxiliary components that fail in materials or workmanship within specified warranty period.
   1. Warranty Period: 2 years from date of Substantial Completion.

1.9 MAINTENANCE SERVICE

A. Initial Maintenance Service: Beginning at Substantial Completion, provide 24 months' full maintenance by skilled employees of manufacturer's designated service organization. Include quarterly exercising to check for proper starting, load transfer, and running under load. Include routine preventive maintenance as recommended by manufacturer and adjusting as required for proper operation. Provide parts and supplies same as those used in the manufacture and installation of original equipment.

1.10 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Fuses: One for every 10 of each type and rating, but no fewer than one of each.
   2. Indicator Lamps: Two for every six of each type used, but no fewer than two of each.
   3. Filters: One set each of lubricating oil, fuel, and combustion-air filters.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Caterpillar, (CAT) Electric Power Generation.
   2. MTU On-Site Energy.
   3. Onan/Cummins Power Generation; Industrial Business Group.
   4. Kohler Power Systems (Basis of Design).
   5. Generac Industrial Power.

B. Basis of Design versus Alternate Manufacturers listed above:
   1. Kohler was used as Basis of Design for the proposed generator enclosure dimensions: refer to plans for overall dimensions, including the sub-base tank. If the submitted generator is a different size, it is the contractor’s responsibility to adjust the concrete foundation and slab for installation, at no cost to the Owner.

2.2 ENGINE-GENERATOR SET

A. Factory-assembled and factory-tested, engine-generator set model Kohler 60REOZK, 60kW Emergency Standby Power (ESP) rated unit as manufactured by Kohler or approved equal by one of the manufacturer's listed above, with a 24-hour sub-base tank.

B. Engine-generator set shall comply with EPA certification level required for the generator size.

C. Mounting Frame: Maintain alignment of mounted components without depending on concrete foundation; and have lifting attachments.
   1. Rigging Diagram: Inscribed on metal plate permanently attached to mounting frame to indicate location and lifting capacity of each lifting attachment and generator-set center of gravity.

D. Capacities and Characteristics:
   1. Power Output Ratings: Nominal ratings as indicated, with capacity as required to operate as a unit as evidenced by records of prototype testing.
   2. Output Connections: Three-phase, four wire.
   3. Nameplates: For each major system component to identify manufacturer's name and address, and model and serial number of component.

E. Generator-Set Performance for Sensitive Loads:
   1. Oversizing generator compared with the rated power output of the engine is permissible to meet specified performance.
      a. Nameplate Data for Oversized Generator: Show ratings required by the Contract Documents rather than ratings that would normally be applied to generator size installed.
   2. Steady-State Voltage Operational Bandwidth: 1 percent of rated output voltage from no load to full load.
   3. Transient Voltage Performance: Not more than 10 percent variation for 50 percent step-load increase or decrease. Voltage shall recover and remain within the steady-state operating band within 0.5 second.
   4. Steady-State Frequency Operational Bandwidth: Plus or minus 0.25 percent of rated frequency from no load to full load.
   5. Steady-State Frequency Stability: When system is operating at any constant load within the rated load, there shall be no random speed variations outside the steady-state operational band and no hunting or surging of speed.
   6. Transient Frequency Performance: Less than 2-Hz variation for 50 percent step-load increase or decrease. Frequency shall recover and remain within the steady-state operating band within three seconds.
   7. Output Waveform: At no load, harmonic content measured line to neutral shall not exceed 2 percent total with no slot ripple. Telephone influence factor, determined according to NEMA MG 1, shall not exceed 50 percent.
   8. Sustained Short-Circuit Current: For a 3-phase, bolted short circuit at system output terminals, system shall supply a minimum of 300 percent of rated full-load current for not less than 10 seconds and then clear the fault automatically, without damage to winding insulation or other generator system components.
   9. Excitation System: Performance shall be unaffected by voltage distortion caused by nonlinear load.
      a. Provide permanent magnet excitation for power source to voltage regulator.

10. Start Time: Comply with NFPA 110, Type 10, system requirements.

F. Overcurrent protective devices:
1. Size as per the drawings.
2. Equal to Square D micrologic LSIG trip units: 6.0P, 6.2P or 6.3P, depending on the frame size of the breakers.
3. 100% rated breakers.
4. Include shunt-trip function for each breaker.

2.3 ENGINE

A. Fuel: Fuel oil.
1. Ultra-low sulfur content to comply with EPA regulations.

B. Rated Engine Speed: 1800 rpm.

C. Maximum Piston Speed for Four-Cycle Engines: 1995 fpm (10.1 m/s).

D. Lubrication System: The following items are mounted on engine or skid:
1. Filter and Strainer: Rated to remove 90 percent of particles 5 micrometers and smaller while passing full flow.
2. Thermostatic Control Valve: Control flow in system to maintain optimum oil temperature. Unit shall be capable of full flow and is designed to be fail-safe.
3. Crankcase Drain: Arranged for complete gravity drainage to an easily removable container with no disassembly and without use of pumps, siphons, special tools, or appliances.

E. Engine Fuel System:
1. Main Fuel Pump: Mounted on engine. Pump ensures adequate primary fuel flow under starting and load conditions.
2. Relief-Bypass Valve: Automatically regulates pressure in fuel line and returns excess fuel to source.

F. Coolant Jacket Heater: Electric-immersion type, factory installed in coolant jacket system. Comply with NFPA 110 requirements for Level 1 equipment for heater capacity.

G. Governor: Adjustable isochronous, with speed sensing.

H. Alternator: 80C temperature rise at full rated load (Standby rating).
1. Basis of design Kohler Alternator: Model #4P8X, or approved equal by alternate manufacturer.

I. Cooling System: Closed loop, liquid cooled, with radiator factory mounted on engine-generator-set mounting frame and integral engine-driven coolant pump.
1. Coolant: Solution of 50 percent ethylene-glycol-based antifreeze and 50 percent water, with anticorrosion additives as recommended by engine manufacturer.
2. Size of Radiator: Adequate to contain expansion of total system coolant from cold start to 110 percent load condition.
3. Expansion Tank: Constructed of welded steel plate and rated to withstand maximum

closed-loop coolant system pressure for engine used. Equip with gage glass and petcock.

4. Temperature Control: Self-contained, thermostatic-control valve modulates coolant flow automatically to maintain optimum constant coolant temperature as recommended by engine manufacturer.
5. Coolant Hose: Flexible assembly with inside surface of nonporous rubber and outer covering of aging-, ultraviolet-, and abrasion-resistant fabric.
    a. Rating: 50-psig (345-kPa) maximum working pressure with coolant at 180 deg F (82 deg C), and noncollapsible under vacuum.
    b. End Fittings: Flanges or steel pipe nipples with clamps to suit piping and equipment connections.

J. Muffler/Silencer: Critical type, sized as recommended by engine manufacturer and selected with exhaust piping system to not exceed engine manufacturer's engine backpressure requirements.
    1. Minimum sound attenuation of 25 dB at 500 Hz.
    2. Sound level measured at a distance of 30 feet (7 m) from exhaust discharge after installation is complete shall be 69 dBA average or less.

K. Exhaust:
    1. All piping outside the enclosure shall be schedule 10 stainless steel, including the hinged rain cap.

L. Air-Intake Filter: Heavy-duty, engine-mounted air cleaner with replaceable dry-filter element and "blocked filter" indicator.

M. Starting System: 24-V electric, with negative ground.
    1. Components: Sized so they will not be damaged during a full engine-cranking cycle with ambient temperature at maximum specified in Part 1 "Project Conditions" Article.
    2. Cranking Motor: Heavy-duty unit that automatically engages and releases from engine flywheel without binding.
    3. Cranking Cycle: As required by NFPA 110 for system level specified.
    4. Battery: Adequate capacity within ambient temperature range specified in Part 1 "Project Conditions" Article to provide specified cranking cycle at least twice without recharging.
    5. Battery Cable: Size as recommended by engine manufacturer for cable length indicated. Include required interconnecting conductors and connection accessories.
    6. Battery-Charging Alternator: Factory mounted on engine with solid-state voltage regulation and 35-A minimum continuous rating.
    7. Battery Charger: Current-limiting, automatic-equalizing and float-charging type. Unit shall comply with UL 1236 and include the following features:
        a. Operation: Equalizing-charging rate of 10 A shall be initiated automatically after battery has lost charge until an adjustable equalizing voltage is achieved at battery terminals. Unit shall then be automatically switched to a lower float-charging mode and shall continue to operate in that mode until battery is discharged again.
        b. Automatic Temperature Compensation: Adjust float and equalize voltages for variations in ambient temperature from minus 40 deg C to plus 60 deg C to prevent overcharging at high temperatures and undercharging at low temperatures.
        c. Automatic Voltage Regulation: Maintain constant output voltage regardless of input voltage variations up to plus or minus 10 percent.
        d. Ammeter and Voltmeter: Flush mounted in door. Meters shall indicate charging rates.

e. Safety Functions: Sense abnormally low battery voltage and close contacts providing low battery voltage indication on control and monitoring panel. Sense high battery voltage and loss of ac input or dc output of battery charger. Either condition shall close contacts that provide a battery-charger malfunction indication at system control and monitoring panel.
f. Enclosure and Mounting: NEMA 250, Type 1, wall-mounted cabinet. Location: Inside the generator enclosure.

2.4 FUEL OIL STORAGE AND PUMPING

A. Comply with NFPA 30.

B. Base-Mounted Fuel Oil Tank: Factory installed and piped, complying with UL 142 fuel oil tank. Features include the following:
1. Tank level indicator.
2. Floats and limit switches for the fuel oil pump.
3. Dual-wall sub-base tank.
4. Capacity: Minimum of 275 gallons.
5. Vandal-resistant fill cap.
6. Containment Provisions: 100% containment.
7. UL 142 Listed.
8. NFPA 37 compliant.
9. Double walled, steel construction.
10. Emergency tank and basin vents.
11. Tank mounted mechanical fuel gauge.
12. Fuel supply and return tubes.
13. Top mounted leak detection float switch.
14. Low and high level fuel switches.
15. Mounting brackets for pump and control.
16. Integral lifting points.
17. Basin drain.
18. Fuel overfill alarm.
19. Overflow and tank fill plugs.
20. Five gallon spill fill box - lockable.

2.5 CONTROL AND MONITORING

A. Automatic Starting System Sequence of Operation:
1. When mode-selector switch on the control and monitoring panel is in the automatic position, remote-control contacts in one or more separate automatic transfer switches initiate starting and stopping of generator set. When mode-selector switch is switched to the on position, generator set starts. The off position of same switch initiates generator-set shutdown. When generator set is running, specified system or equipment failures or derangements automatically shut down generator set and initiate alarms. Operation of a remote emergency-stop switch also shuts down generator set.
2. Provide with generator start circuit integrity monitoring controls between generator and two automatic transfer switches, to comply with NFPA 70-2017.

B. Configuration: Operating and safety indications, protective devices, basic system controls, engine gages, instrument transformers, generator disconnect switch or circuit breaker, and other indicated components shall be grouped in a combination control and power panel. Control and monitoring section of panel shall be isolated from power sections by steel barriers. Panel features shall include the following:
   1. Wall-Mounting Cabinet Construction: Rigid, self-supporting steel unit complying with NEMA ICS 6. Power bus shall be copper. Bus, bus supports, control wiring, and temperature rise shall comply with UL 891.
   2. Current and Potential Transformers: Instrument accuracy class.
   3. Microprocessor based control operator display panel with (3) auxiliary relays and RS-485 monitoring or approved equal by one of the manufacturers listed above.

C. Indicating and Protective Devices and Controls: As required by NFPA 110 for Level 1 system, and the following:
   1. AC voltmeter.
   2. AC ammeter.
   3. AC frequency meter.
   4. DC voltmeter (alternator battery charging).
   5. Engine-coolant temperature gage.
   6. Engine lubricating-oil pressure gage.
   7. Running-time meter.
   8. Ammeter-voltmeter, phase-selector switch(es).
   9. Generator-voltage adjusting rheostat.
   10. Fuel tank derangement alarm.
   11. Fuel tank high-level shutdown of fuel supply alarm.
   12. Generator overload.

D. Supporting Items: Include sensors, transducers, terminals, relays, and other devices and include wiring required to support specified items. Locate sensors and other supporting items on engine or generator, unless otherwise indicated.

E. Connection to Data Link: A separate terminal block, factory wired to Form C dry contacts, for each alarm and status indication is reserved for connections for data-link transmission of indications to remote data terminals.

F. Common Remote Audible Alarm: Comply with NFPA 110 requirements for Level 1 systems. Include necessary contacts and terminals in control and monitoring panel.
   1. Overcrank shutdown.
   2. Coolant low-temperature alarm.
   3. Control switch not in auto position.
   4. Battery-charger malfunction alarm.
   5. Battery low-voltage alarm.

G. Remote Alarm Annunciator: Comply with NFPA 99 and 110. An LED labeled with proper alarm conditions shall identify each alarm event and a common audible signal shall sound for each alarm condition. Silencing switch in face of panel shall silence signal without altering visual indication. Connect so that after an alarm is silenced, clearing of initiating condition will reactivate alarm until silencing switch is reset. Cabinet and faceplate are surface- or flush-mounting type to suit mounting conditions indicated. Connection shall be via RS-485 communications protocol.

H. EM Shutdown: Provide a remote EM shutdown mushroom pushbutton setup with a lexan, hinged cover for installation by the contractor inside the building.

I. Remote Computer Monitoring: Provide Ethernet output from the generator controller or a RS-485 output with a gateway to Ethernet. Programming of the gateway, as required for an IP address on the network. Provide and install the InPower Windows computer software on a designated facilities computer in the building. Commissioning to confirm the software properly communicates with the generator and all required parameters for logging are able to be seen during test/exercise mode.

2.6 GENERATOR, EXCITER, AND VOLTAGE REGULATOR

A. Comply with NEMA MG 1.

B. Drive: Generator shaft shall be directly connected to engine shaft. Exciter shall be rotated integrally with generator rotor.

C. Electrical Insulation: Class H.

D. Stator-Winding Leads: Brought out to terminal box to permit future reconnection for other voltages if required.

E. Construction shall prevent mechanical, electrical, and thermal damage due to vibration, overspeed up to 125 percent of rating, and heat during operation at 110 percent of rated capacity.

F. Enclosure: Dripproof.

G. Voltage Regulator: Solid-state type, separate from exciter, providing performance as specified.
   1. Adjusting rheostat on control and monitoring panel shall provide plus or minus 5 percent adjustment of output-voltage operating band.

H. Strip Heater: Thermostatically controlled unit arranged to maintain stator windings above dew point.

I. Windings: Two-thirds pitch stator winding and fully linked amortisseur winding.

J. Subtransient Reactance: 12 percent, maximum.

2.7 OUTDOOR GENERATOR-SET ENCLOSURE

A. Description: Vandal-resistant, weatherproof steel housing, wind resistant up to 130 mph. Multiple panels shall be lockable and provide adequate access to components requiring maintenance. Panels shall be removable by one person without tools. Instruments and control shall be mounted within enclosure.

B. Engine Cooling Airflow through Enclosure: Maintain temperature rise of system components within required limits when unit operates at 110 percent of rated load for 2 hours with ambient temperature at top of range specified in system service conditions.
   1. Louvers: Fixed-engine, cooling-air inlet and discharge. Storm-proof and drainable louvers prevent entry of rain and snow.
   2. Automatic Dampers: At engine cooling-air inlet and discharge. Dampers shall be closed to reduce enclosure heat loss in cold weather when unit is not operating.

C. Convenience Outlets: Factory wired, GFCI. Arrange for external 120V-20A electrical connection.

D. Provide weather-protective, sound attenuated, Level II sound-attenuating enclosure as manufactured by Kohler or approved equal by one of the manufacturers listed above. Maximum 65 dBA at 7 meters around enclosure at full load.

E. Maximum dimensions (with sub-base tank): refer to plans.

2.8 VIBRATION ISOLATION DEVICES

A. Elastomeric Isolator Pads: Oil- and water-resistant elastomer or natural rubber, arranged in single or multiple layers, molded with a nonslip pattern and galvanized-steel baseplates of sufficient stiffness for uniform loading over pad area, and factory cut to sizes that match requirements of supported equipment.
   1. Material: Natural rubber.
   2. Number of Layers: Two.

2.9 FINISHES

A. Indoor and Outdoor Enclosures and Components: Manufacturer's standard finish over corrosion-resistant pretreatment and compatible primer.

2.10 SOURCE QUALITY CONTROL

A. Prototype Testing: Factory test engine-generator set using same engine model, constructed of identical or equivalent components and equipped with identical or equivalent accessories.
   1. Tests: Comply with NFPA 110, Level 1 Energy Converters and with IEEE 115.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas, equipment bases, and conditions, with Installer present, for compliance with requirements for installation and other conditions affecting packaged engine-generator performance.

B. Examine roughing-in of piping systems and electrical connections. Verify actual locations of

connections before packaged engine-generator installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with packaged engine-generator manufacturers' written installation and alignment instructions and with NFPA 110.

B. Install packaged engine generator to provide access, without removing connections or accessories, for periodic maintenance.

C. Install packaged engine generator with elastomeric isolator pads having a minimum deflection of 1 inch (25 mm) on 4-inch- (100-mm-) high concrete base. Secure sets to anchor bolts installed in concrete bases.

D. Electrical Wiring: Install electrical devices furnished by equipment manufacturers but not specified to be factory mounted.

E. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded. Use Hilti HIT HY-200 epoxy embedment system with a minimum of (8) ¾” galvanized anchors with a minimum embedment of 6”.

3.3 CONNECTIONS

A. Connect engine exhaust pipe to engine with flexible connector.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.4 IDENTIFICATION

A. Identify system components according to Division 26 Section "Identification for Electrical Systems."

3.5 FIELD QUALITY CONTROL

A. 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 installations, including connections, and to assist in testing.

B. Tests and Inspections:
   1. Perform tests recommended by manufacturer and each electrical test and visual and mechanical inspection for "AC Generators and for Emergency Systems" specified in NETA Acceptance Testing Specification. Certify compliance with test parameters.
   2. NFPA 110 Acceptance Tests: Perform tests required by NFPA 110 that are additional to those specified here including, but not limited to, single-step full-load pickup test.
   3. Battery Tests: Equalize charging of battery cells according to manufacturer's written instructions. Record individual cell voltages.
      a. Measure charging voltage and voltages between available battery terminals for full-charging and float-charging conditions. Check electrolyte level and specific gravity under both conditions.
      b. Test for contact integrity of all connectors. Perform an integrity load test and a capacity load test for the battery.
      c. Verify acceptance of charge for each element of the battery after discharge.
      d. Verify that measurements are within manufacturer's specifications.
   4. Battery-Charger Tests: Verify specified rates of charge for both equalizing and float-charging conditions.
   5. System Integrity Tests: Methodically verify proper installation, connection, and integrity of each element of engine-generator system before and during system operation. Check for air, exhaust, and fluid leaks.
   6. Voltage and Frequency Transient Stability Tests: Use recording oscilloscope to measure voltage and frequency transients for 50 and 100 percent step-load increases and decreases, and verify that performance is as specified.
   7. Noise Level Tests: Measure A-weighted level of noise emanating from generator-set installation, including engine exhaust and cooling-air intake and discharge, at four locations, and compare measured levels with required values.
   8. Load Bank Field Test: Provide 2 hour full 100% load resistive load bank field test.

C. Coordinate tests with tests for transfer switches and run them concurrently.

D. Test instruments shall have been calibrated within the last 12 months, traceable to standards of NIST, and adequate for making positive observation of test results. Make calibration records available for examination on request.

E. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

F. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

G. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

H. Remove and replace malfunctioning units and retest as specified above.

I. Retest: Correct deficiencies identified by tests and observations and retest until specified requirements are met.

J. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation resistances, time delays, and other values and observations. Attach a label

or tag to each tested component indicating satisfactory completion of tests.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain packaged engine generators. Provide minimum 2 hours of on-site training for the Owner’s personnel.

END OF SECTION

SECTION 263600

TRANSFER SWITCHES

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes transfer switches rated 600 V and less, including the following:
   1. Automatic transfer switches: 3-pole.

1.3 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.
   1. Single-Line Diagram: Show connections between transfer switch, bypass/isolation switch, power sources, and load; and show interlocking provisions for each combined transfer switch and bypass/isolation switch.

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 01 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.

1.4 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. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a member company of the InterNational Electrical Testing Association or is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.
   1. Testing Agency's Field Supervisor: Person currently certified by the InterNational Electrical Testing Association or the National Institute for Certification in Engineering Technologies to supervise on-site testing specified in Part 3.

C. Source Limitations: Obtain automatic transfer switches through one source from a single manufacturer.

D. 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.

E. Comply with NEMA ICS 1.

F. Comply with NFPA 70.

G. Comply with NFPA 99.

H. Comply with NFPA 110.

I. Comply with UL 1008 unless requirements of these Specifications are stricter.

1.5 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Contactor Transfer Switches:
      a. ASCO Power Technologies, LP. (Basis of Design). No substitutions will be accepted.

2.2 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.
   2. ATS Switches on this project shall have a minimum withstand rating as follows. Provide required upstream fuses to meet this requirement.
      a. 35,000A RMS for the Life Safety ATS.
      b. 35,000A RMS for the Optional Standby ATS.

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: Solid neutral.

H. Neutral Terminal: Fully rated.

I. 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 "Identification for Electrical Systems."
   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.

J. Enclosures: General-purpose NEMA 250, Type 1, complying with NEMA ICS 6 and UL 508,

unless otherwise indicated.

2.3 AUTOMATIC TRANSFER SWITCHES

A. Comply with Level 1 equipment according to NFPA 110.

B. Equal to ASCO 300 Series automatic transfer switch with solid neutral and microprocessor based transfer control center.

C. Switching Arrangement: Double-throw type, incapable of pauses or intermediate position stops during normal functioning, unless otherwise indicated.

D. Manual Switch Operation: Under load, with door closed and with either or both sources energized. Transfer time is same as for electrical operation. Control circuit automatically disconnects from electrical operator during manual operation.

E. 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.

F. Digital Communication Interface: Matched to capability of remote annunciator or annunciator and control panel.

G. In-Phase Monitor: Factory-wired, internal relay controls transfer so it occurs only when the two sources are synchronized in phase. Relay compares phase relationship and frequency difference between normal and emergency sources and initiates transfer when both sources are within 15 electrical degrees, and only if transfer can be completed within 60 electrical degrees. Transfer is initiated only if both sources are within 2 Hz of nominal frequency and 70 percent or more of nominal voltage.

H. 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. Digital LCD screen power manager equal to ASCO Power Manager Xp. Features shall include ability to monitor and display:
    a. Phase-to-Phase Voltages, Phase-to-Neutral Voltages.
    b. Phase and Neutral Currents.
    c. Frequency.
    d. Apparent Power (kVA).
    e. Reactive Power (kVAR).
    f. Real Power (kW).
    g. Power Factor.
11. Additional auxiliary contact sets to indicate switch position. Two sets are standard. Specify total number of sets if more are required.
12. Two-pole, double-throw contacts operate when emergency source voltage is present at transfer switch terminals.
13. Two-pole, double-throw contacts operate when normal source voltage is present at transfer switch terminals.
14. Push-to-Test feature on all pilot light indicators.
15. Engine Starting Contacts: One isolated and normally closed, and one isolated and normally open; rated 10 A at 32-V dc minimum.
16. Engine Shutdown Contacts: Time delay adjustable from zero to five minutes, and factory set for five minutes. Contacts shall initiate shutdown at remote engine-generator controls after retransfer of load to normal source.
17. 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.
18. Load side external surge protection unit rated 100kA per phase with through door rotary disconnect switch.
    a. Provide ASCO 520-120Y-P-13-1-T-C-L-2 surge protection device in NEMA 12 enclosure.

2.4 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

3.1 INSTALLATION

A. Annunciator and Control Panel Mounting: Flush in wall, unless otherwise indicated.

B. Identify components according to Division 26 Section "Identification for Electrical Systems."

C. Set field-adjustable intervals and delays, relays, and engine exerciser clock.

3.2 CONNECTIONS

A. Wiring to Remote Components: Match type and number of cables and conductors to control and communication requirements of transfer switches as recommended by manufacturer. Increase raceway sizes at no additional cost to Owner if necessary to accommodate required wiring.

B. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

C. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

D. Connect each ATS to the security system to monitor the power is on/transferred to the generator.

3.3 FIELD QUALITY CONTROL

A. 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. 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.
   f. 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.
6. Ground-Fault Tests: Coordinate with testing of ground-fault protective devices for power delivery from both sources.
   a. Verify grounding connections and locations and ratings of sensors.

B. Coordinate tests with tests of generator and run them concurrently.

C. Report results of tests and inspections in writing. Record adjustable relay settings and measured insulation and contact resistances and time delays. Attach a label or tag to each tested component indicating satisfactory completion of tests.

D. Remove and replace malfunctioning units and retest as specified above.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel for a minimum of 2 hours to adjust, operate, and maintain transfer switches and related equipment as specified below. Refer to Division 01 Section "Demonstration and Training."

B. Coordinate this training with that for generator equipment.

END OF SECTION

SECTION 265119

LED INTERIOR AND EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes the following:
1. Materials.
2. Finishes.
3. Luminaire support.

D. Related Requirements:
1. Refer to Lighting Fixture Schedule on electrical Construction Documents and drawings and provide equipment from specified Basis of Design manufacturers and products or approved equal.

1.2 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color Rendering Index.

C. Fixture: See "Luminaire."

D. IP: International Protection or Ingress Protection Rating.

E. LED: Light-emitting diode.

F. Lumen: Measured output of lamp and luminaire, or both.

G. Luminaire: Complete lighting unit, including lamp, reflector, and housing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, arranged by designation.

B. Shop Drawings: For nonstandard or custom luminaires.
1. Include plans, elevations, sections, and mounting and attachment details.
2. Include details of luminaire assemblies. Indicate dimensions, weights, loads, required

clearances, method of field assembly, components, and location and size of each field connection.

3. Include diagrams for power, signal, and control wiring.

C. Product Schedule: For luminaires and lamps. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plan(s) and other details, drawn to scale and coordinated with each other, using input from installers of the items involved:

B. Seismic Qualification Certificates: For luminaires, accessories, and components, from manufacturer.

C. Product Certificates: For each type of luminaire.

D. Sample warranty.

1.5 CLOSEOUT SUBMITTALS

A. Operation and maintenance data.

1.6 WARRANTY

A. Warranty: Manufacturer and Installer agree to repair or replace components of luminaires that fail in materials or workmanship within specified warranty period.

B. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 LUMINAIRE REQUIREMENTS

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. Standards:
1. ENERGY STAR certified.
2. Design Lighting Consortium (DLC).
3. California Title 24 compliant.
4. NRTL Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by an NRTL.
5. FM Global Compliance: Luminaires for hazardous locations shall be listed and labeled for indicated class and division of hazard by FM Global.
6. UL Listing: Listed for damp location.

7. Recessed luminaires shall comply with NEMA LE 4.

C. CRI of minimum 80. CCT, or as noted in Lighting Fixture Schedule.

D. Minimum rated fixture life of 50,000 hours to L70.

E. Fixture shall be dimmable from 100 percent to 10 percent of maximum light output in classrooms and common spaces. Provide dimming down to 1% where indicated in lighting schedule.

F. Internal driver, unless otherwise noted.

G. Nominal Operating Voltage: As noted in Lighting Fixture Schedule.
1. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.

2.2 MATERIALS

A. Metal Parts:
1. Free of burrs and sharp corners and edges.
2. Sheet metal components shall be steel unless otherwise indicated.
3. Form and support to prevent warping and sagging.

B. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

C. Diffusers, and Globes:
1. Acrylic: One hundred percent virgin acrylic plastic, with high resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.
2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 METAL FINISHES

A. Variations in finishes are unacceptable in the same piece. Variations in finishes of adjoining components are acceptable if they are within the range of approved Samples and if they can be and are assembled or installed to minimize contrast.

2.4 LUMINAIRE SUPPORT

A. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for channel and angle iron supports and nonmetallic channel and angle supports.

B. Single-Stem Hangers: 1/2-inch (13-mm) steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

C. Wires: ASTM A 641/A 641 M, Class 3, soft temper, zinc-coated steel, 12 gage (2.68 mm).

D. Rod Hangers: 3/16-inch (5-mm) minimum diameter, cadmium-plated, threaded steel rod.

E. Hook Hangers: Integrated assembly matched to luminaire, line voltage, and equipment with threaded attachment, cord, and locking-type plug.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Install luminaires level, plumb, and square with ceilings and walls unless otherwise indicated.

C. Install lamps in each luminaire.

D. Supports: Sized and rated for luminaire weight.

E. Flush-Mounted Luminaire Support: Secured to outlet box.

F. Wall-Mounted Luminaire Support:
1. Do not attach luminaires directly to gypsum board.

G. Suspended Luminaire Support:
1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers. Support with approved outlet box and accessories that hold stem and provide damping of luminaire oscillations. Support outlet box vertically to building structure using approved devices.
3. Continuous Rows of Luminaires: Use tubing or stem for wiring at one point and tubing or rod, wire support for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use ceiling grid as support for pendant luminaires. Connect support wires or rods to building structure.

H. Ceiling-Grid-Mounted (Lay-in) Luminaires:
1. Secure luminaire using approved fasteners in a minimum of two locations, spaced near opposite corners of luminaire, and supported to building structure above.

I. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for wiring connections.

J. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.2 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:
   1. Operational Test: After installing luminaires, switches, and accessories, and after electrical circuitry has been energized, test units to confirm proper operation.
   2. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery power and retransfer to normal.

B. Luminaire will be considered defective if it does not pass operation tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION

SECTION 271500

STRUCTURED CABLING SYSTEMS AND EQUIPMENT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary General Conditions of Specifications, apply to this Section.

B. Requirements specified in all other sections of Division 26 & 27, but especially the following sections, apply to this Section.
   1. Division 26 Section "Identification for Electrical Systems" for labeling and identification of computer cabling network and equipment.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. The extent of the Building Cabling Network is shown on the drawings and is defined to include (but not by way of limitation), furnishing and installing all equipment, materials, labor and services, related work, and performing all operations necessary to install, inspect, and test the computer and telephone cabling systems in all locations as shown on the drawings and as follows:
   1. Building Structured Cabling System shall include all conduit, raceways, innerducts, sleeves, patch panels, equipment racks, j-hooks, supports and backboards whether specifically indicated or not, but required for the complete continuous cabling system that is fully operational based on the Owner’s requirements.
   2. Provide and install Category 6, plenum rated, twisted pair cable, with both ends terminated, from patch panel management system in designated wiring closets to wall, floor, or ceiling outlets. Jacket color shall be as selected by the Owner.
   3. The Owner’s telephone system has not yet been converted to an IP-based system. However, the installation for all telephones shall match an IP-based system, except the contractor shall provide a patch jack and wiring from the CAT6 patch panel to 66M blocks mounted on the wall with multipair copper cabling back to the telephone head-end system location for cross-connection. Coordinate with Owner and the Owner’s telephone vendor for final installation requirements.
   4. Provide and install Category 6 patch cords from the patch panels to the rack mounted hubs. Provide one patch cord for each patch panel jack. Jacket color shall be as selected by the Owner.
   5. Provide and install computer/data cabling accessories and devices as herein specified and

required for cabling continuity. These items include but not limited to cable terminations, connectors, couplers, hangers, brackets, mounting hardware and frame mountings, tie wraps, bushings, sleeves, fire-stop materials, tools and equipment necessary to complete the installation. System shall be grounded and all terminations shall be made per industry standards.

6. Computer data, telephone and other wiring shall be installed concealed in the walls from the typical jack location double gang backbox through a knockout with fiber bushing to prevent cable damage to above the finished ceiling; on exterior walls provide a conduit to above the finished ceiling with a bushing on the end. Route on J-hooks throughout the building and run at 90 degree angles / follow structure.
7. Provide double gang (duplex) backboxes with single gang faceplates for each of the new data/telephone jack locations, unless otherwise noted on Electrical Cover Sheet drawing.
8. All wiring inside concrete blocks and all exterior walls for jacks and devices located on the block walls shall be installed in minimum 1” conduit from the device box up to above the finished ceiling.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions for all cable, components and equipment prior to installation.

B. Cabling Drawings: Submit 1/8" per foot scaled custom layout drawings including cable routing and calculations prepared pursuant to the requirements of the network configuration as listed in this section and shown on the drawings. These drawings, prepared by the cabling system installer must include ALL cable runs, equipment, and associated information for the project. The Owner will review cabling plans with their computer network personnel prior to approval for installation. Include project wiring diagrams showing all connections, cable routes, cable identification, and lengths. Include wiring closet diagrams. Do not exceed IEEE 802.3 Design Guidelines for cable length.

C. Materials List: Submit a complete materials list including part number and quantity for each component.

D. Installer Qualifications: Submit installer’s qualifications as required in 1.4 below.

E. Installation Instructions: Submit manufacturer's printed instructions for each product.

F. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under use conditions.

G. Maintenance Data: Include data in Maintenance Manual specified in General and Supplementary General Conditions of Specifications.

H. Reports: Submit cable and outlet test reports.

1.4 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firm (material producer) with not less than 5 years of production experience, who's published literature clearly indicates compliance of products with requirements of this section.

B. Installer's Qualifications: Firms regularly engaged in the installation of computer network wiring and associated products, of types required and who have been installing same for satisfactory use in similar service for not less than 5 years. Installer shall be BICSI certified - submit qualifications for review and approval.

C. Qualifications of Computer Network Cabling Detailer: The Cabling Detailer/Vendor must have a minimum of five years experience in the design and installation of the type of systems as described. The supplier/vendor must maintain a local service organization within a fifty (50) miles radius of the installation and shall maintain spare service replacement parts and accessories to insure minimal down time in the event of an equipment failure.

D. Codes and Standards.
   1. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction and NEC articles as applicable to installation, and construction of computer networks.
      a. NEC Compliance: Comply with NEC requirements as applicable to construction, installation, and color-coding of both power type wires/cables, and control/signal transmission media.
      b. UL Compliance: Comply with applicable requirements of UL Standards 83, 486A and 910. Provide transmission media products which are UL-listed and labeled.
      c. ASTM Compliance: comply with applicable requirements of ASTM B1, 2, 3, 8, 33, D-2219, and D-2220. provide copper conductors with conductivity of not less than 98% at 20-deg C (68-deg F).
      d. IEEE Compliance: Comply with standard for Gigabit Ethernet.
      e. FCC Compliance: Comply with U.S. Federal Communications Commission Class B standard for allowable radiation from network equipment and wiring.
      f. FDDI Compliance: Comply with Fiber Distributed Data Interface (FDDI) standards.
      g. Manufacturer's Requirements: Comply with the requirements of Owner's Computer Vendor networking design and connections.
      h. BICSI & EIA/TIA standards.

1.5 DELIVERY, STORAGE AND HANDLING

A. Deliver materials to project site in original factory wrappings and containers, clearly labeled with identification of manufacturer. Inspect equipment to ensure that no damage has occurred during shipment. Do not install damaged equipment; remove from site and replace damaged equipment with new.

B. Store materials in original packages and containers, inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, humidity; laid flat, blocked off ground to prevent sagging and warping.

C. Comply with instructions and recommendations of manufacturer for special delivery, storage, and handling requirements.

1.6 SEQUENCING AND SCHEDULING

A. Sequence installation with other work to minimize possibility of damage and soiling during remainder of construction period. Continuously coordinate work schedules and other details with other trades and Owner's representative.

1.7 WARRANTY

A. Warrant the Computer Network Cabling and associated equipment and design to be free from inherent mechanical and electrical defects and to operate to design specifications for a period of twenty (20) years from the date of installation and acceptance by the owner. All cables and connectors shall be by a single vendor or vendor's with an agreement to obtain the required warranty period.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal. Source Limitations: Obtain all products except twisted-pair and optical fiber cables through one source from a single manufacturer.
   1. Cable:
      a. AMP Incorporated; a Tyco International Ltd. Company.
      b. Belden Inc.; Electronics Division.
      c. Berk-Tec; a Leviton Company (Basis of Design).
      d. Brand-Rex Co.; Unit of BICC Cables Corp.
      e. General Cable Corporation.
      f. Lucent Technologies; Global Service Provider.
      g. Superior Essex.
   2. Terminal and Connector Components and Distribution Racks:
      a. Leviton (Basis of Design).
      b. Hubbell.
      c. Legrand/Ortronics.

2.2 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

B. All cable installed in supply and return air plenum must be UL listed and approved for installation in supply and return air plenum.

C. Expansion Capability: Unless otherwise indicated, provide spare conductor pairs in cables, positions in cross-connect and patch panels, and terminal strips to accommodate 20 percent future increase in active workstations.

2.3 MOUNTING ELEMENTS

A. Raceways and Boxes: Comply with Division 26 Section "Raceways and Boxes for Electrical Systems".

B. Backboards: 3/4-inch (19-mm), interior-grade, fire-retardant-treated plywood. Paint with 2 coats of UL723 rated intumescent fire retardant latex.

2.4 TWISTED-PAIR CABLES, CONNECTORS, AND TERMINAL EQUIPMENT

A. Cables and Terminations: Listed as complying with Category6 of TIA/EIA-568-B.

B. Conductors: Solid copper.

C. Data Cabling: Berk-Tec CAT6, LANmark-6 UTP Plenum Rated, or approved equal.
   1. Telephone/Data cabling: Blue.

D. UTP Cable: Comply with TIA/EIA-568-B. Four, thermoplastic-insulated, individually twisted pairs of conductors; No. 24 AWG, color-coded; enclosed in plenum rated jacket.

E. UTP and STP Plenum Cable: Listed for use in air-handling spaces. Features are as specified for cables, conductors, UTP cable, and STP workstation cable except materials are modified as required for listing.

F. UTP Cable Connecting Hardware: Comply with TIA/EIA-568-B. IDC type, using modules designed for punch-down caps or tools.
   1. IDC Terminal Block Modules: Integral with connector bodies, including plugs and jacks where indicated.
   2. IDC Connecting Hardware: Consistent throughout Project.
   3. Data: Leviton Extreme 6 QuickPort Jack, category 6, vendor#: 61110-RW6. Color to be determined by Owner.

G. Cross-Connect Panel: Modular array of IDC terminal blocks arranged to terminate building cables and permit interconnection between cables.
   1. Number of Terminals per Field: One for each conductor in assigned cables.
   2. Mounting: Rack.

H. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.
   1. Number of Jacks per Field: One for each four-pair conductor group of indicated cables, plus spares and blank positions adequate to satisfy specified expansion criteria.
   2. Mounting: Rack.
   3. Ratings: Category 6.

4. Leviton 48 Port, 110/6Port Panel, CAT6, Clarity T568A/B, 8POS, 3.5x19, vendor# 69586-U48.

I. Jacks and Jack Assemblies for UTP Cable: Modular, color-coded, RJ-45 receptacle units with integral IDC-type terminals. Use keyed jacks for data service. Provide all new data jacks in the school rated for Category 6 performance.

J. UTP Patch Cords: Four-pair cables in 72-inch lengths, terminated with RJ-45 plug at each end. Use keyed plugs for data service. Provide patch cords for each data jack shown on the contract drawings, color to match data or phone cable position.

K. Workstation Outlets: Jack assemblies mounted in single or multigang faceplate as shown on the drawings.
1. Faceplate: Stainless Steel.
   a. Single-Gang: 1-port, 2-port, 3-port, 4-port, 6-port.
   b. Dual-Gang: 8-port, 12-port.
2. Mounting: Flush, unless otherwise indicated.

L. Fiber Optic Indoor/Outdoor Plant Cabling:
1. Provide 12 strand 50/125µm multimode fiber optic cabling in 1-1/4" plenum rated innerduct.
   a. Provide Corning ClearCurve (OM3) wide band optical fiber cable or approved equal.
   b. Provide 1-1/4" Carlon Plenum-Gard or approved equal.
2. Fiber Optic cable terminations: Terminate each strand of the multi-mode optical fiber cable at each end on all cables with SC connectors to match the Owner's standard.

2.5 COMPUTER NETWORK EQUIPMENT IN WIRING CLOSETS AND NETWORK ROOMS:

A. Provide the following computer network system equipment:
1. Provide Category 6 rated modular patch panels with 48 standard ports/jacks per panel; quantities as required for the number of incoming cables into each MDF/IDF, plus 25% spare capacity.
2. All Racks to be grounded to building ground via #4 AWG wiring.
3. Swing-Out Wall-Mount Rack:
   a. Wall mounted, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
      1) Swing-out with perforated door, 26RU (49.5" height) Rack: Legrand SWM26RUPD-26-26.
   b. UPS: APC Smart-UPS #SMT2200RM2U or approved equal by Eaton, Dell, or others. Provide (1) UPS with each new wall rack indicated on the plans.
4. Fiber Optic Interconnection Units (LUIs) shall be rack mountable type with capacity to terminate a minimum of 24 SC fiber optic cable terminations. Provide a minimum of (1) on each end of each fiber optic cable. Total spare capacity after all cables installed: 25%. Connector panels shall be installed in closet connector housing (CCH), large enough for the required connector panel.

2.6 CONNECTIONS

A. Ground equipment.
   1. Install ground terminal at service location and connect according to Division 26 Section "Grounding and Bonding for Electrical Systems."
   2. Tighten electrical connectors and terminals according to manufacturers published torque-tightening values. If manufacturers torque values are not indicated, use those specified in UL 486A and UL 486B.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which the computer network cabling system is to be installed, and notify Owner in writing of conditions detrimental to proper completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to Owner and Installer.

3.2 INSTALLATION OF COMPUTER BUILDING CABLING SYSTEM:

A. Install system and components in accordance National Electrical Code, manufacturer’s written instructions, with recognized industry practices, and ensure that system complies with requirements and serves intended purpose.

B. Wiring Methods: Install the entire network wiring system in j-hooks, raceways and sleeves.

C. Provide all additional sleeves, conduits and innerducts etc. which are required but not shown on the electrical drawings.

D. Provide bushings on the cut end of all conduits to prevent cable damage.

E. Cables in conduits shall be securely held in place by an industry acceptable practice and installed with sufficient bending radius so as not to kink, shear or damage electrical conductors or optical fibers. Pulling tension shall be monitored with a dynamometer (tension gauge) to ensure that recommended tensile ratings are not exceeded.

F. Conduit sleeves shall be installed for all wall and floor penetrations, with bushings on each end. Quantity and size of sleeves shall be based on 40% cable fill of sleeve opening.

3.3 LABELING

A. All network cables will be labeled at both end and Faceplate jacks following the convention of w-xxx-yy:
   1. ww = Network Closet Abbreviation (M, I,etc.).
   2. xxx = Room Number (025, 123, 244, etc.).
   3. yy = jack number in room (1A, 1B, 2A, 2B, etc.).

B. Coordinate installation of Patch Panels with Owner prior to installation. All jacks in patch panels will be labelled with printed labels, per the above nomenclature.

3.4 TESTING

A. Certification: Test all network outlets and equipment to the maximum specified performance capability. Provide a report listing each network and telephone outlet location and certify its satisfactory performance in compliance with the specifications.

B. All UTP cabling will be certified to meet and or exceed the Category 6 specifications as set forth in TIA/EIA-568-B.2-1 using field testers. Certifications shall include the following parameters for each pair of each cable installed:
   1. Wire map (pin to pin connectivity).
   2. Length (in feet).
   3. Attenuation.
   4. Near End Crosstalk (NEXT).
   5. Far End Crosstalk (FEXT).
   6. ELFEXT.
   7. Attenuation/Crosstalk Ratio (ACR).
   8. Return Loss.
   9. Propogation Delay.
   10. Delay Skew.

C. All fiber optic cabling shall be tested based on a source/meter setup to report the loss through each fiber strand. Tests shall comply with FOTP-95. Submit written test results to the engineer for review & approval.

D. Test equipment shall provide an electronic and printed record of these tests.

E. Owner reserves the right to hire an independent testing company to spot check the test results. If the results vary more than 10% from the results provided by the Contractor, the Contractor will be required to prove his results are correct or retest the entire system.

3.5 IDENTIFICATION

A. Cable Identification: Identify each cable and termination at both ends with the Owner’s room number and the wiring cabinet or device to which connected. Bind all information in a three ring binder. Deliver cable book to owner and obtain receipt.

END OF SECTION

SECTION 275123

EDUCATIONAL INTERCOMMUNICATION AND PROGRAM SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections and Division 26.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Provide and install new headend public address (PA) system to expand system to accommodate new addition. Speakers and wiring in existing portion of the building is to remain, unless otherwise noted.
   1. The contractor shall furnish and install new Bogen Nquist VOIP system equipment. New equipment includes, but not limited to, 24-Circuit Analog Speaker Bridges, additional Nyquist Station Licensing, Four-Channel IP Amplifier, with new speaker assemblies and volume controls, call switches, exterior horn/speakers, distribution and booster power amplifiers.
   2. System shall be full turn-key solution including all hardware, software, programming, testing, and training by an authorized Bogen service provider. Contact Mike Romano at Intellicom Systems Inc., 856-665-5366, or another authorized Bogen service provider.

D. Provide and install all headend equipment and peripheral components to provide a complete and fully operational local sound reinforcement system for the school Gymnasium. Conduits, backboxes, raceways, cabling, miscellaneous hardware etc. shall be provided as required even if not specifically mentioned herein.
   1. The system shall be designed for manual user control at the headend equipment rack for music reinforcement and sports-related venues.
   2. The system shall be interfaced to the building's Paging System to facilitate local audio muting during building page announcements, emergency announcements, or bell-tone distribution.
   3. Dedicated speakers shall be utilized for paging and bell-tone audio.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's product literature and installation instructions with

system wiring diagrams. Provide a complete listing of all major components required for a complete and fully operational system.

B. Shop drawings: Submit 1/8" scaled floor plans showing all new components and submit riser diagrams showing the wiring routing, types sizes and speaker zones.

C. Maintenance Data: Include data in the maintenance Manual specified in Non-technical Specifications and Division 26 Section "Basic Electrical Requirements".

D. Maintenance Instructions: Submit manufacturer's printed instructions for maintenance of installed work, including methods and frequency recommended for maintaining optimum condition under use conditions. Submit three complete sets of operating instructions including wiring and circuit diagrams.

E. Inventory: Supply with the manuals an inventory of the equipment provided.

1.4 QUALIFICATIONS

A. Manufacturer: Equipment manufactured by those listed shall be considered as meeting these specifications. The naming of the manufacturer or item of material is not intended to be restrictive, but rather to establish criteria for design and quality. Catalog and model numbers are intended to indicate type, quality of design material, as well as exact operating features required.

B. Substitutions shall be made according to the project General Conditions, and shall not be made without prior approval.

C. Supplier: The supplier must have a minimum of five years experience in the design and installation of systems equal in size and type required by this project. The supplier must maintain a local service organization within a one hundred (100) mile radius of the installation with spare service replacement boards, components and accessories.

D. The Supplier must be the authorized representative of the equipment manufacturer supplied and have full-time technicians trained and certified in the installation and service of the equipment supplied.

1.5 REGULATORY REQUIREMENTS

A. Electrical Code Compliance: Comply with applicable local code requirements of the authority having jurisdiction, and that portion of the NEC which pertains to installation and construction of specified products.

B. FCC Compliance: Comply with U.S. Federal Communication Class B standard for allowable radiation from equipment and wiring.

C. Institute for Electrical and Electronic Engineers (IEEE): Comply with all applicable standards for audio, video, and data networks.

D. Americans with Disabilities Act (ADA) - Accessibility Guidelines for buildings and Facilities.

1.6 WARRANTY

A. Special Project Warranty: Submit a written warranty, executed by the contractor, installer, and the manufacturer, agreeing to repair or replace equipment which fails in material or workmanship within the specified warranty period. This warranty shall be in addition to and not a limitation of other rights the owner may have against the contractor under the contract documents.

B. Warranty of Conformance with Specifications: The contractor shall warrant that all specified functions shall be provided even if functional omission is not discovered until the end of the warranty period. This shall warranty full function of the system even if the owner does not fully utilize the capabilities of the system initially.

C. Warranty period is two (2) year after the Date of Substantial Completion as determined solely by the Architect.

PART 2 PRODUCTS

2.1 BOGEN NYQUIST PUBLIC ADDRESS (PA) SYSTEM

A. Central Equipment: Provide (1) of each of the following:
   1. Lowell LWR Series Sectional Wall Cabinet w/Locking Front Door, and.
   2. Bogen NQ-A4060 4-Channel IP Amplifier with Rackmount Kit.
   3. Bogen VAR-1/PRS40C Microphone Input Module.
   4. Bogen TG4C/PRS40C Tone Generator Module.
   5. RDL ST-DA3 Line-Level Distributor.
   6. RDL ST-MX2 Mic/Line Mixer.
   7. Bogen PRS24C Power Supply.
   8. Lot Misc. Connectors, Blank & Vent Panels, etc.

B. Peripheral Equipment.
   1. TOA PM-660U Desk Paging Microphone (Qty 1).
   2. Bogen S86T725PG8U/RE84/TB8 Recessed Ceiling Speaker Assembly (Quantity as shown on plans).
   3. Bogen MB8TSQ Surface Wall or Ceiling Speaker (Quantity as shown on plans).
   4. Bogen SPT15A 15-Watt Interior/Exterior Horn Speaker (Quantity as shown on plans).

2.2 PA SYSTEM CABLING SCHEME

A. All hallway speakers shall be parallel-wired in a 25-Volt daisy-chain method, with separate home-runs per floor, per wing. Maximum of 10 speakers per individual homerun.

B. Gymnasium shall be separate homerun.

C. Classrooms speakers shall be parallel-wired in a 25-Volt daisy-chain method, with separate home-runs, per wing. Maximum of 10 speakers per individual homerun.

D. Provide the following cabling from Paging Rack to device:
   1. Paging Speaker, 1-Pair Twisted 18 AWG.
   2. Desk Paging Microphone, 1-Pair Tw/Shielded and 1-Pair Twisted 20 AWG.
   3. Telephone System, 4-Pair Category 6.
   4. Master Clock/Bell Tone Dry Contact, 1-Pair Twisted 18AWG.

2.3 CENTRAL PA EQUIPMENT

A. Existing Equipment Rack:
   1. Central PA headend equipment is to be installed in existing equipment rack in basement electrical room. Provide all necessary mounting accessories and hardware.

B. Gymnasium AV System PA Over-ride Equipment:
   1. Provide one (1) Bogen VAR-1 Voice Activated Relay. This unit will serve as the Gymnasium AV System priority over-ride controller. Device will provide line-level output and control relay(s) for interface to the AV system headend and utilize local system speakers for paging.

2.4 PA SYSTEM LOUDSPEAKER ASSEMBLIES

A. The following equipment shall be furnished and installed in all locations and quantities as shown on the plans:

B. Ceiling speaker assemblies.
   1. Ceiling speaker assemblies shall be equal to Bogen S86, and shall have the following features:
      a. Flush mounted, steel, white powder epoxy painted.
      b. Equipped with 8" - 4 watt speaker.
      c. Frequency Response: 50Hz to 12kHz.
      d. Power Rating: 4 Watts Continuous.
      e. Voice Coil Impedance: 8 ohms.
      f. Integral Line Transformer: 25/70V.
      g. Provide with volume control knob.
      h. The ceiling speakers shall come complete with ceiling bridges and ceiling backboxes equal to Bogen RE84+TB8.
   2. Wall speaker assemblies shall be equal to Bogen MB8TSQVR, and shall have the following features:
      a. Flush mounted, steel, white powder epoxy painted.
      b. Equipped with 8" - 10 watt speaker.
      c. Frequency Response: 110Hz to 15kHz.
      d. Power Rating: 4 Watts Continuous.
      e. Voice Coil Impedance: 8 ohms.
      f. Integral Line Transformer: 25/70V.

3. Horn assemblies shall be equal to Bogen SPT15A, and shall have the following features:
   a. Transformer: 25V/70V, 15W, Integral to unit 5 taps at -3dB levels.
   b. Speaker Type Compression, re-entrant horn.
   c. Average Sensitivity: 95 dB-SPL, 1W/ 1M.
   d. Power rating: 15W-RMS, EIA 426A Standard.
   e. Calculated Maximum System Output: 121 dB-SPL, 15W / 1M.
   f. Frequency Response: 275 - 14 kHz, EIA 426A Standard.
   g. Nominal Coverage Angle: 110° Included angle, -6dB, 2 kHz.
   h. Transformer Tap Selection: Selector switch.
   i. Audio Connection: Binding Screw.
4. Where shown on plans, provide a wall mounted volume controls with 10 distinct steps and capability to fully dissipate all power going to the speaker it is controlling.
   a. Unit to be manufactured by Atlas, Lowell, or Quam.
5. Quantities and locations for above materials as shown on plans.

2.5 GYMNASIUM LOCAL SOUND REINFORCEMENT SYSTEM

A. This specification is based on major products of recognized commercial and professional audio manufacturers. Major system components by Lowell, Biamp, Shure, and Williams, constitute the equipment quality, performance and reliability required for use on this project.
   1. Contractor is required to hire an audio/visual sub-contractor to provide and install a turn-key audio system based on the contract drawings. Basis of design vendor is Intellicom Systems Inc. 856-665-5366 or approved equal by the Engineer.
   2. AV sub-contractor shall provide all wiring, terminations, equipment, devices, programming, startup, testing and training for a complete and fully functional system.

B. Provide and install the following (or approved equal):
   1. Lowell LWR Series Sectional Wall Cabinet w/Locking Front Door, and.
   2. Shure UA221 Antenna Combiner.

C. Cabling.
   1. Provide the following cabling from Central Rack to device or other system as a minimum:
      a. Full-Range Ceiling Loudspeaker, 1-Pair Twisted 14 AWG.
      b. Microphone Receptacle, 1-Pair Tw/Shld'd 20 AWG.
      c. Wireless Microphone Antenna, RG58U (Vendor-Provided).
      d. Assisted Listening System Antenna, RG59.
      e. Bluetooth Receiver Antenna, RG178 (Vendor-Provided).
      f. Building Paging System Mute, 1-Pair Twisted 18 AWG.

PART 3 EXECUTION

3.1 INSTALLATION

A. Comply with installation instructions provided by system manufacturer. Provide type of cables

as shown on plans and schedules.

B. All wiring shall be plenum rated.

C. Install system to comply with drawings and final shop drawings in compliance with manufacturer's printed instructions.

D. Cable identification shall be provided on both ends of each cable and termination with the owner's room number and the wiring block or device to which it is connected. Tags shall be permanent and neat.

E. Furnish and install necessary conduit, raceways, pull boxes, outlet boxes and wire to provide a complete system or systems as herein specified. All wiring shall be tested for continuity and freedom of all grounds and short circuits.

F. All paging speaker cables shall be terminated on wall mounted 66M2-50 block(s) behind the PA rack location. Quick disconnect amphenol cables shall be used to connect punchblocks to rack components. There shall be no hard-wring to the rack.

G. Each cable run between the system rack and remote locations shall be one continuous cable. All cable shall be manufactured by Comscope, Belden, or West Penn. Intercommunications system cable shall not share conduit with any other system and shield conductors must be continuous and fully insulated from building ground.

H. The minimum cable size to utilized for all home-runs shall be 18/2 twisted, shielded, stranded, with plenum jacket.

I. The Contractor shall use the types of wire recommended by the Sound Equipment Manufacturer. However, the size and quality shall not be less than that previously specified or indicated on the drawings. If cross talk, appreciable loss of volume or distortion occurs after installation has been completed, it shall be the mutual responsibility of the Contractor and Manufacturer to correct any such condition without cost to the owner. The Contractor in no case shall use the type of wire which he merely assumes to be the best. This recommendation shall be from the equipment manufacturer.

J. Separations: Sound and voice cables shall be separated from power as follows: 6" from light fixtures, 12" from power conduits, and minimum 48" from motors/transformers.

3.2 DEMONSTRATION

A. Programming: Review system operation with designated Owner's representatives, and obtain written approval before system system final acceptance.

B. Subsequent to equipment termination, test the entire system and demonstrate proper functioning in accordance with requirements. Where necessary, correct malfunctioning units, and then retest to demonstrate compliance.

C. Documentation: Bind the test results and cable identification in a cable record book indexed for easy reference during future maintenance operations. Turn book over to the Owner's authorized representative upon completion of commissioning.
   1. Two (2) complete sets of operation and maintenance manuals and two (2) copies of as-built wiring plans shall be turned over to the Owner's representative at job closeout.

3.3 TRAINING

A. Upon completion of the PA system installation, arrange in service training of the system operation for personnel designated by the Owner. Provide a minimum of one two-hour session. Notify in writing through the Engineer, the Architect, and the Owner of the time and date the first demonstration will take place. Conduct a walking tour of the system.

B. Upon completion of the gymnasium local sound reinforcement system installation, arrange in service training of the system operation for personnel designated by the Owner. Provide a minimum of one two-hour session. Notify in writing through the Engineer, the Architect, and the Owner of the time and date the first demonstration will take place. Conduct a walking tour of the system.

3.4 WARRANTY

A. Warranty.
   1. Contractor shall warranty all new central and peripheral equipment for a period two (2) years against defects in material and workmanship.
   2. Warranty service shall be provided during normal working hours at no cost to Owner.

END OF SECTION

SECTION 276000

MASTER CLOCK SYSTEMS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections and Division 26.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Scope of work: New Sapling wireless master-clock system.
   1. Equipment:
      a. Wireless Repeater(s), if required.
      b. Secondary Wireless Analog Clocks, 120V.
      c. Control Relays, Network Cabling, etc. as required.

1.3 DEFINITIONS

A. Wireless Clock System. Spread-spectrum, frequency-hopping, license-free 900MHz wireless transmission protocol.

B. NTP - Network Time Protocol. Precise time synchronization derived from multiple, internet-based, time server websites.

1.4 SUBMITTALS

A. PRODUCT DATA.
   1. Submit complete product data for each component, describing physical characteristics and method of installation. Submit brochure with color card showing available colors and finishes of clocks. Color and finish choices to be selected by Owner prior to installation.

B. MANUFACTURER'S INSTRUCTIONS.
   1. Contractor shall provide Owner with complete installation, set-up and maintenance instructions.

C. SAMPLES.
   1. Submit one clock for approval.

D. LICENSE REQUIREMENTS.
   1. Sapling's low-power, master/repeater, "Mesh" architecture requires no FCC site licensing.

E. SHOP DRAWINGS.
   1. Submit shop drawings for approval to the Owner, prior to the start of work. The Contractor shall not start work until shop drawings have been approved, in writing, by the Owner.

F. CONSTRUCTION SCHEDULE.
   1. Prepare and issue a construction schedule to the Owner within ten working days following the Contract award. The Contractor shall be responsible for updating that schedule on a weekly basis.

1.5 REGULATORY REQUIREMENTS

A. Equipment and components furnished shall be of manufacturer's latest model.

B. Transmitter and receiver shall comply with Part 90 of FCC rules as follows:
   1. This device may not cause harmful interference, and.
   2. This device must accept interference received, including interference that may cause undesired operation.
   3. Transmitter frequency shall be governed by FCC Part 90.35.
   4. Transmitter output power shall be governed by FCC Part 90 257 (b).

C. System shall be installed in compliance with local and state authorities having jurisdiction.

1.6 CONDITIONS

A. The Contractor shall supply all necessary expansion components and field devices to provide a complete, fully functioning system.

B. The Contractor shall be permitted to use Subcontractors only upon written approval by the Owner.

C. The Contractor shall provide all items and work called for in this Specification, except as otherwise noted. This includes all incidentals, equipment, appliances, services, hoisting, scaffolding, supports, tools, supervision, labor, consumable items, fees, licenses, clean up and debris removal and any other items necessary to provide a complete, fully functional system.

D. Certain terms such as "shall, provide, install, complete, start up and cut over" 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.

E. It is the intent of these Specifications to provide expansion equipment, as needed, to support new clocks in renovated and new areas within the HS building. Any item not specifically called for in the Specification, but normally required to conform to the intent, is to be considered part of this Contract. Failure to understand the Specification, scope of work, project site or plans, does not exempt the Contractor from any additional required expense in

labor and materials that may be required to complete the project.

F. These Specifications are material, equipment and performance Specifications. Drawings shall govern actual installation. Any discrepancy between drawings and other documents shall require the Contractor to provide the larger quantity, or apply the more stringent requirement.

G. Any given item of material or equipment shall be the product of one manufacturer throughout the facility. Multiple manufacturers of any one item will not be permitted unless specifically noted and approved by the Owner.

H. Work shall be completed in accordance with phasing set up by the Owner.

I. The work called for under this Contract shall be carried on simultaneously with the work of other trades and Owner functions in such a manner as to not delay the overall progress of the construction project.

J. The Contractor shall perform all work necessary to meet all construction schedules.

K. The Contractor shall maintain a complete file of shop drawings that shall be available at all times to the Owner.

L. When directed by the Owner, the Contractor shall, without extra charge, make reasonable minor modifications in the layout of hardware as needed to prevent conflict with work of the trades, Owner functions, or for proper execution of the Contract.

1.7 QUALITY ASSURANCE

A. All materials used shall bear the Underwriters Laboratory, Inc. label, provided a standard has been established for the materials in question.

B. All products and materials shall be new and unused, clean, free of defects, and free of damage and corrosion.

C. The Contractor shall submit certified data from the respective manufacturers to the Owner to identify that all products furnished have been manufactured to all applicable Industry Standards.

D. The Contractor shall provide copies of all factory test documentation to the Owner.

E. If requested, the Contractor shall supply the Owner with documentation that it has experience in the installation of wireless clock systems.

F. All materials and work shall be in compliance with, or exceed, the minimum requirements of all current, in force, construction, seismic, electrical and technical codes, standards, regulations and guidelines, using the most stringent when more than one applies.

G. The installation shall comply with all applicable Town, County, State and Federal laws, ordinances, regulations and codes. Local electrical and building codes may be more restrictive than national codes or practices. The Contractor shall follow the most restrictive codes or

regulations.

H. Should a change in plans or Specifications be required to comply with the codes, standards, regulations or guidelines, the Contractor shall notify the Owner prior to installation. The Contractor must have a working knowledge of all applicable codes, standards, regulations and guidelines prior to the submission of their bid. Additional costs required for changes related to non-compliance of required codes, regulations, standards or guidelines shall be the responsibility of the Contractor.

I. The contractor shall be an established communications and electronics contractor that has had and currently maintains a locally run and operated business for at least three (3) years. The contractor shall utilize a duly authorized distributor of the equipment supplied for this project location with full manufacturer's warranty privileges. Intellicom Systems Inc., 856-665-5366, is the local, authorized Sapling distributor currently providing clock service and equipment for the District.

J. All items of equipment shall be designed by the manufacturer to function as a complete system and shall be accompanied by the manufacturer's complete service notes and drawings detailing all interconnections.

K. The contractor shall show satisfactory evidence, upon request, that the supplier maintains a fully equipped service organization capable of furnishing adequate inspection and service to the system. The supplier shall maintain at his facility the necessary spare parts in the proper proportion as recommended by the manufacturer to maintain and service the equipment being supplied.

L. Electrical Component Standard: Provide work complying with applicable requirements of NFPA 70 "National Electrical Code" including, but not limited to:
   1. Article 250, Grounding.
   2. Article 300, Part A. Wiring Method.
   3. Article 310, Conductors for General Wiring.
   4. Article 725, Remote Control, Signaling Circuits.
   5. Article 800, Communication Systems.

M. Installation and start-up of all systems shall be under the direct supervision of a local agency regularly engaged in installation, repair, and maintenance of such systems. The supplier shall be accredited by the proposed equipment manufacturers.

N. The agency providing equipment shall be responsible for providing all specified equipment and mentioned services for all equipment as specified herein. The agency must be a local authorized distributor of all specified equipment for single source of responsibility and shall provide documents proving such. The agency must provide written proof that the agency is adequately staffed with factory-trained technicians for all of the specified equipment. The agency must have established business for and currently be providing all services for the equipment.

O. The contractor shall guarantee availability of local service by factory-trained personnel of all specified equipment from an authorized distributor of all equipment specified under this section. Maintenance shall be provided at no cost to the purchaser for a period of one (1) year (parts and labor) from date of acceptance unless damage or failure is caused by misuse, abuse,

neglect, or accident. Additionally, all manufacturer supplied products must be covered by a two (2) year (parts only) limited warranty from the date of acceptance. The warranty period shall begin on the date of purchase by the owner/engineer.

P. The contractor shall, at the owner's request, make available a service contract offering continuing factory authorized service of the system after the initial warranty period.

Q. The supplier shall visit the sites and familiarize himself with the existing conditions and field requirements prior to submitting a proposal.

R. The contractor is responsible for all cost associated with proper installation, termination, configuration, programming, impedance and load matching of all system components.

S. The contractor shall provide all necessary masonry, covering, patching, and painting work in order to render any residue of the existing central equipment invisible. All finished surfaces shall be chosen in consultation with the Owner, to assure that the Owner's aesthetic preferences have been adhered to.

T. The following codes, standards, regulatory organizations and guidelines shall be adhered to during the construction period.
1. ADA AMERICAN DISABILITIES ACT.
2. ANSI AMERICAN NATIONAL STANDARDS INSTITUTE.
3. ASA AMERICAN STANDARDS ASSOCIATION.
4. ASTIM AMERICAN SOCIETY OF TESTING MATERIALS.
5. BICSI BUILDING INDUSTRY CONSULTING SERVICE INTERNATIONAL.
6. BOCA BUILDING OFFICIALS CONFERENCE OF AMERICA.
7. EIA ELECTRONIC INDUSTRIES ASSOCIATION.
8. EIC ELECTRONIC INDUSTRIES CODE.
9. ETL ELECTRICAL TESTING LABORATORIES, INC.
10. FCC FEDERAL COMMUNICATIONS COMMISSION.
11. IEEE INSTITUTE OF ELECTRICAL AND ELECTRONICS ENGINEERS.
12. IES ILLUMINATING ENGINEERING SOCIETY.
13. IPCEA INTERNATIONAL POWER CABLE ENGINEERS ASSOCIATION.
14. ISO INTERNATIONAL STANDARDS ORGANIZATION.
15. NEC NATIONAL ELECTRICAL CODE.
16. NEMA NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION.
17. NFPA NATIONAL FIRE PROTECTION ASSOCIATION.
18. NESC NATIONAL ELECTRICAL SAFETY CODE.
19. NTSC NATIONAL TELEVISION STANDARDS CODE.
20. OSHA OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION.
21. TIA TELECOMMUNICATION INDUSTRIES ASSOCIATION.
22. UL UNDERWRITERS LABORATORIES, INC.

1.8 WORK INCLUDED

A. The Contractor shall be responsible for all necessary wall, ceiling and floor penetrations. Bushed sleeves and fire stopping are required for all penetrations.

B. A complete set of drawings has been included with these Specifications. These documents

shall be followed unless specific exemptions are granted by the Owner.

C. The scope of work generally includes, but is not limited to the following:
   1. New 120V wireless secondary analog clocks.
   2. All required wiring shall be concealed in walls or ceilings, in innerduct or surface mounted raceway.
   3. Provide SPD protection for all cables entering the building from outside.
   4. Non-specified miscellaneous hardware such as nuts, bolts and cable ties, as required.
   5. All innerduct, core drilling and fire stopping, as required.
   6. Testing and preparation of test documentation as required.
   7. Preparation and submittal of manufacturers data, shop drawings, progress reports, and record drawings.
   8. Submit, subsequent to issuance of Contract, but prior to product ordering, manufacturers product data for all equipment being furnished and installed per this Contract.
   9. Any request for product substitutions must be accompanied by written justification and submitted to the Owner for approval prior to installation.
   10. Submit shop drawings within thirty working days after issuance of Contract documents. All drawings shall be submitted to the Owner for review and acceptance. All drawings shall be complete and contain all required information.
   11. The Contractor shall attend periodic progress meetings.

1.9 SPARE PARTS

A. Clocks: Provide 2% spare clocks of each type and size, with a minimum of 1.

1.10 DELIVERIES, STORAGE AND PROTECTION OF WORK AND PROPERTY

A. The Contractor shall coordinate the physical sizes of equipment to ensure passage through the delivery path.

B. The Contractor shall coordinate the delivery schedule with the construction schedule.

C. The Contractor shall be responsible for all hoisting and hoisting requirements.

D. The Contractor shall certify, in writing, that all materials received are free from defects and comply with the manufacturers specifications.

E. The Contractor shall be responsible for the protection and safekeeping of all his materials, tools and equipment.

F. It is the responsibility of the Contractor to take care in the storage of materials so as not to create a fire hazard, safety hazard or exceed any floor ratings.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following:
   1. Sapling (Basis of Design - no substitutions).

B. The project involves the expansion of the existing Sapling Wireless Clock System, currently serviced and maintained by Intellicom Systems Inc., 856-665-5366.

C. The intent of this specification is to establish a standard of quality, function and features. It is the responsibility of the bidder to insure that the proposed product meets or exceeds every standard set forth in these specifications and that all proposed equipment is completely compatible with existing equipment which is to remain.

D. The functions and features specified are vital to the operation of this facility, therefore, the acceptance of alternate manufacturers does not release the contractor from strict compliance with the requirements of this specification.

E. The Contractor for this work shall be held to have read all of the Bidding Requirements, the General Requirements, and Contract Proposal Forms; and in the execution of this work, he will be bound by all of the conditions and requirements therein.

F. The contractor shall be responsible for providing a complete functional system including all necessary components whether included in this specification or not.

G. In preparing the bid, the bidder should consider the following:
   1. No claim will be made against the owner for any costs incurred by the bidder for any equipment demonstrations which the owner requests.

H. Alternate equipment shall only be considered if it is 100% compatible with existing Sapling equipment. Supporting documentation must be submitted to the specifying authority at least ten (10) days prior to bid date. Submission of alternate equipment shall contain an original draft point by point comparison of the submitted product relative to the requirements of this specification, engineering drawings of the system, and specification sheets covering all components of the system as well as all items of Section 1 "SUBMITTALS". The devices and equipment drawings and specification sheet shall meet all items of the specification.

I. Proposed alternate equipment shall be accompanied by a letter from the manufacturer clearly stating the 100% compatibility requirement.

J. Any alternate equipment failing to comply with the aforementioned requirements shall be deemed as non-compliant.

2.2 SYSTEM REQUIREMENTS

A. Sapling wireless analog clock system expansion equipment and devices.

2.3 SYSTEM DESCRIPTION

A. The Sapling Wireless Clock System system is interfaced to the existing building Public Address system for transmission of class change signals as well as the District LAN for timebase synchronization and system administration.

B. Each new clock to be provided shall be a transceiver, capable of receiving and re-transmitting the wireless signal. This feature permits each clock to operate as a repeater, boosting the data stream coverage in a building. With this capability there shall be no limit on the number of clocks that can be used in the installation. All clocks are to automatically operate together without interference with each other. The system shall be capable of increasing the quality of the signal while increasing the quantity of the clocks.

C. The analog clocks shall the following mode of operation:
   1. 120 volts AC; the clock receives and re-transmits the time synchronization every minute.

D. All system clocks shall incorporate automatic time-base calibration to minimize deviation from each other.

E. The analog clock shall have a built-in closed-loop system that will allow the clock to detect the position of its hands and bring them to the correct time even if the hands were manually or forcefully moved.

F. The analog clock shall have a diagnostic function that will permits the user to view the quality of the signal, the period since the last time the clock signal was received, as well as functional tests of the electronics and the gears.

G. Master Clock/Transmitter.
   1. Master Clock, Sapling 3000 Series.

H. The Sapling Master Clock/Transmitter shall be, model SMA-3R0-1104-1.

I. Repeaters - There are two types of repeaters that are available for the wireless system, wireless and network-based. Provide as required for proper signal propagation.
   1. Wireless Repeater.

J. The repeater shall wirelessly transmit and receive data and be capable of transmitting to SAL analog clocks. The repeater shall operate on 915-928 MHz frequency-hopping technology. The repeater shall have a maximum antenna size of seven (7) inches and have an RF input sensitivity of -103 dbm. The repeater shall have an RF power output of 27 dbm. The voltage input for the repeater shall be 120 volts/60 Hz. Sapling Model SMA-1SR-0000-1.
   1. Network Repeater.

K. The repeater shall receive timebase information via TCP/IP from the SMA 3000 master clock. The repeater shall be capable of transmitting to SAL analog and SBL digital clocks. The repeater shall operate on 915-928 MHz frequency-hopping technology. The repeater shall have a maximum antenna size of seven (7) inches and have an RF input sensitivity of -103 dbm. The repeater shall have a RF power output of 27 dbm. The voltage input for the repeater shall be 120 volts/60 Hz. Sapling Model SMA-1SM-0000-1.
   1. Wireless Secondary Clocks.

L. The secondary clock shall be Sapling SAL Series wireless clock. The clock will be capable of receiving a signal from multiple clocks. The clock shall receive and transmit with 915-928 MHz frequency-hopping technology. The clock is to be capable of transmitting the time simultaneously without interfering with each other. The clocks shall include automatic calibration, as well as a diagnostic function that allows the user to view the quality of the signal, the last time the clock received a correction signal, a gearbox test and a comprehensive analysis of the entire clock. The clock shall have a maximum correction time of five (5) minutes. It shall be designed to be used with the Sapling Transceiver or the Sapling Repeater, which can be regulated via Sapling wireless communication protocol. Upon receipt of the wireless signal, the clock will immediately self-correct. The clock shall have a semi-flush smooth surface ABS case. The dial is to be made of durable polystyrene material. The crystal is to be shatterproof, side molded polycarbonate. Glass and visible molding marks are unacceptable. The clock shall have black hour and minute hands as well as a red second hand and be 12" or 16" diameter with/without wireguard as indicated. The clock shall be FCC compliant, part 15 Section 15,247 and operate on 120V power. Sapling model SAL-4BS-12R-14.

PART 3 EXECUTION

3.1 WIRELESS CLOCK INSTALLATION

A. GENERAL.
1. The Contractor shall follow manufacturer's instructions for installing, connecting and adjusting components and associated hardware of the wireless clock system.
2. The Contractor shall be responsible for providing adequate protection of equipment before and after installation.
3. The Contractor shall be responsible for clean up of debris on a daily basis. Cost of clean up shall be the responsibility of the Contractor.
4. The locations of structural and architectural features indicated on the drawings are approximate. The Contractor shall verify the existence, locations and suitability of such items and shall make all revisions necessary to provide a fully functional installation.
5. Cable runs shall be concealed in walls, ceilings, conduits or surface mounted raceways. All labor and material costs necessary to conceal cable runs shall be included in the Contractor's bid.
6. The Contractor shall restore fire ratings to all wall, floor and ceiling penetrations made during the installation of the wireless clock system.
7. Equipment shall comply with all applicable FCC rules.
8. Install equipment in accordance with manufacturer's written instructions.

B. Wiring Methods:
1. Each clock shall be local-powered with 120VAC with a regressed receptacle. Refer to project plans for specific locations and power requirements.
2. Conceal wiring except in unfinished spaces.
3. Any new wiring on this project must be properly rated for the application.
4. Cable to the new devices at new locations, if any, shall be installed in a neat and workmanlike manner, following the standard procedures used in the electrical contracting trade.
5. Exposed wiring will not be permitted under any circumstances on this project.

3.2 TRAINING

A. The Contractor shall provide training for the Wireless Clock System with the Owner and its designated employees. The time for this training is to be agreed upon between the Owner and the Contractor at the completion of the system installation. Training shall include general operation & administrative instructions as well as maintenance requirements.

B. The Contractor shall provide the Owner with all system manuals.

3.3 TEST AND ACCEPTANCE

A. At completion of installation and prior to final acceptance, the Contractor shall confirm that all new equipment is functioning properly.

B. At completion of installation and prior to final acceptance, the Contractor shall clean exposed surfaces of clocks, using cleaning methods recommended by the manufacturer.

C. The Contractor shall notify the Owner at least three working days prior to the date when system testing is to begin. The Owner reserves the right to observe and/or participate in system testing. The Contractor shall be required to retest at his expense if written notification is not given.

D. Upon installation completion, a room-by-room test shall be conducted for every device in the system. A technician shall perform the test after school hours, and repairs shall be performed as needed at no cost to the Owner to any devices, which do not function correctly, including cable. A written room-by-room report following testing and repairs shall be prepared and submitted to the Engineer.

E. Rectify deficiencies indicated by tests and completely re-test work affected by such deficiencies at the Contractor's expense.

3.4 WARRANTY

A. The Contractor shall submit a single Guarantee stating all portions of the work are in accordance with the Contract requirements. The Contractor shall guarantee all work against faulty and improper material and workmanship, including work and materials of all subcontractors, manufacturers, suppliers and sub-trade specialists for a period of two (2) years (parts and labor) from date of acceptance unless damage or failure is caused by misuse, abuse, neglect, or accident. Additionally, all manufacturer supplied products must be covered by a two (2) year (parts only) limited warranty from the date of acceptance.

B. Where guarantees or warranties for longer terms are provided, such longer terms shall apply.

C. Within 24 hours of notification, the Contractor shall correct any deficiencies that occur during the guarantee period, at no additional cost to the Owner and to the satisfaction of the Owner.

END OF SECTION

SECTION 284700

COMBINATION FIRE ALARM MASS NOTIFICATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this and the other sections of Division 26.

B. Requirements specified in all other sections of Division 26 apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section covers fire alarm voice evacuation systems, including initiating devices, notification appliances, controls, and supervisory devices.

D. 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.

E. Provide and install new digital addressable fire alarm panels with new Digital Voice Communicator (ECC), remote annunciator and microphone panel, speaker notification appliances, initiation devices, cellular and IP DACT, and all associated wiring, programming, and testing for a complete system.

F. The complete installation is to conform to the applicable sections of NFPA-72, NFPA 90A, Local Code Requirements and National Electrical Code with particular attention to Article 760. Additionally, the entire installed system and all integrated system operations shall be within the guidelines of the 2021 ICC code series and ANSI A117.1, including all the latest revisions.

G. Provide system modifications suitable for type occupancy as defined by local Building Code and as approved by local Fire Marshal. Prior to commencing the construction work, contact the local Fire Marshal, and obtain all the necessary approvals.

H. New fire alarm system shall be completely installed and tested prior to demo of existing fire alarm system. Existing fire alarm system to be maintained until new fire alarm system is approved.

I. Provide cellular and IP-based DACT communication equipment for required offsite monitoring.

1.3 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following or approved equal satisfying the requirements stipulated in paragraph 1.2(C) in this specification section:
   1. Fire-Lite (Basis of Design).
   2. Silent Knight 6820EVS.
   3. Or approved equal by Engineer.

1.4 CODES

A. The system and all associated operations shall be in accordance with the following:
   1. Guidelines of the following Building Code: IBC 2021.
   2. NFPA 72, National Fire Alarm Code 2019.
   3. NFPA 70, National Electrical Code 2020.
   4. NFPA 101, Life Safety Code.
   5. NFPA 90A, Standard for the Installation of Air Conditioning and Ventilating Systems.
   6. Other applicable NFPA standards.
   7. Local Jurisdictional Adopted Codes and Standards.
   8. ADA Accessibility Guidelines.

1.5 SYSTEM DESCRIPTION

A. General: Provide a complete, non-coded, addressable, microprocessor-based fire alarm system with voice evacuation, initiating devices, notification appliances, and monitoring and control devices as indicated on the drawings and as specified herein.

B. Software: The fire alarm system shall allow for loading and editing instructions and operating sequences as necessary. The system shall be capable of 100% on-site programming to accommodate system expansion and facilitate changes in operation. All programming shall be capable of being accomplished via the front panel and via a lap top computer. All software operations shall be stored in a non-volatile programmable memory within the FACP. Loss of primary and secondary power shall not erase the instructions stored in memory.

C. History Logs: The system shall provide a means to recall alarms and trouble conditions in chronological order for the purpose of recreating an event history. Separate alarm, supervisory and trouble logs shall be provided.

D. Wiring/Signal Transmission:
   1. Transmission shall be addressable signal transmission, dedicated to fire alarm service only.
   2. System connections for initiating (signaling) circuits and notification appliance circuits shall be Class B.

3. Circuit Supervision: Circuit faults shall be indicated by a trouble signal at the FACP. Provide a distinctive indicating audible tone and alphanumeric annunciation.

E. Remote Access:
1. FACP shall have the capability to provide Remote Access through a cellular modem. The cellular equipment and 2-year of cellular service are to be included in the bid contract.
2. A personal computer or technician's laptop, configured with terminal emulation software shall have the ability to access the FACP for diagnostics, maintenance reporting and information gathering.
3. FACP shall provide access via IP DACT card via Owner’s Ethernet network.
4. Cellular dialer shall be equal to Telguard model TG-7FS, or approved equal. Coordinate with Owner prior to purchase whether AT&T or Verizon service is preferred.

F. Required Functions: The following are required system functions and operating features:
1. Priority of Signals: Alarm events have highest priority. Subsequent alarm events are queued in the order received and do not affect existing alarm conditions. Supervisory and Trouble events have second-, and third-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: The activation of an addressable device does not prevent the receipt of signals from subsequent activations.
3. Transmission to Remote Central Station: Automatically route alarm, supervisory, and trouble signals to a remote central station service transmitter provided under another contract.
4. Annunciation: Operation of alarm and supervisory initiating devices shall be annunciated at the FACP and any required remote annunciators, indicating the location and type of device.
5. General Alarm: A system general alarm shall include:
   a. Indication of alarm condition at the FACP and any required remote annunciator(s).
   b. Identification of the device that is the source of the alarm at the FACP and any required remote annunciator(s).
   c. Sound all audible speaker appliances with a prerecorded message. Audible devices shall have the ability to be silenced. The speaker devices shall meet all audibility requirements and provide a minimum of 15 decibels above the ambient sound level. Speaker devices shall also meet the requirements of an intelligible voice system per NFPA 72 2016 edition.
   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. Initiation of smoke control sequence.
   i. Notifying the local fire department.
   j. Initiation of elevator recall in accordance with ASME/ANSI A17.1, when specified sensors are activated.
6. Supervisory Operations: Upon activation of a supervisory device such as fire pump power failure, low air pressure switch, and tamper switch, the system shall operate as follows:
   a. Activate the system supervisory service audible signal and illuminate the LED at the

FACP 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 FACP historical log.
d. Transmission of supervisory signal to remote central station.

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. Drill: A manual evacuation (drill) switch shall be provided to initiate an alarm on the FACP.
10. Manual Control: Manual controls shall be supervised so that an "off normal" position of any switch shall cause an "off normal" system trouble. The "off normal" status shall be clearly identified in plain-language on the FACP alphanumeric display.
    a. Manual Bypass Control: The ability to perform a manual bypass of selected automatic functions shall be provided.
    b. Circuit Enable/Disable Control: The system shall have provisions for disabling and enabling each circuit individually for maintenance or testing purposes.
11. WALKTEST: The system shall have a one person test feature. Enabling the one person test feature at the FACP shall activate the "One Person Testing" mode of the system as follows:
    a. The city circuit connection and suppression release circuits shall be bypassed for the testing group.
    b. Control relay functions associated to the testing group shall be bypassed.
    c. The FACP shall indicate a trouble condition.
    d. The alarm activation of any initiation device in the testing group shall cause the audible notification appliances to sound a code to identify the device.
    e. The control panel shall automatically reset itself after signaling is complete.
    f. Any momentary opening of an initiating or notification appliance circuit wiring shall cause the audible signals to sound for 4 seconds indicating the trouble condition.

G. Duct Smoke Detector: Activation of a duct smoke detector shall initiate a supervisory alarm at the system control panel and at the remote annunciator. Duct smoke detector activation shall also initiate an air handler unit shutdown as required by NFPA 90A.

H. Audible Alarm Notification: By horns in areas as indicated on drawings.

I. Power Requirements.
1. The control panel shall receive AC power via a dedicated circuit breaker.
2. The system shall be provided with sufficient battery capacity to operate the entire system upon loss of normal AC power in a normal supervisory mode for a period of 24 hours with 5 minutes of alarm operation at the end of this period. The system shall automatically transfer to battery standby upon power failure. All battery charging and

recharging operations shall be automatic.

3. All circuits requiring system-operating power shall be 24 VDC and shall be individually fused at the control panel.
4. The incoming power to the system shall be supervised so that any power failure will be indicated at the control panel. A green "power on" LED shall be displayed continuously while incoming power is present.
5. The system batteries shall be supervised so that a low battery condition or disconnection of the battery shall be indicated at the control panel.
6. The system shall support 100% of addressable devices in alarm operated at the same time, under both primary (AC) and secondary (battery) power conditions.
7. Loss of primary power shall sound a trouble signal at the FACP. FACP shall indicate when the system is operating on an alternate power supply.

1.6 SUBMITTALS

A. General: Submit the following according to Conditions of Contract and Division 01 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: Provide shop drawings showing equipment/device locations and connecting wiring of entire fire alarm system. Include wiring and riser diagrams, the candela values for all strobes and full battery & voltage drop calculations for the system. The shop drawings for the fire alarm system shall be performed and signed by a licensed professional engineer in the State of Pennsylvania. These shall be submitted to the authority having jurisdiction along with a letter of approval from the engineer of record on the design team.
4. Scaled Drawings showing the intelligible speaker layout with all ADS (Acoustically Distinguishable Spaces) locations.
5. System Power and battery charts with performance graphs and voltage drop calculations to assure that the system will operate per the prescribed backup time periods and under all voltage conditions per all applicable standards.
6. Provide copies of NICET Level II Fire Alarm certifications for the technicians assigned to this project.
7. 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 SLC, NAC, RAC, Sensor, and auxiliary control circuits.
8. Operating instructions for FACP.
9. 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.
10. Record of field tests of system.
11. Record Shop Drawings: A final fire alarm shop drawing as-built will be required for each

building at the completion of construction. This as-built must show all devices, their address (NAC or SLC) and the wiring configuration; wiring configuration means to show the notification and initiation wiring sequence from device to device, not the actual wiring location in the building. The goal is to have an accurate shop drawing showing how the fire alarm system is wired in the building.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A factory authorized installer is to perform the work of this section.

B. The equipment and installation supervision furnished under this specification is to be provided by a manufacturer who has been engaged in production of this type (software driven) of equipment for at least ten (10) years, and has a fully-equipped service organization within fifty (50) miles of the installation capable of providing immediate emergency service response.

C. The system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.

D. Installer's Qualifications: Firm with at least 5 years of successful installation experience on projects with fire alarm systems work similar to that required for this project. At least one NICET Level 2 technician shall be on site at all times during the fire alarm installation. The installer shall have a NICET Level 3 technician visit the site at least one time per week during the fire alarm installation to review and approve the installation.
   1. Firm with manufacturer’s factory trained personnel.
   2. Firm with factory authorized service organization and spare parts stock.
   3. All control equipment must have transient protection devices to comply with UL 864 requirements. In addition to the UL-UOJZ requirement mentioned above, the system controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760-23.

E. Each and all items of the Fire Alarm System shall be listed as a product of a single fire alarm system manufacturer under the appropriate category by Underwriters Laboratories, Inc. (UL), and shall bear the "UL" label.

1.8 EXTRA MATERIALS

A. General: Furnish extra materials, packaged with protective covering for storage, and identified with labels clearly describing contents as follows. Refer to contract drawings for list of spare parts, equipment, and labor to be included in the base contract.

1.9 WARRANTY

A. The Contractor shall provide the Owner with a 2-year warranty on all materials, labor and systems from the date of Substantial Completion. The date of Substantial completion will be as set in a letter issued by the Architect - no exceptions.

B. During the course of the 2-year warranty period, the contractor shall provide a full service contract, including all labor and materials. In addition, the contractor shall provide full NFPA 72 required testing and maintenance services during the 2-year warranty period including semi-annual and annual NFPA-72 testing and certification requirements. NFPA 72 testing and maintenance certified reports shall be submitted to the Owner for record.

PART 2 PRODUCTS

2.1 COMBINATION FIRE ALARM - MASS NOTIFICATION CONTROL PANEL (FACP) FIRE-LITE BY HONEYWELL ES-200X

A. General: Comply with UL 864, "Control Panels for Fire-Protective Signaling Systems."

B. Main FACP or network node shall be a Fire-Lite ES-200X and shall contain a microprocessor based Central Processing Unit (CPU) and power supply in an economical space saving single board design. The CPU shall communicate with and control the following types of equipment used to make up the system: intelligent addressable smoke and thermal (heat) detectors, addressable modules, printer, annunciators, and other system controlled devices.

C. Operator Control.
   1. Acknowledge Switch:
      a. Activation of the control panel acknowledge switch in response to new alarms and/or troubles shall silence the local panel piezo electric signal and change the alarm and trouble LEDs from flashing mode to steady-ON mode. If multiple alarm or trouble conditions exist, depression of this switch shall advance the LCD display to the next alarm or trouble condition.
      b. Depression of the Acknowledge switch shall also silence all remote annunciator piezo sounders.
   2. Alarm Silence Switch:
      a. Activation of the alarm silence switch shall cause all programmed alarm notification appliances and relays to return to the normal condition after an alarm condition. The selection of notification circuits and relays that are silenceable by this switch shall be fully field programmable within the confines of all applicable standards. The FACP software shall include silence inhibit and auto-silence timers.
   3. Alarm Activate (Drill) Switch:
      a. The Alarm Activate switch shall activate all notification appliance circuits. The drill function shall latch until the panel is silenced or reset.
   4. System Reset Switch:
      a. Activation of the System Reset switch shall cause all electronically-latched initiating devices, appliances or software zones, as well as all associated output devices and circuits, to return to their normal condition.

5. Lamp Test:
    a. The Lamp Test switch shall activate all local system LEDs, light each segment of the liquid crystal display and display the panel software revision for service personal.

D. System Capacity and General Operation.
1. The control panel or each network node shall provide, or be capable of expansion to 198 intelligent/addressable devices.
2. The control panel or each network node shall include Form-C alarm, trouble, supervisory, and security relays rated at a minimum of 2.0 amps @ 30 VDC.
3. It shall also include four Class A (NFPA Style Z) programmable Notification Appliance Circuits.
4. The Notification Appliance Circuits shall be programmable to Synchronize with System Sensor, Gentex and Wheelock Notification Appliances.
5. The system shall include a full featured operator interface control and annunciation panel that shall include a backlit Liquid Crystal Display (LCD), individual color coded system status LEDs, and an alphanumeric keypad with easy touch rubber keys for the field programming and control of the fire alarm system.
6. The system shall be programmable, configurable, and expandable in the field without the need for special tools, PROM programmers or PC based programmers. It shall not require replacement of memory ICs to facilitate programming changes.
7. The system shall allow the programming of any input to activate any output or group of outputs. Systems that have limited programming (such as general alarm), have complicated programming (such as a diode matrix), or require a laptop personal computer are not considered suitable substitutes.
8. The FACP shall support up to 20 logic equations, including "and," "or," and "not," or time delay equations to be used for advanced programming. Logic equations shall require the use of a PC with a software utility designed for programming.
9. The FACP or each network node shall provide the following features:
    a. Drift compensation to extend detector accuracy over life. Drift compensation shall also include a smoothing feature, allowing transient noise signals to be filtered out.
    b. Detector sensitivity test, meeting requirements of NFPA 72.
    c. Maintenance alert, with two levels (maintenance alert/maintenance urgent), to warn of excessive smoke detector dirt or dust accumulation.
    d. Nine sensitivity levels for alarm, selected by detector. The alarm level range shall be.5 to 2.35 percent per foot for photoelectric detectors and 0.5 to 2.5 percent per foot for ionization detectors. The system shall also support sensitive advanced detection laser detectors with an alarm level range of.02 percent per foot to 2.0 percent per foot. The system shall also include up to nine levels of Prealarm, selected by detector, to indicate impending alarms to maintenance personnel.
    e. The ability to display or print system reports.
    f. Alarm verification, with counters and a trouble indication to alert maintenance personnel when a detector enters verification 20 times.
    g. PAS presignal, meeting NFPA 72 requirements.
    h. Rapid manual station reporting (under 3 seconds) and shall meet NFPA 72 requirements for activation of notification circuits within 10 seconds of initiating device activation.
    i. Periodic detector test, conducted automatically by the software.
    j. Self optimizing pre-alarm for advanced fire warning, which allows each detector to learn its particular environment and set its prealarm level to just above normal

peaks.

k. Cross zoning with the capability of counting: two detectors in alarm, two software zones in alarm, or one smoke detector and one thermal detector.
l. Walk test, with a check for two detectors set to same address.
m. Control-by-time for non-fire operations, with holiday schedules.
n. Day/night automatic adjustment of detector sensitivity.
o. Device blink control for sleeping areas.

10. The FACP shall be capable of coding main panel node notification circuits in March Time (120 PPM), Temporal (NFPA 72), and California Code. Panel notification circuits (NAC 1, 2, 3 and 4) shall also support Two-Stage operation, Canadian Dual Stage (3 minutes) and Canadian Dual Stage (5 minutes). Two stage operation shall allow 20 Pulses Per Minute (PPM) on alarm and 120 PPM after 5 minutes or when a second device activates. Canadian Dual stage is the same as Two-Stage except will only switch to second stage by activation of Drill Switch 3 or 5 minute timer. The panel shall also provide a coding option that will synchronize specific strobe lights designed to accept a specific "sync pulse."
11. Network Communication.
    a. The FACP shall be capable of communicating on a Local Area Network (LAN), a firmware package that utilizes a peer-to-peer, inherently regenerative communication format and protocol.
12. Minimum spare capacity on the SLC and NAC loops: 25% spare capacity for future devices on each loop.

E. Central Microprocessor.
1. The microprocessor shall be a state-of-the-art, high speed, 16-bit RISC device and it shall communicate with, monitor and control all external interfaces. It shall include an EPROM for system program storage, Flash memory for building-specific program storage, and a "watch dog" timer circuit to detect and report microprocessor failure.
2. The microprocessor shall contain and execute all control-by-event programs for specific action to be taken if an alarm condition is detected by the system. Control-by-event equations shall be held in non-volatile programmable memory, and shall not be lost even if system primary and secondary power failure occurs.
3. The microprocessor shall also provide a real-time clock for time annotation of system displays, printer, and history file. The time-of-day and date shall not be lost if system primary and secondary power supplies fail. The real time clock may also be used to control non-fire functions at programmed time-of-day, day-of-week, and day-of-year.
4. A special program check function shall be provided to detect common operator errors.
5. An auto-program (self-learn) function shall be provided to quickly install initial functions and make the system operational.
6. For flexibility and to ensure program validity, an optional Windows(TM) based program utility shall be available. This program shall be used to off-line program the system with batch upload/download, and have the ability to upgrade the manufacturers (FLASH) system code changes. This program shall also have a verification utility, which scans the program files, identifying possible errors. It shall also have the ability to compare old program files to new ones, identifying differences in the two files to allow complete testing of any system operating changes. This shall be in incompliance with the NFPA 72 requirements for testing after system modification.

F. System Display.
   1. The display shall annunciate status information and custom alphanumeric labels for all intelligent detectors, addressable modules, internal panel circuits, and software zones.
   2. The 640-character display shall provide 11 Light-Emitting-Diodes (LEDs), that indicate the status of the following system parameters: AC POWER, FIRE ALARM, PREALARM WARNING, SECURITY ALARM, SUPERVISORY EVENT, SYSTEM TROUBLE, ALARM SILENCED, DISABLED POINTS, OTHER EVENTS, CPU FAILURE and Controls Active.
   3. The display shall have QWERTY type keypad.
      a. The 80-character display. Full programming access shall require use of a laptop and the proper programming utility.

G. Signaling Line Circuits (SLC).
   1. Each FACP or FACP network node shall support up to two SLCs. Each SLC interface shall provide power to and communicate with up to 99 intelligent detectors (ionization, photoelectric or thermal) and 99 intelligent modules (monitor or control) for a loop capacity of 198 devices.
   2. CPU shall receive analog information from all intelligent detectors to be processed to determine whether normal, alarm, prealarm, or trouble conditions exist for each detector. The software shall automatically maintain the detector's desired sensitivity level by adjusting for the effects of environmental factors, including the accumulation of dust in each detector. The analog information shall also be used for automatic detector testing and for the automatic determination of detector maintenance requirements.

H. Serial Interfaces.
   1. The system shall include two serial EIA-232 interfaces. Each interface shall be a means of connecting UL Listed Information Technology Equipment (ITE) peripherals.
      a. The EIA-485 interface may be used for network connection to a proprietary-receiving unit.

I. Emergency Command Center.
   1. The Emergency Command Center located with the FACP, shall contain all equipment required for all audio control, emergency telephone system control, signaling and supervisory functions. This shall include speaker zone indication and control, telephone circuit indication and control, digital voice units, microphone and main telephone handset. The ECC shall support up to 8 channels of voice when configured with Digital Audio Amplifiers and 4 channels of voice when employing the optional analog output card. Each ECC shall support up to 32 digital audio amplifiers.
   2. Function: The Voice Command Center equipment shall perform the following functions:
      a. Operate as a supervised multi-channel emergency voice communication system.
      b. Audibly and visually annunciate the active or trouble condition of every speaker circuit and emergency telephone circuit.
      c. Audibly and visually annunciate any trouble condition for digital tone and voice units required for normal operation of the system.
      d. Provide all-call Emergency Paging activities through activation of a single control switch.
      e. As required, provide vectored paging control to specific audio zones via dedicated control switches.
      f. Provide a factory recorded "library" of voice messages and tones in standard WAV.

File format, which may be edited and saved on a PC running a current Windows® operating system.

g. Provide a software utility capable of off-line programming for the ECC operation and the audio message files. This utility shall support the creation of new programs as well as editing and saving existing program files. Uploading or downloading the ECC shall not inhibit the emergency operation of other nodes on the fire alarm network.
h. Support an optional mode of operation with four analog audio outputs capable of being used with UL 864 fire-listed analog audio amplifiers and SCL controlled switching.
i. The Emergency Command shall be modular in construction, and shall be capable of being field programmable without requiring the return of any components to the manufacturer and without requiring use of any external computers or other programming equipment.
j. The Emergency Command and associated equipment shall be protected against unusually high voltage surges or line transients.

J. Audio Amplifiers.
1. The Audio Amplifiers will provide Audio Power (@25 Volt RMS or 70 RMS) for distribution to speaker circuits.
2. Multiple audio amplifiers may be mounted in a single enclosure, either to supply incremental audio power, or to function as an automatically switched backup amplifier(s).
3. The audio amplifier shall include an integral power supply, and shall provide built-in LED indicators for the following conditions:
a. Earth Fault on DAP A (Digital Audio Port A).
b. Earth Fault on DAP B (Digital Audio Port B).
c. Audio Amplifier Failure Detected Trouble.
d. Active Alarm Bus input.
e. Audio Detected on Aux Input A.
f. Audio Detected on Aux Input B.
g. Audio Detected on Firefighter's Telephone Riser.
h. Receiving Audio from digital audio riser.
i. Short circuit on speaker circuit 1.
j. Short circuit on speaker circuit 2.
k. Short circuit on speaker circuit 3.
l. Short circuit on speaker circuit 4.
m. Data Transmitted on DAP A.
n. Data Received on DAP A.
o. Data Transmitted on DAP B.
p. Data Received on DAP B.
q. Board failure.
r. Active fiber optic media connection on port A (fiber optic media applications).
s. Active fiber optic media connection on port B (fiber optic media applications).
t. Power supply Earth Fault.
u. Power supply 5V present.
v. Power supply conditions - Brownout, High Battery, Low Battery, Charger Trouble.
4. The audio amplifier shall provide the following built-in controls:
a. Amplifier Address Selection Switches.
b. Signal Silence of communication loss annunciation Reset.

c. Level adjustment for background music.
d. Enable/Disable for Earth Fault detection on DAP A.
e. Enable/Disable for Earth Fault detection on DAP A.
f. Switch for 2-wire/4-wire FFT riser.

5. Adjustment of the correct audio level for the amplifier shall not require any special tools or test equipment.
6. Includes audio input and amplified output supervision, back up input, and automatic switch over function, (if primary amplifier should fail).
7. System shall be capable of backing up digital amplifiers.
8. One-tone backup shall be provided by either a plug-in-amplifier card or a designated backup amplifier of identical model as the primary amplifier.
9. One designated backup amplifier shall be capable of backing up multiple primary amplifiers mounted in the same or adjacent cabinets.
10. Multi-channel operation from a single amplifier shall be supported by the addition of an optional plug-in amplifier card.

K. Audio Message Generator (Prerecorded Voice)/Speaker Control:
1. Each initiating zone or intelligent device shall interface with an emergency voice communication system capable of transmitting a prerecorded voice message to all speakers in the building.
2. Actuation of any alarm initiating device shall cause a prerecorded message to sound over the speakers. The message shall be repeated four (4) times. Pre- and post-message tones shall be supported.
3. A built-in microphone shall be provided to allow paging through speaker circuits.
4. System paging from emergency telephone circuits shall be supported.
5. The audio message generator shall have the following indicators and controls to allow for proper operator understanding and control:
a. LED Indicators:
b. Lamp Test.
c. Trouble.
d. Off-Line Trouble.
e. Microphone Trouble.
f. Phone Trouble.
g. Busy/Wait.
h. Page Inhibited.
i. Pre/Post Announcement Tone.

L. Controls with associated LED Indicators:
1. Speaker Switches/Indicators.
a. The speaker circuit control switches/indicators shall include visual indication of active and trouble status for each speaker circuit in the system.
b. The speaker circuit control panel shall include switches to manually activate or deactivate each speaker circuit in the system.

M. Enclosures:
1. The control panel shall be housed in a UL-listed cabinet suitable for surface or semi-flush mounting. The cabinet and front shall be corrosion protected, given a rust-resistant prime coat, and manufacturer's standard finish.
2. The back box and door shall be constructed of 0.060 steel with provisions for electrical

conduit connections into the sides and top.

3. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators. For convenience, the door may be site configured for either right or left hand hinging.

N. Power Supply:
   1. A high tech off-line switching power supply shall be available for the fire alarm control panel or network node and provide 6.0 amps of available power for the control panel and peripheral devices.
   2. Provisions will be made to allow the audio-visual power to be increased as required by adding modular expansion audio-visual power supplies.
   3. Positive-Temperature-Coefficient (PTC) thermistors, circuit breakers, or other over-current protection shall be provided on all power outputs. The power supply shall provide an integral battery charger for use with batteries up to 55 AH or may be used with an external battery and charger system. Battery arrangement may be configured in the field.
   4. The power supply shall continuously monitor all field wires for earth ground conditions, and shall have the following LED indicators:
      a. Ground Fault LED.
      b. AC Power Fail LED.
      c. NAC on LED (4).
   5. The main power supply shall operate on 120 VAC, 60 Hz, and shall provide all necessary power for the FACP.
   6. The main power supply shall provide a battery charger using dual-rate charging techniques for fast battery recharge and be capable of charging batteries up to 200 AH.
   7. All circuits shall be power-limited, per UL864 requirements.

O. Auxiliary Field Power Supply - Addressable.
   1. The auxiliary addressable power supply is a remote 24 VDC power supply used to power Notification Devices and field devices that require regulated 24VDC power. The power supply shall also include and charge backup batteries.
   2. The addressable power supply for the fire alarm system shall provide up a minimum of 6.0 amps of 24 volt DC regulated power for Notification Appliance Circuit (NAC) power or 5 amps of 24 volt DC general power. The power supply shall have an additional.5 amp of 24 VDC auxiliary power for use within the same cabinet as the power supply. It shall include an integral charger designed to charge 7.0 - 25.0 amp hour batteries.
   3. The addressable power supply shall provide four individually addressable Notification Appliance Circuits that may be configured as two Class "A" and two Class "B" or four Class "B" only circuits. All circuits shall be power-limited per UL 864 requirements.
   4. The addressable power supply shall provide built-in synchronization for certain Notification Appliances on each circuit without the need for additional synchronization modules. The power supply's output circuits shall be individually selected for synchronization. A single addressable power supply shall be capable of supporting both synchronized and non-synchronized Notification Devices at the same time.
   5. The addressable power supply shall operate on 120 or 240 VAC, 50/60 Hz.
   6. The interface to the power supply from the Fire Alarm Control Panel (FACP) shall be via the Signaling Line Circuit (SLC) or other multiplexed means Power supplies that do not use an intelligent interface are not suitable substitutes. The required wiring from the FACP to the addressable power supply shall be a single unshielded twisted pair wire. Data on the SLC shall be transmitted between 24 VDC, 5 VDC and 0 VDC at

approximately 3.33k baud.

7. The addressable power supply shall supervise for battery charging failure, AC power loss, power brownout, battery failure, NAC loss, and optional ground fault detection. In the event of a trouble condition, the addressable power supply shall report the incident and the applicable address to the FACP via the SLC.
8. The addressable power supply shall have an AC Power Loss Delay option. If this option is utilized and the addressable power supply experiences an AC power loss, reporting of the incident to the FACP will be delayed. A delay time of eight or sixteen hours shall be Dip-switch selected.
9. The addressable power supply shall have an option for Canadian Trouble Reporting and this option shall be Dip-switch selectable.
10. The addressable power supply mounts in either the FACP backbox or it's own dedicated surface mounted backbox with cover.
11. Each of the power supply's four output circuits shall be DIP-switch selected for Notification Appliance Circuit or General Purpose 24 VDC power. Any output circuit shall be able to provide up to 2.5 amps of 24 VDC power.
12. The addressable power supply's output circuits shall be individually supervised by the use of and end-of-line resistor. When the power supply's output circuit is selected as General 24VDC power, the circuit shall be individually supervised when an end-of-line relay is used.
13. When selected for Notification Appliance Circuits, the output circuits shall be individually DIP-switch selectable for Steady, March Time, Dual Stage or Temporal.
14. When selected as a Notification Appliance Circuit, the output circuits of the addressable power supply shall have the option to be coded by the use of a universal zone coder.
15. The addressable power supply shall interface and synchronize with other power supplies of the same type. The required wiring to interface multiple addressable power supplies shall be a single unshielded, twisted pair wire.
16. An individual or multiple interfaced addressable power supplies shall have the option to use an external charger for battery charging. Interfaced power supplies shall have the option to share backup battery power.

2.2 REMOTE LCD ANNUNCIATOR FIRELITE ANN-80 SERIES

A. Provide Remote LCD Annunciator(s) as required with the same "look and feel" as the FACP operator interface. The Remote LCD Annunciator shall use the same Primary Acknowledge, Silence, and Reset Keys, Status LEDs and LCD Display as the FACP.

B. Annunciator shall have super-twist LCD display with two lines of 40 characters each. Annunciator shall be provided with three (3) programmable LEDs (two selectable as red or yellow; one selectable as green or yellow).

C. Under normal conditions the LCD shall display a "SYSTEM IS NORMAL" message and the current time and date.

D. Should an abnormal condition be detected the appropriate LED (Alarm, Supervisory or Trouble) shall flash. The unit audible signal shall pulse for alarm conditions and sound steady for trouble and supervisory conditions.

E. The LCD shall display the following information relative to the abnormal condition of a point in the system:
   1. 40 character custom location label.
   2. Type of device (e.g., smoke, pull station, waterflow).
   3. Point status (e.g., alarm, trouble).

F. Operator keys shall be key switch enabled to prevent unauthorized use. The key shall only be removable in the disabled position. Acknowledge, Silence and Reset operation shall be the same as the FACP.

G. Where indicated on drawings, provide remote annunciator with microphone setup for voice evacuation messaging and announcements.

2.3 SPEAKERS

A. All speakers shall operate on 25 VRMS or with field selectable output taps from 0.5 to 2.0 Watts.

B. Speakers in corridors and public spaces shall produce a nominal sound output of 84 dBA at 10 feet (3m).

C. Frequency response shall be a minimum of 400 HZ to 4000 HZ.

D. The back of each speaker shall be sealed to protect the speaker cone from damage and dust.

2.4 ADDRESSABLE MANUAL PULL STATIONS FIRELITE NBG-12LX SERIES

A. Description: Addressable double-action push type, red LEXAN, with molded, raised-letter operating instructions of contrasting color. Station will mechanically latch upon operation and remain so until manually reset by opening with a key common with the main fire alarm control panel.

B. Mounting shall be as directed. Enclose pull station in protective lexan shield for all locations, equal to Safety Technology International (STI), series STI-1200, or approved equal, without audible horn.

C. Manual pull stations shall be located so that, from any part of the building, a distance no greater than 200 ft need be traveled to reach the pull station.

2.5 SMOKE SENSORS FIRE LITE SD365SERIES

A. General: Comply with UL 268, "Smoke Detectors for Fire Protective Signaling Systems." Include the following features:
   1. Factory Nameplate: Serial number and type identification.
   2. Operating Voltage: 24 VDC, nominal.
   3. The sensor's electronics shall be immune from false alarms caused by EMI and RFI.
   4. Sensors include a communication transmitter and receiver in the mounting base having a

unique identification and capability for status reporting to the FACP. Sensor address shall be located in base to eliminate false addressing when replacing sensors.

5. Removal of the sensor head for cleaning shall not require the setting of addresses.

B. Type: Smoke sensors shall be of the photoelectric or combination photoelectric / heat type.

C. Bases: Relay output, sounder and isolator bases shall be supported alternatives to the standard base.

D. Duct Smoke Sensor: Fire Lite D4120 series or approved equal. Photoelectric type, with sampling tube of design and dimensions as recommended by the manufacturer for the specific duct size and installation conditions where applied. Sensor base includes relay as required for fan shutdown and sensor requires remote test capable.

1. Environmental compensation, programmable sensitivity settings, status testing, and monitoring of sensor dirt accumulation for the duct sensor shall be provided by the FACP.
2. 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. Relay shall be mounted within 3 feet of HVAC control circuit.
3. Duct Housing shall provide a relay control trouble indicator Yellow LED.
4. Compact 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.
5. 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.
6. Duct Housing shall provide a magnetic test area and Red sensor status LED.
7. For maintenance purposes, it shall be possible to clean the duct housing sampling tubes by accessing them through the duct housing front cover.
8. Each duct sensor shall have a Remote Test Station with an alarm LED and test switch. The test station shall have a keyed reset, which matches the main fire alarm panel keying system. The RTS shall be mounted in the ceiling directly below the duct detector or adjacent on the wall at a maximum height of 96” or as noted on the drawings.
9. The EC is responsible for installing all wiring, conduit and controls for the HVAC unit shut-down for each respective duct detector.

2.6 HEAT SENSORS FIRE LITE H365 SERIES

A. Thermal Sensor: Combination fixed-temperature unit with plug-in base and alarm indication lamp; 135-deg F fixed-temperature setting except as indicated.

B. 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.

C. 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.

2.7 INDIVIDUAL ADDRESSABLE MODULES FIRE LITE MFF-300 SERIES

A. Individual Addressable Modules: Arrange to monitor 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, activating systems, controlling elevators, monitoring Ansul systems and for control of evacuation indicating appliances and AHU systems.

B. Individual Addressable Modules will be capable of mounting in a standard electric outlet box. Modules will include cover plates to allow surface or flush mounting. Modules will receive their operating power from the signaling line or a separate two wire pair running from an appropriate power supply as required.

2.8 STANDARD ALARM NOTIFICATION APPLIANCES

A. Visible/Only: Strobe shall be listed to UL 1971. The V/O shall consist of a xenon flash tube and associated lens/reflector system. The V/O enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings. V/O appliances shall be provided with different minimum flash intensities of 15cd, 30cd, 75cd and 110cd. Provide a label inside the strobe lens to indicate the listed candela rating of the specific Visible/Only appliance.
   1. Candela values: The candela values for each strobe shall be selected based on the location and room size on the drawings. The shop drawing submission shall reflect the final candela value of each strobe.

B. Audible/Visible: Combination Audible/Visible (A/V) Notification Appliances shall be listed to UL 1971 and UL 464. The strobe light shall consist of a xenon flash tube and associated lens/reflector system. Provide a label inside the strobe lens to indicate the listed candela rating of the specific strobe. The audible portion of the appliance shall comply with the “SPEAKER” section above. The audible/visible enclosure shall mount directly to standard single gang, double gang or 4" square electrical box, without the use of special adapters or trim rings.
   1. Candela values: The candela values for each strobe shall be selected based on the location and room size on the drawings. The shop drawing submission shall reflect the final candela value of each strobe.

C. Notification Appliance Circuit provides synchronization of strobes at a rate of 1Hz and operates horns with a Temporal Code Pattern operation. The circuit shall provide the capability to silence the audible signals, while the strobes continue to flash, over a single pair of wires. The capability to synchronize multiple notification appliance circuits shall be provided.

D. Manufacturer shall determine the appropriate candela value of each strobe based on the layout of the floor plans. The candela values shall be indicated on the submitted shop drawings.

E. Where recessed/flush backbox is not able to be installed, provide manufacturer’s surface mount backbox, same color as device, System Sensor (SBBSPWL).

2.9 NAC POWER EXTENDER HONEYWELL HPF-PS10 SERIES OR APPROVED EQUAL.

A. Where required to source additional notification appliance circuits, the NAC Power Extender panel shall be a stand-alone panel capable of powering a minimum of 3 notification appliance circuits. Notification appliance circuits shall be Class B Style Y rated at a maximum of 3 amps each.

B. The internal power supply & 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 panel or can be remotely located. The Addressable NAC Extender Panel when connected to an addressable panel shall connect to the host panel via a communications channel. Via the channel each output NAC can be individually controlled for general alarm or selective area notification.

D. Alarms from the host fire panel 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.

2.10 MISCELLANEOUS MONITORING

A. Provide addressable control modules at each duct mounted smoke detector shown on drawings, for shutdown of equipment upon smoke detection activation in building.

2.11 BATTERIES

A. The battery shall have sufficient capacity to power the fire alarm system for not less than twenty-four hours plus 5 minutes of alarm upon a normal AC power failure.

B. The batteries are to be completely maintenance free. No liquids are required. Fluid level checks for refilling, spills, and leakage shall not be required.

C. If necessary to meet standby requirements, external battery and charger systems may be used.

PART 3 EXECUTION

3.1 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.

3.2 EQUIPMENT INSTALLATION

A. Furnish and install a complete Fire Alarm & Voice Evacuation 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, and all other necessary material for a complete operating system.

B. System Retrofits shall require that 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 Owner. 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. Label all fire alarm devices with the initiation circuit and device number as well as the notification circuit and device number. All labeling shall exactly match the as-built shop drawings, which shall be submitted with the O&M manuals.

G. Each of the following types of devices or equipment shall be provided with supervised circuits as shown on the drawings but shall be typically as follows:
   1. Sprinkler Valve Supervisory Switches: Provide one (1) supervisory module circuit for each sprinkler valve supervisory switch.
   2. When waterflow and tamper switches exist at the same location, provide one (1) dual input addressable module. When odd numbers of devices exist at a single location, provide additional single input addressable modules.

H. Each of the following types of alarm notification appliances shall be circuited as shown on the drawings but shall be typically as follows:
   1. Audible Signals: Provide sufficient spare capacity to assure that the addition of five (5) audible devices can be supported without the need for addition control components (power supplies, signal circuit modules, amplifiers, batteries, etc.).
   2. Visual Signals Provide sufficient spare capacity to assure that the addition of three (3) visual devices can be supported without the need for addition control components (power supplies, signal circuit modules, batteries, etc.).

3.3 WIRING INSTALLATION

A. System Wiring:
   1. All fire alarm wiring shall either be installed in raceway or be metalclad MC-cable type. Where concealed, wire and cable shall be MC cable type FPLP and shall be acceptable to the Authority Having Jurisdiction (AH) and shall be installed in accordance with the appropriate articles from the current approved edition of NFPA 70: National Electric Code (NEC).
   2. Exposed wiring in public areas shall be installed in surface metallic raceway (Wiremold). Exposed wiring in non-public areas (in Boiler Rooms, Electrical Rooms, Storage Rooms, and the like, shall be installed in conduit.
   3. Standard FPLP or FPLR cabling shall not be used, unless installed in conduit or raceway.

B. Each addressable analog loop shall be circuited so device loading is not to exceed 80% of loop capacity in order to leave for space for future devices. The loop shall have Class B operation and provide for Isolation protection between every 50 devices per NFPA 72 2013.

C. Contractor shall obtain from the Fire Alarm System Manufacturer written instruction regarding the appropriate wire/cable sizes and types (shielded and non-shielded) 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.

D. Color Coding: Color-code fire alarm conductors differently from the normal building power wiring. Paint fire alarm system junction boxes and covers red.

E. Installing dedicated outgoing RJ-31X telephone lines (2) shall be the responsibility of the Installing Electrical Contractor. Establishment of central station monitoring account shall be the responsibility of the fire alarm equipment vendor.

3.4 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. Final Test Notice: Provide a 10-day minimum notice in writing when the system is ready for final acceptance testing.

E. Minimum System Tests: Test the system according to the procedures outlined in NFPA 72.

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.

H. Final Test, Certificate 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.

3.5 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 levels and adjusting controls and sensitivities to suit actual occupied conditions. Provide up to three visits to the site for this purpose.

3.6 TRAINING

A. Provide the services of a factory-authorized service representative to demonstrate the system and train Owner's maintenance personnel as specified below.
   1. Train Owner's maintenance personnel in the procedures and schedules involved in operating, troubleshooting, servicing, and preventive maintaining of the system. Provide a minimum of 2 hours of training.
   2. Schedule training with the Owner at least seven days in advance.

3.7 CLOSEOUTS

A. As part of the closeout documents, the contractor is required to provide the passcode for each fire alarm panel. The passcode shall not be changed after it is given to the District, without written authorization from the District.

END OF SECTION

SECTION 311000

SITE CLEARING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, as applicable.

B. "Pennsylvania Erosion and Sediment Pollution Control Program Manual" Pennsylvania Department of Environmental Protection, Latest Edition.

C. National Pollutant Discharge Elimination System (NPDES) permit for Stormwater Discharges from Construction Activities, Latest Edition.

D. Specification Section 31 25 00 "Erosion and Sediment Control."

E. Project Geotechnical Engineering/Foundation Report/Memoranda.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Protecting existing vegetation to remain.
2. Removing existing vegetation.
3. Clearing and grubbing.
4. Stripping and stockpiling topsoil.
5. Removing above- and below-grade site improvements.
6. Disconnecting, capping or sealing, removing site utilities, and/or abandoning site utilities in place.

1.3 DEFINITIONS

A. Subsoil: Soil beneath the level of subgrade; soil beneath the topsoil layers of a naturally occurring soil profile, typified by less than 1 percent organic matter and few soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile. In undisturbed areas, surface soil is typically called "topsoil," but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil; the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown, gray, or red than underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects larger than 2 inches in diameter; and free of weeds, roots, toxic materials, or other non-soil materials.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction and indicated on Drawings.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference if specifically requested by the Owner at a location of the Owner's choosing.

1.5 MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.
   1. Use sufficiently detailed photographs or video recordings.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plant designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.7 FIELD 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 Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for performing site clearing indicated on property adjoining Owner's property will be obtained by Owner before award of Contract.
   1. Do not proceed with work on adjoining property until directed by Owner.

C. Salvageable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises.

D. Utility Locator Service: Notify local utility locator service for area where Project is located before site clearing.

E. Do not commence site clearing operations until temporary erosion- and sedimentation-control and plant-protection measures are in place.

F. Tree- and Plant-Protection Zones: Protect according to requirements in Drawings. The following activities are prohibited within Tree-Protection Zones or the canopy zone of any trees scheduled to remain:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Foot traffic.
   4. Erection of sheds or structures.
   5. Impoundment of water.
   6. Excavation or other digging unless otherwise indicated.
   7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

G. Soil Stripping, Handling, and Stockpiling: Perform only when the soil is dry or slightly moist.

PART 2 PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material: Requirements for satisfactory soil material are specified in Project Geotechnical Engineering report and/or memorandum.
   1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site. Any imported materials shall be approved for use by the Project Geotechnical Engineer.

PART 3 EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Verify that trees, shrubs, and other vegetation to remain or to be relocated have been flagged and that protection zones have been identified and enclosed according to requirements in

Drawings.

C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 EROSION AND SEDIMENT CONTROL

A. See Section 312500 - Erosion and Sediment Control.

B. Provide temporary erosion- and sediment-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 sediment-control Drawings and requirements of authorities having jurisdiction.

C. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross tree-protection zones.

3.3 TREE AND PLANT PROTECTION

A. Protect trees and plants remaining on-site according to requirements in Drawings.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations.

3.4 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place. Arrange with utility companies to shut off indicated utilities. Contractor shall verify that utility removals have been completed before proceeding with site clearing or additional utility removals.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others, unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner not less than three days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.
   1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
   2. Grind down stumps and remove roots larger than 2 inches in diameter, obstructions, and debris to a depth of 18 inches below exposed subgrade.
   3. Use only hand methods or air spade for grubbing within protection zones.

4. Chip removed tree branches and dispose of off-site.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.
   1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches or to depth as defined in Project Geotechnical Engineering/Foundation Report/Memorandum in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and non-soil materials from topsoil, including clay lumps, gravel, and other objects larger than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil or other materials. Grade and shape stockpiles to drain surface water. Cover to prevent windblown dust and erosion by water.
   1. Limit height of topsoil stockpiles to 72 inches.
   2. Do not stockpile topsoil within protection zones.
   3. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or required for reuse. Consult with Landscape Architect if surplus topsoil may be used for respreading of deeper topsoil prior to disposal.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade improvements as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.
   1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, unsuitable topsoil, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities.

END OF SECTION

SECTION 312013

EARTHWORK WITHIN PERIMETER OF BUILDING FOOTPRINT

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. This Section includes the following:
1. Preparing subgrades for slabs-on-grade.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for slabs-on-grade.
4. Subsurface drainage backfill for walls and trenches.
5. Excavating and backfilling trenches within building lines.

D. Related Sections include the following:
1. Division 01 Section "Temporary Facilities and Controls."

1.3 DEFINITIONS

A. Backfill: Soil materials 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: Layer placed over the excavated subgrade in a trench before laying pipe.

C. Borrow: Satisfactory soil imported from off-site for use as fill or backfill.

D. Drainage Course: Layer supporting slab-on-grade used to minimize capillary flow of pore water.

E. Excavation: Removal of material encountered above subgrade elevations.
1. Additional Excavation: Excavation below subgrade elevations as directed by Architect.

Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Bulk Excavation: Excavations more than 10 feet in width and pits more than 30 feet in either length or width.
3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, and conglomerate deposits and boulders of rock material exceeding 1 cu. yd. for bulk excavation or 3/4 cu. yd. for footing, trench, and pit excavation that cannot be removed by rock excavating equipment equivalent to the following in size and performance ratings, without systematic drilling, ram hammering, ripping, or blasting, when permitted:
1. Excavation of Footings, Trenches, and Pits: Late-model, track-mounted hydraulic excavator; equipped with a 42-inch- wide, short-tip-radius rock bucket; rated at not less than 120-hp flywheel power with bucket-curling force of not less than 25,000 lbf and stick-crowd force of not less than 18,700 lbf; measured according to SAE J-1179.
2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 210-hp flywheel power and developing a minimum of 45,000-lbf breakout force; measured according to SAE J-732.

H. 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.

I. Subgrade: Surface or elevation remaining after completing excavation, or top surface of a fill or backfill immediately below subbase, drainage fill, or topsoil materials.

J. Utilities include on-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.4 SUBMITTALS

A. Material Test Reports: From a qualified testing agency indicating and interpreting test results for compliance of the following with requirements indicated:
1. Classification according to ASTM D 2487 of each on-site or borrow soil material proposed for fill and backfill.
2. Laboratory compaction curve according to ASTM D 1557 for each on-site or borrow soil material proposed for fill and backfill.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: An independent testing agency qualified according to ASTM E 329 to conduct soil materials and rock-definition testing, as documented

according to ASTM D 3740 and ASTM E 548.

1.6 PROJECT CONDITIONS

A. Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted in writing by Architect and then only after arranging to provide temporary utility services according to requirements indicated:
   1. Notify Owner not less than two days in advance of proposed utility interruptions.
   2. Do not proceed with utility interruptions without Owner's written permission.
   3. Contact utility-locator service for area where Project is located before excavating.

B. Demolish and completely remove from site existing underground utilities indicated to be removed. Coordinate with utility companies to shut off services if lines are active.

C. Demolish and completely remove from site existing foundation walls and foundations for portions of the building indicated to be removed.

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:
   1. Imported Fill Material: Any imported material placed as structural fill or backfill to raise elevations or restore design grades is to consist of clean, relatively well graded sand or gravel with a maximum particle size of two inches and five percent to 15 percent of material finer than a #200 sieve. Silts, clays, and silty or clayey sands and gravels with higher percentage of fines and with a liquid limit less than 40 and a plasticity index less than 20 may be considered subject to the Owner’s Geotechnical Engineer’ approval, provided that the moisture content and compaction controls are met during the construction phase. The material is to be free of clay lumps, organics, and deleterious material. Imported structural fill material is to be approved by the Owner’s Geotechnical engineer prior to delivery to the site.
   2. On-Site Materials: Based on the conditions disclosed by the subsurface investigation, a majority of the site soils should be suitable for selective reuse as structural fill/backfill material provided that soil moisture contents are controlled within two percent of optimum moisture level and objectionable materials (if encountered) are removed. Additionally, the site soils must be properly compacted and evaluated during the construction phase. Areas requiring over excavation and replacement may be required due to moisture sensitivity of the on-site soils and potential variability of undocumented existing fill. Immediate reuses of on-site material is not be expected, especially following inclement weather or if construction occurs during winter/early spring.
   3. Material that are or become exceedingly wet will likely require discing and aerating.

Alternatively, imported fill materials may be used to attain the desired grades and expedite earthwork operations during wet weather periods. The contractor is to cover stockpiled soils, seal subgrades, and provide proper surface drainage prior to forecasted wet weather.

C. Unsatisfactory Soils: ASTM D 2487 soil classification groups MH, CH, OL, OH, and PT, or a combination of these group symbols.
   1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Structural Fill: Naturally or artificially well graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; with not more than 20 percent passing a No. 200 sieve and a plasticity index not greater than 8 percent. Maximum particle size of 3 inches.

E. Bedding: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D 448; coarse-aggregate grading Size 57; with 100 percent passing a 1-1/2-inch sieve and 0 to 5 percent passing a No. 8 sieve.

G. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch sieve and 0 to 5 percent passing a No. 4 sieve.

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 earthwork operations.

B. Protect subgrades and foundation soils against freezing temperatures or frost. Provide protective insulating materials as necessary.

C. Provide 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. All vegetation, rootmat, topsoil, unsuitable existing fill, asphalt, and other soft or unsuitable materials within 10 feet of the foundation edges is to be removed. Existing structural elements such as foundation walls, footings, and slabs are to be removed entirely from below new footings and their zones of influence (as determined by the Owner’s Geotechnical Engineer) and excavated to at least two feet below construction subgrade elsewhere.

3.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.
   1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.
   2. Install a dewatering system to keep subgrades dry and convey ground water away from excavations. Maintain until dewatering is no longer required.

3.3 EXPLOSIVES

A. Explosives: Blasting is not permitted on the project.

3.4 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.
   2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:
      a. 24 inches outside of concrete forms other than at footings.
      b. 12 inches outside of concrete forms at footings.
      c. 6 inches outside of minimum required dimensions of concrete cast against grade.
      d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
      e. 6 inches beneath bottom of concrete slabs-on-grade.
      f. 6 inches beneath pipe in trenches, and the greater of 24 inches wider than pipe or 42 inches wide.

3.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. Extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.
   1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

3.6 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

B. Excavate trenches to uniform widths to provide a working 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: 12 inches on each side of pipe or conduit.

C. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe elevation to allow for bedding course. Hand excavate for bell of pipe.
   1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

3.7 APPROVAL OF SUBGRADE

A. Notify Geotechnical Engineer when excavations have reached required subgrade.

B. Prior to placing any fill, backfill or subbase materials to raise or restore grades to the desired building or pavement subgrade elevations, the exposed soils should be compacted to a firm and unyielding surface with a minimum of two passes in perpendicular directions of a minimum 10-ton smooth vibratory drum roller.

C. If Geotechnical Engineer determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
   1. Additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

D. Proof roll subgrade in the presence of the Owner’s Geotechnical engineer using a loaded tandem axle truck. Do not proof roll wet or saturated subgrades.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Geotechnical Engineer.

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 may be used when approved by Architect.
   1. Fill unauthorized excavations under other construction or utility pipe as directed by Architect.

3.9 STORAGE OF SOIL MATERIALS

A. Stockpile borrow materials and satisfactory excavated soil materials. Stockpile 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 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:
   1. Construction below finish grade including, where applicable, dampproofing, waterproofing, and perimeter insulation.
   2. Surveying locations of underground utilities for record documents.
   3. Inspecting and testing underground utilities.
   4. Removing concrete formwork.
   5. Removing trash and debris.
   6. Removing temporary shoring and bracing, and sheeting.
   7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

3.11 UTILITY TRENCH BACKFILL

A. 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.

B. Backfill trenches excavated under footings and within 18 inches of bottom of footings; fill with concrete to elevation of bottom of footings.

C. Coordinate backfilling with utilities testing.

D. Fill voids with approved backfill materials while shoring, bracing, and sheeting is removed.

E. Place and compact final backfill of satisfactory soil material to final subgrade.

F. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under slabs.

3.12 FILL

A. Preparation: Remove vegetation, topsoil, debris, unsatisfactory soil materials, obstructions, deleterious materials, and existing structure from ground surface before placing fills.

B. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

C. Place and compact fill material in layers to required elevations as follows:
   1. Under building slabs, use satisfactory or structural fill.
   2. Under footings and foundations, use satisfactory or structural fill.

3.13 MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill layer before compaction to within 2 percent of optimum moisture content.
   1. Do not place backfill or fill 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.

3.14 COMPACTION OF BACKFILLS AND FILLS

A. Place backfill and fill materials in layers not more than 9 inches in loose depth.

B. Place backfill and fill materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. When heavy duty construction equipment is used (10-ton vibratory, smooth drum roller, or equivalent), compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D1557:
   1. Under foundations, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent.

D. When small, hand operated compaction equipment is used, compact soil to not less than the following percentages of maximum dry unit weight according to ASTM D 1557:
   1. Under foundations, scarify and recompact top 12 inches of existing subgrade and each layer of backfill or fill material at 95 percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free from irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.
   1. Provide a smooth transition between adjacent existing grades and new grades.
   2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent geotechnical engineering testing agency to perform field quality-control testing.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earthwork 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.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2922, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:
   1. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. or less of paved area or building slab, but in no case fewer than three tests.
   2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for each 100 feet or less of wall length, but no fewer than two tests.
   3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for each 150 feet or less of trench length, but no fewer than two tests.

E. 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 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.
   1. Scarify or remove and replace soil material to depth as directed by the Owner’s Geotechnical Engineer; reshape and recompact.

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 the greatest extent possible.

3.18 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Disposal: Remove surplus satisfactory soil and waste material, including unsatisfactory soil, trash, and debris, and legally dispose of it off Owner's property.

END OF SECTION

SECTION 312500

EROSION AND SEDIMENT CONTROL

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, as applicable.

B. "Pennsylvania Erosion and Sediment Pollution Control Program Manual" Pennsylvania Department of Environmental Protection, Latest Edition.

C. National Pollutant Discharge Elimination System (NPDES) permit for Stormwater Discharges from Construction Activities, Latest Edition.

D. Specification Section 31 10 00 "Site Cleaning."

E. Project Geotechnical Engineering/Foundation Report/Memoranda.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. The Contractor shall provide all work and take all measures to control soil erosion resulting from construction operations, prevent flow of sediment from construction site. The Contractor shall also provide a construction entrance with tracking pad, wheel wash station, street sweeping and all related controls to prevent erosion of onsite materials to the stormwater system or adjacent roadways. The Contractor shall also control dust at the site. The Contractor shall comply with any municipal stormwater management regulations.

1.3 `MATERIAL OWNERSHIP

A. Except for materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 SUBMITTALS

A. Shop Drawings: Submit the following in accordance with the Conditions of the Contract and Division 1.
   1. Contractor shall submit manufacturer's literature describing products, installation

procedures, and routine maintenance of the erosion and sediment control devices as indicated on the plans.

1.5 FIELD CONDITIONS

A. Traffic: Erosion and Sediment Controls shall not impede vehicular or pedestrian circulation on adjoining roads, streets, walks, and other adjacent occupied or used facilities.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed trafficways if required by Owner or authorities having jurisdiction.

B. Improvements on Adjoining Property: Authority for installing erosion and sediment controls indicated on property adjoining Owner's property, if applicable, will be obtained by Owner before award of Contract. Do not proceed with work on adjoining property until directed by Owner.

1.6 QUALITY ASSURANCE

A. Provide and maintain erosion and sediment controls indicated on the Drawings and required by the approved NPDES permit, PADEP requirements, Bucks County Conservation District requirements, and authorities having jurisdiction.

B. Operations restricted to areas of work indicated on Contract Drawings.

C. If construction materials are washed away during construction, including vehicle track-out, contractor shall remove materials from fouled areas and roadways.

PART 2 PRODUCTS

2.1 COMPOST SOCKS (COMPOST FILTER TUBES)

A. Compost socks shall consist of a three-dimensional tubular mesh with compost filter media specifically designed for sediment control and as a storm water runoff filtration device.

B. Shall be 12" diameter minimum.

C. The compost material shall consist of unvegetated composting material and be made with sanitized, mature compost that has no identifiable feedstock constituents or offensive odors. The compost used in the composting sock shall meet all local, state, and Federal quality requirements.

D. Shall be Siltsoxx, manufactured by Filtrexx, or approved equal.

E. Hay bales and straw wattles shall not be permitted without approval from the authority having jurisdiction.

2.2 CONSTRUCTION FABRICS

A. Silt fence and Construction Entrance/Exit filter fabrics shall conform to the properties shown in Table A.

Property	Test Method	Units	Silt Fence	Construction Entrance/Exit
Grab Tensile Strength[1]	ASTM D 4632	kN (lbs)	0.55 (124)	1.40 (315)
Grab Tensile Elongation	ASTM D 4632	% MD / CD	15 / 15	15 / 10
Trapezoid Tear Strength	ASTM D 4533	kN (lbs)	0.29 (65)	0.53 (120)
Mullen Burst Strength	ASTM D 3786	kPa (psi)	2060 (300)	4134 (600)
Puncture Strength	ASTM D 4833	kN (lbs)	0.27 (60)	0.53 (120)
UV Resistant after 500 hours	ASTM D 4355	% Strength	70	70
Apparent Opening Size	ASTM D 4751	mm (US Sieve)	0.60 (30)	0.425 (40)
Permittivity	ASTM D 4491	sec^{-1}	0.1	0.05

2.3 INLET PROTECTION (SEDIMENT FILTER DEVICE)

A. Sediment filter device shall be manufactured to fit the opening of the catch basin or drop inlet. The sediment filter device shall have the following features:
   1. Two dump straps attached at the bottom to facilitate the emptying of the device and shall have lifting loops as an integral part of the system.
   2. Yellow restraint cord approximately halfway up the sack to keep the sides away from the catch basin walls. Yellow restraint cord is also a visual means of indicating when the sack should be emptied.
   3. Fabric shall consist of a woven polypropylene geotextile and be sewn by a double needle machine, using a high strength nylon thread.
   4. Sediment filter device shall have a certified average wide width per ASTM Standard D-4884 standard of 165 lbs/in.

2.4 EROSION CONTROL SEED MIX

A. Temporary erosion control seed for quick growing grasses such as wheat, rye or oats shall be planted only when permanent grasses cannot be planted due to the growing season. All permanent grass areas planted with temporary erosion control seed shall be replaced with permanent seed per the Landscape Drawings. Apply seed mixture at a rate of 100 pounds per acre. See Table B.

B. Table B - Erosion Control Seed Mixes

Seed	Weight	% Germination (Min.)
Winter Rye	80% Min	85
Red Fescue (Creeping)	4% Min	80
Perennial Rye Grass	3% Min	90
Red Clover	3% Min	90
Other Crop Grass	0.5% Max	
Noxious Weed Seed	0.5% Max	
Inert Matter	1.0% Max	

PART 3 EXECUTION

3.1 GENERAL

A. The Contractor shall not discharge chemicals, fuels, lubricants, bitumen, raw sewage, and other harmful waste into or alongside any body of water or into natural or manmade channel.

B. It is the intent of these Specifications to prevent the unnecessary occurrence of sedimentation or siltation of waterways and private properties. In the event the sedimentation or siltation prevention measures used by the Contractor prove to be inadequate as determined by the General Contractor or Owner, the Contractor shall be required to adjust his operations to the extent necessary to prevent any such sedimentation or siltation from occurring.

C. The Contractor shall inspect, maintain and document all erosion control activities throughout construction and until directed by the Owner to remove erosion control devise.

3.2 INSTALLATION

A. Compost Socks shall be placed to form temporary water stops, dams, diversions, dikes, berms and for other uses connected with water pollution control. Bales, if approved, shall be disposed of by the Contractor upon completion. Compost socks shall be installed according to the manufacturer's written installation procedures.

B. The Contractor shall protect catch basins by installing sediment filter devices as specified in this Specification in every catch basin within and downstream of the project limits.
   1. The Contractor shall install the sediment filter device before any work begins and shall place the device flush with the material around the frame of the grate of the catch basin structure. The Contractor shall be responsible for maintenance and placement of the strap lift holes to ensure that they do not become a hazard for pedestrians.
   2. The Contractor shall maintain the sediment filter device and remove the collected debris as required by the Engineer. If any material is lost in the removal of the sediment filter device, then the Contractor shall be responsible for cleaning of the catch basin. The Contractor shall inspect the position of the device to ensure that the sediment filter device will work properly during any heavy rain or any storm greater than a 10-year flood.

C. Existing natural drainage patterns and vegetative cover shall be preserved to the maximum possible extent.

D. Utilize temporary vegetation, mulching, and paving to protect areas exposed during construction. Minimize the amount of bare earth exposed at any one time during construction, and minimize the length of time bare earth is exposed.

E. On sloping terrain, compost socks may be used to trap sediment until vegetation has become established. The details of their placement shall be as approved by the OPM/Engineer.

F. Water that is being pumped from the trenches or excavations shall not be pumped directly into water courses or pipe conveyance systems. At a minimum, sedimentation control measures shall include portable sedimentation tanks, pumps, and piping, or other means acceptable to the General Contractor and Owner to meet the water quality parameters specified in NPDES Construction General Permit and Dewatering Permits and these Specifications, whichever is more stringent.

G. Spoil resulting from the trench excavation shall be leveled or removed to permit free entry of water from adjacent land surfaces without excessive erosion or harmful ponding.

END OF SECTION

SECTION 321216

ASPHALT PAVING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, as applicable.

B. Reference is made herein to the Pennsylvania Department of Transportation (PennDOT), Publication 408, latest edition, and all addendums/supplemental specs hereinafter referred to as the "Standard Specifications." References made to particular sections or paragraphs in the Standard Specifications shall include all related articles mentioned therein. Pavement shall comply with PennDOT Standard Specifications.

C. Project Geotechnical Engineering/Foundation Report/Memoranda. In case of discrepancies, Geotechnical report recommendations shall supersede.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Hot-mix asphalt paving.
2. Hot-mix asphalt overlay where indicated on the Drawings.
3. Cold milling of existing asphalt pavement where indicated on the Drawings.
4. Hot-mix asphalt patching where indicated on the Drawings.

D. Related Requirements:
1. Section 321313 "Concrete Paving" for concrete pavement and for separate concrete curbs, gutters, and driveway aprons.
2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants and fillers at pavement terminations.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at if specifically requested by the Owner at a location of the Owner's choosing.
1. Review methods and procedures related to hot-mix asphalt paving including, but not limited to, the following:

a. Review proposed sources of paving materials, including capabilities and location of plant that will manufacture hot-mix asphalt.
b. Review requirements for protecting paving work, including restriction of traffic during installation period and for remainder of construction period.

1.4 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.
1. Joint sealant.

B. Hot-Mix Asphalt Designs:
1. Certification, by authorities having jurisdiction, of approval of each active hot-mix asphalt design proposed for the Work.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For paving-mix manufacturer and testing agency.

B. Material Certificates: Include statement that mixes containing recycled materials will perform equal to mixes produced from all new materials.
1. Aggregates.
2. Asphalt binder.
3. Emulsified asphalt prime coat.
4. Tack coat.

C. Field quality-control reports for submission to Owner as record.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A paving-mix manufacturer registered with and approved by authorities having jurisdiction or the DOT of state in which Project is located.

B. Testing Agency Qualifications: Qualified in accordance with ASTM D3666 for testing indicated.

C. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of PennDOT for asphalt paving work.
1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.7 FIELD 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. Prime Coat: Minimum surface temperature of 50 deg F and air temperature of 45 deg F.

2. Tack Coat: Minimum surface temperature of 50 deg F and air temperature of 45 deg F.
3. Slurry Coat: Comply with weather limitations in ASTM D3910.
4. Asphalt Intermediate/Binder/Base Course: Minimum surface temperature of 40 deg F and air temperature of 35 deg F, and rising, at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 50 deg F and air temperature of 45 deg F at time of placement.

PART 2 PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Coarse Aggregate: ASTM D692/D692M, sound; angular crushed stone, or crushed gravel. Blast-furnace slag shall not be accepted.

C. Fine Aggregate: ASTM D1073, sharp-edged natural sand or sand prepared from stone, gravel, or combinations thereof. Blast-furnace slag shall not be accepted.
1. For hot-mix asphalt, limit natural sand to a maximum of 20 percent (10 percent if slow, heavily loaded traffic is anticipated) by weight of the total aggregate mass.

D. Mineral Filler: AASHTO M 17, rock or slag dust, hydraulic cement, or other inert material.

2.2 ASPHALT MATERIALS

A. Asphalt Binder: AASHTO M 320 binder designation PG 64S-22.

B. Emulsified Asphalt Prime Coat: ASTM D977 emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

C. Tack Coat: ASTM D977 emulsified asphalt, or ASTM D2397/D2397M cationic emulsified asphalt, slow setting, diluted in water, of suitable grade and consistency for application.

2.3 MIXES

A. Recycled Asphalt Product (RAP).
1. Course Limit: Recycled content no more than 20 percent by weight or as dictated by local standards if more stringent.

B. Hot-Mix Asphalt: Dense-graded, hot-laid, hot-mix asphalt plant mixes approved by PennDOT and complying with the following requirements:
1. Provide mixes with a history of satisfactory performance in geographical area where Project is located.
2. Base Course as detailed on the plans.

3. Binder Course as detailed on the plans.
4. Surface Course as detailed on the plans.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proceed with paving only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Protection: Provide protective materials, procedures, and worker training to prevent asphalt materials from spilling, coating, or building up on curbs, driveway aprons, manholes, and other surfaces adjacent to the Work.

B. 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.
1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph.
2. Proof-roll with a loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect, and replace with compacted backfill or fill as directed.

3.3 COLD MILLING

A. Clean existing pavement surface of loose and deleterious material immediately before cold milling. Remove existing asphalt pavement by cold milling to grades and cross sections indicated.
1. Mill to a depth as indicated on plans to achieve design elevation with 1.5" overlay.
2. Mill to a uniform finished surface free of excessive gouges, grooves, and ridges.
3. Control rate of milling to prevent tearing of existing asphalt course.
4. Repair or replace curbs, driveway aprons, manholes, and other construction damaged during cold milling.
5. Excavate and trim unbound-aggregate base course, if encountered, and keep material separate from milled hot-mix asphalt.
6. Patch surface depressions deeper than 1 inch after milling, before wearing course is laid.
7. Handle milled asphalt material in accordance with state and local requirements.
8. Keep milled pavement surface free of loose material and dust.
9. Do not allow milled materials to accumulate on-site.

3.4 PATCHING

A. Asphalt Pavement: Saw cut perimeter of patch and excavate existing pavement section to

sound base. Excavate rectangular or trapezoidal patches, extending 12 inches into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Remove excavated material. Recompact existing unbound-aggregate base course to form new subgrade.

B. Portland Cement Concrete Pavement: Break cracked slabs and roll as required to reseat concrete pieces firmly.
   1. Undersealing: Pump hot undersealing asphalt under rocking slab until slab is stabilized or, if necessary, crack slab into pieces and roll to reseat pieces firmly.
   2. Remove disintegrated or badly cracked pavement. Excavate rectangular or trapezoidal patches, extending into perimeter of adjacent sound pavement, unless otherwise indicated. Cut excavation faces vertically. Recompact existing unbound-aggregate base course to form new subgrade.

C. Tack Coat: Before placing patch material, apply tack coat uniformly to vertical asphalt surfaces abutting the patch. Apply at a rate of 0.05 to 0.15 gal./sq. yd.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

D. Placing Single-Course Patch Material: Fill excavated pavement areas with hot-mix asphalt base mix for full thickness of patch and, while still hot, compact flush with adjacent surface.

E. Placing Two-Course Patch Material: Partially fill excavated pavements with hot-mix asphalt base course mix and, while still hot, compact. Cover asphalt base course with compacted layer of hot-mix asphalt surface course, finished flush with adjacent surfaces.

3.5 SURFACE PREPARATION

A. Ensure that prepared subgrade has been proof-rolled and is ready to receive paving. Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces.

B. Cutback Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.15 to 0.50 gal./sq. yd. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
   1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
   2. Protect primed substrate from damage until ready to receive paving.

C. Emulsified Asphalt Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.10 to 0.30 gal./sq. yd. per inch depth. Apply enough material to penetrate and seal, but not flood, surface. Allow prime coat to cure.
   1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
   2. Protect primed substrate from damage until ready to receive paving.

D. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd.
   1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
   2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.

3.6 HOT-MIX ASPHALT PLACEMENT

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand in areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.
   1. Place hot-mix asphalt base course and binder course in number of lifts and thicknesses indicated on the plans.
   2. Place hot-mix asphalt surface course in single lift.
   3. Spread mix at a minimum temperature of 250 deg F.
   4. Begin applying mix along centerline of crown for crowned sections and on high side of one-way slopes unless otherwise indicated.
   5. Regulate paver machine speed to obtain smooth, continuous surface free of pulls and tears in asphalt-paving mat.

B. Place paving in consecutive strips not less than 10 feet wide unless infill edge strips of a lesser width are required.
   1. After first strip has been placed and rolled, place succeeding strips and extend rolling to overlap previous strips. Overlap mix placement about 1 to 1-1/2 inches from strip to strip to ensure proper compaction of mix along longitudinal joints.
   2. Complete a section of asphalt base course and binder course before placing asphalt surface course.

C. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.7 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.
   1. Clean contact surfaces and apply tack coat to joints.
   2. Offset longitudinal joints, in successive courses, a minimum of 6 inches.
   3. Offset transverse joints, in successive courses, a minimum of 24 inches.
   4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method in accordance with AI MS-22, for both "Ending a Lane" and "Resumption of Paving Operations."
   5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
   6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.8 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.
   1. Complete compaction before mix temperature cools to 185 deg F.

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:
   1. Average Density, Marshall Test Method: 96 percent of reference laboratory density in accordance with ASTM D6927, but not less than 94 percent or greater than 100 percent.
   2. Average Density, Rice Test Method: 92 percent of reference maximum theoretical density in accordance with ASTM D2041/D2041M, but not less than 90 percent or greater than 96 percent.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.

E. Edge Shaping: While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. Repairs: Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. Protection: After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

3.9 INSTALLATION TOLERANCES

A. Pavement Thickness: Compact each course to produce thickness indicated within the following tolerances:
   1. Base Course and Binder Course: Plus or minus 1/2 inch.
   2. Surface Course: Plus 1/4 inch, no minus.

B. Pavement Surface Smoothness: Compact each course to produce surface smoothness within the following tolerances as determined by using a 10-foot straightedge applied transversely or longitudinally to paved areas:
   1. Base Course and Binder Course: 1/4 inch.
   2. Surface Course: 1/8 inch.
   3. Crowned Surfaces: Test with crowned template centered and at right angle to crown.

Maximum allowable variance from template is 1/4 inch.

C. Asphalt Traffic-Calming Devices: Compact and form asphalt to the shapes indicated and within a tolerance of plus or minus 1/8 inch of height indicated above pavement surface.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Thickness: In-place compacted thickness of hot-mix asphalt courses will be determined in accordance with ASTM D3549/D3549M.

C. Surface Smoothness: Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.

D. Asphalt Traffic-Calming Devices: Finished height of traffic-calming devices above pavement will be measured for compliance with tolerances.

E. In-Place Density: Testing agency will take samples of uncompacted paving mixtures and compacted pavement in accordance with ASTM D979/D979M.
   1. Reference maximum theoretical density will be determined by averaging results from four samples of hot-mix asphalt-paving mixture delivered daily to site, prepared in accordance with ASTM D2041/D2041M, and compacted in accordance with job-mix specifications.
   2. In-place density of compacted pavement will be determined by testing core samples in accordance with ASTM D1188 or ASTM D2726/D2726M.
      a. One core sample will be taken for every 1000 sq. yd. or less of installed pavement, with no fewer than three cores taken.
      b. Field density of in-place compacted pavement may also be determined by nuclear method in accordance with ASTM D2950/D2950M and coordinated with ASTM D1188 or ASTM D2726/D2726M.

F. Replace and compact hot-mix asphalt where core tests were taken.

G. 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

SECTION 321313

CONCRETE PAVING

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section includes concrete paving for the following:
1. Concrete driveways and pavement where indicated on the Drawings.
2. Concrete parking and vehicular pavement where indicated on the Drawings.
3. Concrete curbs and tapered or flush curb transitions where indicated on the Drawings.
4. Concrete sidewalks, ramps, pads, and other pedestrian paving where indicated on the Drawings.

D. Related Requirements:
1. Section 033000 "Cast-in-Place Concrete" for general building applications of concrete.
2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within concrete paving and in joints between concrete paving and asphalt paving or adjacent construction.
3. Section 321723 "Pavement Markings."
4. Section 321726 "Tactile Warning Surfacing" for detectable warning panel/surface.

1.2 DEFINITIONS

A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement, fly ash, slag cement, and other pozzolans.

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference if specifically requested by the Owner at a location of the Owner's choosing.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when

characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified ready-mix concrete manufacturer and testing agency.

B. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   3. Fiber reinforcement.
   4. Admixtures.
   5. Curing compounds.
   6. Applied finish materials.
   7. Bonding agent or epoxy adhesive.
   8. Joint fillers.

C. Material Test Reports: For each of the following:
   1. Aggregates: Include service-record data indicating absence of deleterious expansion of concrete due to alkali-aggregate reactivity.

D. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Ready-Mix-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.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: Qualified according to ASTM C1077 and ASTM E329 for testing indicated.
   1. Personnel conducting field tests must be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

1.7 FIELD CONDITIONS

A. Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

B. Cold-Weather Concrete Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40 deg F, uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less

than 50 deg F and not more than 80 deg F at point of placement.
2. Do not use frozen materials or materials containing ice or snow.
3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

C. Hot-Weather Concrete Placement: Comply with ACI 301 and as follows when hot-weather conditions exist:
1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
2. Cover steel reinforcement with water-soaked burlap, so steel temperature will not exceed ambient air temperature immediately before embedding in concrete.
3. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

PART 2 PRODUCTS

2.1 CONCRETE, GENERAL

A. ACI Publications: Comply with ACI 301 unless otherwise indicated.

2.2 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
1. Use flexible or uniformly curved forms for curves with a radius of 100 feet or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.

2.3 STEEL REINFORCEMENT

A. Plain-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, fabricated from as drawn steel wire into flat sheets.

B. Deformed-Steel Welded-Wire Reinforcement: ASTM A1064/A1064M, flat sheet.

C. Epoxy-Coated Welded-Wire Reinforcement: ASTM A884/A884M, Class A, plain steel.

D. Reinforcing Bars: ASTM A615/A615M, Grade 60; deformed.

E. Galvanized Reinforcing Bars: ASTM A767/A767M, Class II zinc coated, hot-dip galvanized after fabrication and bending; with ASTM A615/A615M, Grade 60 deformed bars.

F. Epoxy-Coated Reinforcing Bars: ASTM A775/A775M or ASTM A934/A934M; with ASTM A615/A615M, Grade 60 deformed bars.

G. Steel Bar Mats: ASTM A184/A184M; with ASTM A615/A615M, Grade 60 deformed bars; assembled with clips.

H. Plain-Steel Wire: ASTM A1064/A1064M, as drawn.

I. Deformed-Steel Wire: ASTM A1064/A1064M.

J. Joint Dowel Bars: ASTM A615/A615M, Grade 60 plain-steel bars; zinc coated or galvanized after fabrication according to ASTM A767/A767M, Class I coating. Cut bars true to length with ends square and free of burrs.

K. Epoxy-Coated, Joint Dowel Bars: ASTM A775/A775M; with ASTM A615/A615M, Grade 60 plain-steel bars.

L. Tie Bars: ASTM A615/A615M, Grade 60 deformed.

M. Hook Bolts: ASTM A307, Grade A, internally and externally threaded. Design hook-bolt joint assembly to hold coupling against paving form and in position during concreting operations, and to permit removal without damage to concrete or hook bolt.

N. 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" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:
   1. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.
   2. For epoxy-coated reinforcement, use epoxy-coated or other dielectric-polymer-coated wire bar supports.

O. Epoxy Repair Coating: Liquid, two-part, epoxy repair coating, compatible with epoxy coating on reinforcement.

P. Zinc Repair Material: ASTM A780/A780M.

2.4 CONCRETE MATERIALS

A. Cementitious Materials: Use the following cementitious materials, of same type, brand, and source throughout Project. Materials shall maintain qualification under AHJ.
   1. Portland Cement: ASTM C150/AASHTO M85, gray portland cement Type I/II, unless otherwise noted.
   2. Fly Ash: ASTM C618, Class C or Class F.
   3. Slag Cement: ASTM C989/C989M, Grade 100 or 120.
   4. Blended Hydraulic Cement: ASTM C595/AASHTO M240, Type IS, portland blast-furnace slag, Type IFA, portland-fly ash cement, Type ISF, Portland-silica fume cement, Type IL, Portland-limestone, Type IT, ternary blended cement.

B. from a single source with documented service-record data of at least 10 years' satisfactory service in similar paving applications and service conditions using similar aggregates and cementitious materials.
   1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
   2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
   3. Aggregate Sizes: 3/4 to 1 inch or 1/2 to 3/4 inch or 3/8 to 5/8 inch nominal.

C. Air-Entraining Admixture: ASTM C260/AASHTO M154.

D. Chemical Admixtures: Admixtures 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.
   1. Water-Reducing Admixture: ASTM C494/AASHTO M194, Type A.
   2. Retarding Admixture: ASTM C494/AASHTO M194, Type B.
   3. Water-Reducing and Retarding Admixture: ASTM C494/AASHTO M194, Type D.
   4. High-Range, Water-Reducing Admixture: ASTM C494/AASHTO M194, Type F.
   5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494/AASHTO M194, Type G.
   6. Plasticizing and Retarding Admixture: ASTM C1017/C1017M, Type II.

E. Color Pigment (If Applicable): ASTM C979/C979M, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

F. Water: Potable and complying with ASTM C94/C94M.

2.5 FIBER REINFORCEMENT

A. Synthetic Fiber, Monofilament Fibers: Monofilament polypropylene fibers engineered and designed for use in decorative concrete paving, complying with ASTM C1116/C1116M, Type III, 1/2 to 1-1/2 inches long.

2.6 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. dry or cotton mats.

B. Moisture-Retaining Cover: ASTM C171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Evaporation Retarder (If Required): Waterborne, monomolecular, film forming, manufactured for application to fresh concrete.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C309, Type 1, Class B, dissipating. VOC < 350 g/L, or per AHJ.

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C1315, Type 1, Class A. VOC < 350 g/L, or per AHJ.

2.7 RELATED MATERIALS

A. Joint Fillers: ASTM D1751, asphalt-saturated cellulosic fiber, ASTM D1752, cork or self-expanding cork or ASTM D8139, semirigid, closed-cell polypropylene foam in preformed strips.

B. Slip-Resistive Aggregate Finish: Factory-graded, packaged, rustproof, nonglazing, abrasive aggregate of fused aluminum-oxide granules or crushed emery aggregate containing not less than 50 percent aluminum oxide and not less than 20 percent ferric oxide; unaffected by freezing, moisture, and cleaning materials.

C. Bonding Agent: ASTM C1059/C1059M, Type II, non-redispersible, 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, of grade complying with requirements, and of the following types:
   1. Types I and II, (non-load bearing applications) or Types IV and V (load bearing applications), for bonding hardened or freshly mixed concrete to hardened concrete.

E. Chemical Surface Retarder: Water-soluble, liquid, set retarder with color dye, for horizontal concrete surface application, capable of temporarily delaying final hardening of concrete to a depth of 1/8 to 1/4 inch.

2.8 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301, for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.
   1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
   2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that comply with or exceed requirements.

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
   1. Fly Ash or Pozzolan: 25 percent.
   2. Slag Cement: 50 percent.
   3. Combined Fly Ash or Pozzolan, and Slag Cement: 50 percent, with fly ash or pozzolan not exceeding 25 percent.

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:
   1. Air Content, 1-1/2-inch Nominal Maximum Aggregate Size: 5-1/2 or 4-1/2 or 2-1/2 percent plus or minus 1-1/2 percent.

2. Air Content, 1-inch Nominal Maximum Aggregate Size: 6 or 4-1/2 or 3 percent plus or minus 1-1/2 percent.
3. Air Content, 3/4-inch Nominal Maximum Aggregate Size: 6 or 5 or 3-1/2 percent plus or minus 1-1/2 percent.

D. Limit water-soluble, chloride-ion content in hardened concrete to 0.15 percent by weight of cement.

E. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

F. Synthetic Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 1.0 lb/cu. yd.

G. Color Pigment (If Applicable): Add color pigment to concrete mixture according to manufacturer's written instructions and to result in hardened concrete color consistent with approved mockup.

H. Concrete Mixtures: Normal-weight concrete.
1. Compressive Strength (28 Days): 4000 psi.
2. Maximum W/C Ratio at Point of Placement: 0.45.
3. Slump Limit: 5 inches, plus or minus 1 inch.

2.9 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M and ASTM C1116/C1116M. Furnish batch certificates for each batch discharged and used in the Work.
1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C94/C94M. Mix concrete materials in appropriate drum-type batch machine mixer.
1. For concrete batches of 1 cu. yd. or smaller, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released.
2. For concrete batches 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, mixing time, quantity, and amount of water added.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for

dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving in areas of proposed vehicular traffic to identify soft pockets and areas of excess yielding.
   1. Completely proof-roll subbase in one direction and repeat in perpendicular direction. Limit vehicle speed to 3 mph.
   2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons.
   3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch according to requirements in Section 312000 "Earth Moving."

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides 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.

3.4 INSTALLATION OF STEEL REINFORCEMENT

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded-wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

E. Zinc-Coated Reinforcement: Use galvanized-steel wire ties to fasten zinc-coated reinforcement. Repair cut and damaged zinc coatings with zinc repair material.

F. Epoxy-Coated Reinforcement: Use epoxy-coated steel wire ties to fasten epoxy-coated reinforcement. Repair cut and damaged epoxy coatings with epoxy repair coating according to ASTM D3963/D3963M.

G. Install fabricated bar mats in lengths as long as practicable. Handle units to keep them flat and

free of distortions. Straighten bends, kinks, and other irregularities, or replace units as required before placement. Set mats for a minimum 2-inch overlap of adjacent mats.

3.5 JOINTS

A. General: Form construction, isolation, and contraction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
   1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
   1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
   2. Provide tie bars at sides of paving strips where indicated.
   3. Butt Joints: Use bonding agent or epoxy-bonding adhesive at joint locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
   4. Keyed Joints: Provide preformed keyway-section forms or bulkhead forms with keys unless otherwise indicated. Embed keys at least 1-1/2 inches into concrete.
   5. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

C. Isolation Joints: Form isolation joints of preformed joint-filler strips abutting concrete curbs, catch basins, manholes, inlets, structures, other fixed objects, and where indicated.
   1. Locate expansion joints at intervals of 50 feet unless otherwise indicated.
   2. Extend joint fillers full width and depth of joint.
   3. Terminate joint filler not less than 1/2 inch or more than 1 inch below finished surface if joint sealant is indicated.
   4. Place top of joint filler flush with finished concrete surface if joint sealant is not indicated.
   5. Furnish joint fillers in one-piece lengths. Where more than one length is required, lace or clip joint-filler sections together.
   6. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

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, as follows[, to match jointing of existing adjacent concrete paving]:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with grooving tool to a 1/4-inch or 3/8-inch radius. Repeat grooving of contraction joints after applying surface finishes.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch-wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.

3. Doweled Contraction Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or coat with asphalt one-half of dowel length to prevent concrete bonding to one side of joint.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/4-inch or 3/8-inch radius. Repeat tooling of edges after applying surface finishes.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, reinforcement if applicable, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement, if applicable, before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 requirements for measuring, mixing, transporting, and placing concrete.

E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. 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.

G. Consolidate concrete according to ACI 301 by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies, reinforcement, or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating reinforcement, dowels, and or joint devices.

H. Screed paving surface with a straightedge and strike off.

I. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleedwater appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

J. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.

B. Float Finish: Begin the second floating operation when bleedwater 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. Provide medium-to-fine broom finish on pedestrian concrete paving unless otherwise indicated on the Drawings.
   2. 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.

3.8 SPECIAL FINISHES

A. Seeded Exposed-Aggregate Finish: Immediately after initial floating, spread a single layer of aggregate uniformly on paving surface. Tamp aggregate into plastic concrete and float finish to entirely embed aggregate with mortar cover of 1/16 inch.
   1. Spray-apply chemical surface retarder to paving according to manufacturer's written instructions.
   2. Cover paving surface with plastic sheeting, sealing laps with tape, and remove sheeting when ready to continue finishing operations.
   3. Without dislodging aggregate, remove mortar concealing the aggregate by lightly brushing surface with a stiff, nylon-bristle broom. Do not expose more than one-third of the average diameter of the aggregate and not more than one-half of the diameter of the smallest aggregate.
   4. Fine-spray surface with water and brush. Repeat cycle of water flushing and brushing until cement film is removed from aggregate surfaces to depth required.

3.9 INSTALLATION OF DETECTABLE WARNINGS

A. Cast-in-Place Detectable Warning Tiles: Form blockouts in concrete for installation of tiles specified in Section 321726 "Tactile Warning Surfacing." Screed surface of concrete where tiles are to be installed to elevation, so that edges of installed tiles will be flush with surrounding concrete paving. Embed tiles in fresh concrete to comply with Section 321726 "Tactile Warning Surfacing" immediately after screeding concrete surface.

3.10 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 as follows:
   1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
      a. Water.
      b. Continuous water-fog spray.
      c. Absorptive cover, water saturated and kept continuously wet. Cover concrete surfaces and edges with 12-inch lap over adjacent absorptive covers.
   2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover, placed in widest practicable width, with sides and ends lapped at least 12 inches and sealed by waterproof tape or adhesive. Immediately repair any holes or tears occurring during installation or curing period, using cover material and waterproof tape.
   3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

3.11 PAVING TOLERANCES

A. Comply with tolerances in ACI 117 and as follows:
   1. Elevation: 1/2 inch.
   2. Thickness: Plus 3/8 inch minus 1/4 inch.
   3. Surface: Gap below 10-feet-long; unleveled straightedge not to exceed 1/2 inch.
   4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches of tie bar.
   5. Lateral Alignment and Spacing of Dowels: 1 inch.
   6. Vertical Alignment of Dowels: 1/4 inch.
   7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches of dowel.
   8. Joint Spacing: 3 inches.
   9. Contraction Joint Depth: Plus 1/4 inch, no minus.
   10. Joint Width: Plus 1/8 inch, no minus.

3.12 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Testing Services: Testing and inspecting of composite samples of fresh concrete obtained according to ASTM C172/C172M will be performed according to the following requirements:
   1. Testing Frequency: Obtain at least one composite sample for each 200 cu. yd. or fraction thereof of each concrete mixture placed each day.

a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing 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; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
3. Air Content: ASTM C231/C231M, pressure method; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
4. Concrete Temperature: ASTM C1064/C1064M; one test hourly when air temperature is 40 deg F and below and when it is 80 deg F and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C31/C31M; cast and laboratory cure one set of three standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C39/C39M; test one specimen at seven days and two specimens at 28 days.
   a. A compressive-strength test to be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

C. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.

D. Test results to be reported in writing to Architect, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests to contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.

E. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.

F. Additional Tests: Testing and inspecting agency will 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 Architect.

G. Concrete paving will be considered defective if it does not pass tests and inspections.

H. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

I. Prepare test and inspection reports.

3.13 REPAIR AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Drill test cores, where directed by Architect, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION

SECTION 321373

CONCRETE PAVING JOINT SEALANTS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, as applicable.

B. Reference is made herein to the Pennsylvania Department of Transportation (PennDOT), Publication 408, latest edition, and all addendums/supplemental specs hereinafter referred to as the "Standard Specifications." References made to particular sections or paragraphs in the Standard Specifications shall include all related articles mentioned therein. Pavement shall comply with PennDOT Standard Specifications.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Cold-applied joint sealants.
2. Joint-sealant backer materials.
3. Primers.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Statements: For Installer.

1.4 QUALITY ASSURANCE

A. Qualifications:
1. Installers: Entity that employs installers and supervisors who are trained and approved by manufacturer.

1.5 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 or are below 40 deg F.

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 SOURCE LIMITATIONS

A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 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.

2.3 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant: ASTM D5893/D5893M, Type NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant: ASTM D5893/D5893M, Type SL.

C. Multicomponent, Nonsag, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade NS, Class 25, for Use T.

D. Single Component, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type S, Grade P, Class 25, for Use T.

E. Multicomponent, Pourable, Urethane, Elastomeric Joint Sealant: ASTM C920, Type M, Grade P, Class 25, for Use T.

2.4 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. Round Backer Rods for Cold- and Hot-Applied Joint Sealants: ASTM D5249, Type 1, of diameter and density required to control sealant depth and prevent bottom-side adhesion of sealant.

C. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D5249, Type 3, of diameter and

density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

D. 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.

2.5 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, nonsag, silicone joint sealant or Single component, pourable, urethane, elastomeric joint sealant or Hot-applied, single-component joint sealant.

3. Joint-Sealant Color: Manufacturer's standard.

B. Joints within concrete paving and between concrete and asphalt paving:
   1. Joint Location:
      a. Joints between concrete and asphalt paving.
      b. Joints between concrete curbs and asphalt paving.
      c. Other joints as indicated.
   2. Joint Sealant: Hot-applied, single-component joint sealant.
   3. Joint-Sealant Color: Manufacturer's standard.

END OF SECTION

SECTION 321723

PAVEMENT MARKINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, as applicable.

B. Reference is made herein to the Pennsylvania Department of Transportation (PennDOT), Publication 408, latest edition, and all addendums/supplemental specs hereinafter referred to as the "Standard Specifications." References made to particular sections or paragraphs in the Standard Specifications shall include all related articles mentioned therein. Pavement shall comply with PennDOT Standard Specifications.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Thermoplastic pavement markings applied to asphalt paving, with acrylic pavement-marking paint permitted where indicated or approved.
2. Acrylic pavement-marking paint applied to concrete surfaces unless the thermoplastic manufacturer provides an approved system for concrete.

1.3 ACTION SUBMITTALS

A. Product Data: Include technical data and tested physical and performance properties.
1. Thermoplastic pavement-marking material and acrylic pavement-marking paint.
2. Glass beads.

B. Shop Drawings:
1. Indicate pavement markings, colors, lane separations, defined parking spaces, and dimensions to adjacent work.
2. Indicate, with international symbol of accessibility, spaces allocated for people with disabilities.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of state or local DOT for pavement-marking work within right-of-way.
   1. Measurement and payment provisions and safety program submittals included in standard specifications do not apply to this Section.

1.5 FIELD CONDITIONS

A. Environmental Limitations: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature specified by the manufacturer, but no less than 40°F and no exceeding 95°F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain pavement-marking paints from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Accessibility Standard: Comply with applicable provisions in the USDOJ's "2010 ADA Standards for Accessible Design", ICC A117.1, and the local authority having jurisdiction.

2.3 THERMOPLASTIC AND ACRYLIC PAVEMENT MARKINGS

A. Pavement-Marking Material, Thermoplastic: Hot-applied thermoplastic pavement-marking material, lead and chromate free, formulated for reflectorized traffic markings, and complying with PennDOT Publication 408, Section 960.
   1. Color: As indicated on Drawings. Provide white and yellow materials conforming to PennDOT color requirements.
   2. Reflective Glass Beads: Provide factory-intermixed and surface-applied reflective glass beads compatible with the thermoplastic material and complying with AASHTO M 247. Apply beads at the rate recommended by the thermoplastic manufacturer and as required by PennDOT Publication 408.
   3. Application: Apply thermoplastic pavement markings at the thickness, temperature, and application rate recommended by the manufacturer and required by PennDOT Publication 408. Provide primer or sealer where required by the manufacturer for the pavement substrate.
   4. Primary Material: Thermoplastic shall be the primary pavement-marking material on asphalt pavement. Acrylic pavement-marking paint may be used where indicated on Drawings, on concrete surfaces, or where approved by Owner.

B. Pavement-Marking Paint, Acrylic: Acrylic, waterborne emulsion, lead and chromate free, ready mixed, complying with FS TT-P-1952F, Type II.
   1. Color: As indicated on Drawings. Yellow paint shall be organic Yellow No. 75 pigment.
   2. Install using reflective glass beads if required by authority having jurisdiction (e.g. pavement markings within right-of-way) or Owner.

C. Glass Beads: AASHTO M 247, Type 1 or FS TT-B-1325D, Type 1.
   1. Roundness: Minimum 80 percent true spheres by weight.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that pavement-marking substrate is dry and in suitable condition to begin pavement marking in accordance with manufacturer's written instructions.

B. Proceed with pavement marking only after unsatisfactory conditions have been corrected.

3.2 PAVEMENT MARKING

A. Do not apply pavement markings until layout, colors, materials, and placement have been verified against the Drawings and found acceptable by construction manager.

B. Allow asphalt paving or concrete surfaces to age for a minimum of 90 days or as recommended by manufacturer, but no sooner than 30 days before starting pavement marking.

C. Sweep and clean surface to eliminate loose material and dust.

D. Apply paint with mechanical equipment to produce pavement markings, of dimensions indicated, with uniform, straight edges. Apply at manufacturer's recommended rates to provide a minimum wet film thickness of 15 mils.
   1. Apply symbols, lettering, and striping with templates, stencils, or mechanical equipment suitable for the specified thermoplastic or acrylic material. Produce uniform dimensions and clean, straight edges.
   2. Broadcast glass beads uniformly into wet markings at a rate of 6 lb/gal.

3.3 PROTECTING AND CLEANING

A. Protect pavement markings from damage and wear during remainder of construction period.

B. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION

SECTION 321726

TACTILE WARNING SURFACING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, as applicable.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Cast-in-place detectable warning tiles.
2. Surface-applied detectable warning tiles.
3. Detectable warning mats.

D. Related Requirements:
1. Section 321313 "Concrete Paving" for concrete walkways serving as substrates for tactile warning surfacing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples for Verification: For each type of tactile warning surface, in manufacturer's standard sizes unless otherwise indicated, showing edge condition, truncated-dome pattern, texture, color, and cross section; with fasteners and anchors.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For tactile warning surfacing, to include in maintenance manuals.

1.5 PROJECT CONDITIONS

A. Cold-Weather Protection: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen subgrade or setting beds. Remove and replace unit paver work damaged by frost or freezing.

B. Weather Limitations for Adhesive Application:
   1. Apply adhesive only when ambient temperature is above 50 deg F and when temperature has not been below 35 deg F for 12 hours immediately before application. Do not apply when substrate is wet or contains excess moisture.

C. Weather Limitations for Mortar and Grout:
   1. Cold-Weather Requirements: Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
   2. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602. Provide artificial shade and windbreaks, and use cooled materials as required. Do not apply mortar to substrates with temperatures of 100 deg F and higher.
      a. When ambient temperature exceeds 100 deg F, or when wind velocity exceeds 8 mph and ambient temperature exceeds 90 deg F.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of tactile warning surfaces that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Deterioration of finishes beyond normal weathering and wear.
      b. Separation or delamination of materials and components.
   2. Warranty Period: Five years from date of Substantial Completion.

PART 2 PRODUCTS

2.1 TACTILE WARNING SURFACING, GENERAL

A. Accessibility Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for tactile warning surfaces.
   1. For tactile warning surfaces composed of multiple units, provide units that when installed provide consistent side-to-side and end-to-end dome spacing that complies with requirements.

B. Source Limitations: Obtain each type of tactile warning surfacing, joint material, setting material, anchor, and or fastener from single source with resources to provide materials and products of consistent quality in appearance and physical properties.

2.2 DETECTABLE WARNING TILES

A. Shapes and Sizes:
   1. Thickness: 2 inches to 2-1/2 inches at field of tile.
   2. Face Size: Nominal 12 by 12 inches or 24 by 24 inches.

B. Dome Spacing and Configuration: 2.4-inch spacing, in manufacturer's standard pattern.

C. Color: As indicated on the Drawings and contrasting visually with adjacent paving.

2.3 CAST-IN-PLACE DETECTABLE WARNING TILES

A. Accessible truncated-dome detectable warning tiles configured for setting flush in new concrete walkway surfaces, with slip-resistant surface treatment on domes and field of tile.
   1. Material: Cast-fiber-reinforced polymer concrete tile or Molded glass- and carbon-fiber-reinforced polyester.
   2. Color: As selected by Architect from manufacturer's full line.
   3. Shapes and Sizes:
      a. Rectangular panel, sizes as needed to install as shown.
      b. Radius panel, sizes as needed to install as shown.
   4. Dome Spacing and Configuration: 2.4-inch spacing, in square pattern.
   5. Mounting:
      a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
      b. Detectable warning tile set into formed recess in concrete and adhered with mortar or adhesive.

B. Surface-Applied Detectable Warning Tiles: Accessible truncated-dome detectable warning concrete tiles configured for surface application on existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of tile, and beveled outside edges.
   1. Material: Cast-fiber-reinforced polymer concrete tile or Molded glass- and carbon-fiber-reinforced polyester.
   2. Color: As selected by Architect from manufacturer's full line.
   3. Shapes and Sizes:
      a. Rectangular panel, sizes as needed to install as shown.
      b. Radius panel, sizes as needed to install as shown.
   4. Dome Spacing and Configuration: 2.4-inch spacing, in square pattern.
   5. Mounting:
      a. Permanently embedded detectable warning tile wet-set into freshly poured concrete.
      b. Detectable warning tile set into formed recess in concrete and adhered with mortar or adhesive.
   6. Mounting: Adhered and or fastened to concrete walkway.

2.4 DETECTABLE WARNING MATS

A. Surface-Applied Detectable Warning Mats: Accessible truncated-dome detectable warning resilient mats, UV resistant, manufactured for adhering to existing concrete walkway surfaces, with slip-resistant surface treatment on domes, field of mat, and beveled outside edges.
   1. Material: Modified rubber compound, UV resistant.
   2. Color: As selected by Architect from manufacturer's full range.
   3. Shapes and Sizes:
      a. Rectangular panel, sizes as needed to install as shown.
   4. Dome Spacing and Configuration: : 2.4-inch spacing, in square pattern.
   5. Mounting: Adhered to pavement surface with adhesive and or fastened with fasteners.

2.5 ACCESSORIES

A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of tactile warning surfaces, noncorrosive and compatible with each material joined, and complying with the following:
   1. Furnish Type 304 stainless-steel fasteners for exterior use.
   2. Fastener Heads: For nonstructural connections, use flathead or oval countersunk screws and bolts with tamper-resistant heads, colored to match tile.

B. Adhesive: As recommended by manufacturer for adhering tactile warning surfacing unit to pavement.

C. Sealant: As recommended by manufacturer for sealing perimeter of tactile warning surfacing unit.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify that pavement is in suitable condition to begin installation according to manufacturer's written instructions. Verify that installation of tactile warning surfacing will comply with accessibility requirements upon completion.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF TACTILE WARNING SURFACING

A. General: Prepare substrate and install tactile warning surfacing according to manufacturer's written instructions unless otherwise indicated.

B. Place tactile warning surfacing units in dimensions and orientation indicated. Comply with location requirements of AASHTO MP 12.

3.3 INSTALLATION OF DETECTABLE WARNING TILES

A. Cast-in-Place Detectable Warning Tiles:
   1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of tile.
   2. Set each detectable warning tile accurately and firmly in place and completely seat tile back and embedments in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
   3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.

4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
5. Clean tiles using methods recommended in writing by manufacturer.

B. Removable Cast-in-Place Detectable Warning Tiles:
1. Concrete Paving Installation: Comply with installation requirements in Section 321313 "Concrete Paving." Mix, place, and finish concrete to conditions complying with detectable warning tile manufacturer's written requirements for satisfactory embedment of removable tile.
2. Set each detectable warning tile accurately and firmly in place with embedding anchors and fasteners attached, and firmly seat tile back in wet concrete by tamping or vibrating. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
3. Set surface of tile flush with surrounding concrete and adjacent tiles, with variations between tiles and between concrete and tiles not exceeding plus or minus 1/8 inch from flush.
4. Protect exposed surfaces of installed tiles from contact with wet concrete. Complete finishing of concrete paving surrounding tiles. Remove concrete from tile surfaces.
5. Clean tiles using methods recommended in writing by manufacturer.

C. Surface-Applied Detectable Warning Tiles:
1. Lay out detectable warning tiles as indicated and mark concrete pavement.
2. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.
   a. Cut perimeter kerf in existing concrete pavement to receive metal tile flange.
3. Apply adhesive to back of tiles in amounts and pattern recommended by manufacturer, and set tiles in place. Firmly seat tiles in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to tiles to ensure full contact with concrete.
4. Install anchor devices through face of tiles and into pavement using anchors located as recommended by manufacturer. Set heads of anchors flush with top surface of mat.
5. Mask perimeter of tiles and adjacent concrete, and apply sealant in continuous bead around perimeter of tile installation.
6. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning tiles and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.
7. Protect installed tiles from traffic until adhesive has set.

3.4 INSTALLATION OF DETECTABLE WARNING MATS

A. Lay out detectable warning mats as indicated and mark concrete pavement at edges of mats.

B. Prepare existing paving surface by grinding and cleaning as recommended by manufacturer.

C. Apply adhesive to back of mat in amounts and pattern recommended by manufacturer, and set mat in place. Firmly seat mat in adhesive bed, eliminating air pockets and establishing full adhesion to pavement. If necessary, temporarily apply weight to mat to ensure full contact with adhesive.

D. Install anchor devices through face of mat and into pavement using anchors located as

recommended by manufacturer. Set heads of anchors flush with mat surface.

E. Mask mat perimeter and adjacent concrete, and apply sealant in continuous bead around perimeter of mat.

F. Remove masking, adhesive, excess sealant, and soil from exposed surfaces of detectable warning mat and surrounding concrete pavement using cleaning agents recommended in writing by manufacturer.

G. Protect installed mat from traffic until adhesive has set.

3.5 CLEANING AND PROTECTION

A. Remove and replace tactile warning surfacing that is broken or damaged or does not comply with requirements in this Section. Remove in complete sections from joint to joint unless otherwise approved by Architect. Replace using tactile warning surfacing installation methods acceptable to Architect.

B. Protect tactile warning surfacing from damage and maintain free of stains, discoloration, dirt, and other foreign material.

END OF SECTION

SECTION 323113

CHAIN LINK FENCES AND GATES

PART 1 GENERAL

1.1 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Chain-link fence framework.
2. Chain-link fence fabric.
3. Chain-link fittings.
4. Chain-link wires and ties.
5. Chain-link swing gates.
6. Chain-link horizontal-slide gates.

D. Related Requirements:
1. Section 033000 "Cast-in-Place Concrete" for cast-in-place concrete for post footings.

1.2 ACTION SUBMITTALS

A. Product Data:
1. For each type of product.
a. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for the following:
b. Fence and gate posts, rails, and fittings.
c. Chain-link fabric, reinforcements, gate types, hardware, and attachments.
d. Accessories if applicable.
e. Gates and hardware.

B. Shop Drawings: For each type of fence and gate assembly.
1. Include plans, elevations, sections, ground details, mounting, post spacing, and attachments to other work.
2. Include accessories, hardware, gate operation, and operational clearances.

C. Samples for Initial Selection: For each type of factory-applied finish.

D. Samples for Verification: For each type of component with factory-applied finish, prepared on Samples of size indicated below:
1. Polymer-Coated Components: In 6-inch lengths for components and on full-sized units for accessories.

E. Delegated Design Submittal: For structural performance of chain-link fence and gate frameworks, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of chain-link fence and gate.

B. Field quality-control reports.

C. Sample Warranty: For special warranty.

1.4 QUALITY ASSURANCE

1.5 FIELD CONDITIONS

A. Field Measurements: Verify layout information for chain-link fences and gates shown on Drawings in relation to property survey and existing structures. Verify dimensions by field measurements.

1.6 WARRANTY

A. Special Warranty: Manufacturer agrees and or Installer agrees to repair or replace components of fences and gates that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Failure to comply with performance requirements.
      b. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
      c. Faulty operation of gate operators and controls.
   2. Warranty Period: Five year minimum from date of Substantial Completion.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design chain-link fence and gate frameworks.

B. Structural Performance: Chain-link fence and gate frameworks are to withstand the design wind loads and stresses for fence height(s) and under exposure conditions indicated in accordance with ASCE/SEI 7.

C. Accessibility: Pedestrian gates to comply with the United States Access Board's ADA-ABA Accessibility Guidelines.

2.2 CHAIN-LINK FENCES, GENERAL

A. CLFMI Publications: Comply with the CLFMI Product Manual unless modified by requirements in the Contract Documents.

B. Chain-Link Fence and Gate Assemblies: Include materials applicable for a complete assembly of application types, consisting of commercial, industrial, and security chain-link fences and gates.
   1. Source Limitations: Obtain chain-link fence and gate components from single source or manufacturer.

2.3 CHAIN-LINK FENCE FRAMEWORK

A. Posts and Rails: ASTM F1043 for framework, including rails, braces, and line; terminal; and corner posts. Provide members with minimum dimensions and wall thicknesses in accordance with ASTM F1043 based on the following:
   1. Fence Height: As indicated on Drawings.
   2. Light-Industrial-Strength Material: Group IC-L, round steel pipe, electric-resistance-welded pipe.
      a. Line Post: As indicated on Drawings.
      b. End, Corner, and Pull Posts: As indicated on Drawings.
   3. Horizontal Framework Members: Top rails in accordance with ASTM F1043.
      a. Top Rail: 1.5 inches in diameter.
   4. Brace Rails: ASTM F1043.
   5. Metallic Coating for Steel Framework:
      a. External, Type B: Zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft of zinc after welding, a chromate conversion coating, and a clear, verifiable polymer film. Internal, Type D, consisting of 81 percent, not less than 0.3-mil-thick, zinc-pigmented coating.
      b. Coatings: Any coating above.
   6. Polymer coating over metallic coating.
      a. Color: As selected by Architect from manufacturer's full range, in accordance with ASTM F934.

2.4 CHAIN-LINK FENCE FABRIC

A. General: Provide fabric in one-piece heights measured between top and bottom of outer edge of selvage knuckle or twist in accordance with "CLFMI Product Manual" and requirements indicated below:
   1. Fabric Height: 5.5' to 5.75'
   2. Steel Wire for Fabric: Wire diameter of 13 Gauge.
      a. Mesh Size: 2-1/8 inches or 2 inches or 1-3/4 inches.
      b. Polymer-Coated Fabric: ASTM F668, over galvanized coated steel wire.
         1) Color: As selected by Architect from manufacturer's full range, in accordance with ASTM F934.
      c. Coat selvage ends of metallic-coated fabric before the weaving process with manufacturer's standard clear protective coating.

2.5 CHAIN-LINK FITTINGS

A. Provide fittings in accordance with ASTM F626.

B. Post Caps: Provide for each post.
   1. Provide line post caps with loop to receive tension wire or top rail.

C. Rail and Brace Ends: For each gate, corner, pull, and end post.

D. Rail Fittings: Provide the following:
   1. Top Rail Sleeves: round-steel tubing or Aluminum Alloy 6063 not less than 4 inches long.
   2. Rail Clamps: Line and corner boulevard clamps for connecting rails to posts.

E. Tension and Brace Bands: Pressed steel or Aluminum Alloy 6063.

F. Tension Bars: Aluminum, length not less than 2 inches shorter than full height of chain-link fabric. Provide one bar for each gate and end post, and two for each corner and pull post, unless fabric is integrally woven into post.

G. Truss Rod Assemblies: Steel, hot-dip galvanized after threading rod and turnbuckle or other means of adjustment.

H. Tie Wires, Clips, and Fasteners: In accordance with ASTM F626.
   1. Standard Round Wire Ties: For attaching chain-link fabric to posts, rails, and frames, in accordance with the following:
      a. Hot-Dip Galvanized Steel: 0.106-inch-diameter wire; galvanized coating thickness matching coating thickness of chain-link fence fabric.
      b. Aluminum: ASTM B211/B211M; Alloy 1350-H19; 0.148-inch-diameter, mill-finished wire.

I. Finish:
   1. Metallic Coating for Pressed Steel or Cast Iron: Not less than 1.2 oz./sq. ft of zinc.
      a. Polymer coating over metallic coating.
   2. Aluminum: Mill finish.

2.6 CHAIN-LINK WIRE AND TIES

A. Metallic-Coated Steel Wire: 0.177-inch-diameter, marcelled tension wire in accordance with ASTM A817 or ASTM A824, with the following metallic coating:
   1. Type II: Zinc coated (galvanized) by hot-dip or electrolytic process, with the following minimum coating weight:
      a. Matching chain-link fabric coating weight.
   2. Type III: Zn-5-Al-MM alloy with the following minimum coating weight:
      a. Matching chain-link fabric coating weight.

B. Polymer-Coated Steel Wire: 0.177-inch- or 0.148-inch-diameter, tension wire in accordance with ASTM F1664, over galvanized-coated steel wire.
   1. Color: As selected by Architect from manufacturer's full range, in accordance with

ASTM F934.

2.7 CHAIN-LINK HORIZONTAL-SLIDE GATES

A. Chain-Link Horizontal-Slide Gates: ASTM F1184 for gate posts and double sliding gate types for vehicle assembly.
   1. Classification:
      a. Type II Cantilever Slide, Class 1 with external roller assemblies:
         1) Slide Gate Frame Width and Height: matching dimensions for fence or as indicated on the plans.

B. Slide Gate Pipe and Tubing Finish:
   1. Zinc-Coated Steel: Protective coating and finish to match fence framework.
   2. Aluminum: ASTM B429/B429M; manufacturer's standard finish.
   3. Sliding Gate Posts: ASTM F1184. Provide round tubular steel posts.
   4. Sliding Gate Frames and Bracing: Round tubular steel.

C. Slide Gate Frame Corner Construction: assembled with corner fittings.

D. Slide Extended Gate Posts and Frame Members: Extend gate posts and frame end members above top of chain-link fabric at both ends of gate frame 12 inches as required.

E. Overhead Track Assembly: Manufacturer's standard track, with overhead framework supports, bracing, and accessories, engineered to support size, weight, width, operation, and design of gate and roller assemblies.

F. Slide Gate Hardware:
   1. Hangers, Roller Assemblies, and Stops: Fabricated from galvanized steel.
   2. Latch: Permitting operation from both sides of gate with provision for padlocking accessible from both sides of gate.
   3. Lock: Manufacturer's standard internal device.
   4. Padlock and Chain per Owner.

2.8 GROUT AND ANCHORING CEMENT

A. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M. Provide grout, recommended in writing by manufacturer, for exterior applications.

B. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound. Provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating, and that is recommended in writing by manufacturer for exterior applications.

2.9 CONCRETE

A. Concrete Post Footings: Minimum 28-day compressive strength of 4000 psi.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for a certified survey of property lines and legal boundaries, site clearing, earthwork, pavement work, and other conditions affecting performance of the Work.
   1. Do not begin installation before final grading is completed unless otherwise permitted by Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Stake locations of fence lines, gates, and terminal posts. Do not exceed intervals of 500 feet or line of sight between stakes. Indicate locations of utilities, lawn sprinkler system, underground structures, benchmarks, and property monuments.

3.3 INSTALLATION OF CHAIN-LINK FENCES

A. Install chain-link fencing in accordance with ASTM F567 and more stringent requirements specified.
   1. Install fencing on established boundary lines inside property line.

B. Post Excavation: Drill or hand-excavate holes for posts to diameters and spacings indicated, in firm, undisturbed soil.

C. Post Setting: Set posts in concrete at indicated spacing into firm, undisturbed soil.
   1. Verify that posts are set plumb, aligned, and at correct height and spacing, and hold in position during setting with concrete or mechanical devices.
   2. Concrete Fill: Place concrete around posts to dimensions indicated and vibrate or tamp for consolidation. Protect aboveground portion of posts from concrete splatter. As indicated on plans.

D. Terminal Posts: Install terminal end, corner, and gate posts in accordance with ASTM F567 and terminal pull posts at changes in horizontal or vertical alignment 30 degrees or more For runs exceeding 500 feet, space pull posts an equal distance between corner or end posts.

E. Line Posts: Space line posts uniformly at 9 feet o.c.

F. Post Bracing and Intermediate Rails: Install in accordance with ASTM F567, maintaining plumb position and alignment of fence posts. Diagonally brace terminal posts to adjacent line posts with truss rods and turnbuckles. Install braces at end and gate posts and at both sides of corner and pull posts.
   1. Locate horizontal braces at midheight of fabric 72 inches or higher, on fences with top rail, and at two-third fabric height on fences without top rail. Install so posts are plumb when diagonal rod is under proper tension.

G. Tension Wire: Install in accordance with ASTM F567, maintaining plumb position and alignment of fence posts. Pull wire taut, without sags. Fasten fabric to tension wire with 0.120-inch-diameter hog rings of same material and finish as fabric wire, spaced a maximum of 24 inches o.c. Install tension wire in locations indicated before stretching fabric. Provide horizontal tension wire at the following locations:
   1. Extended along bottom of fence fabric. Install top tension wire through post cap loops. Install bottom tension wire within 3 inches of bottom of fabric and tie to each post with not less than same diameter and type of wire.
   2. As indicated on Drawings.

H. Top Rail: Install in accordance with ASTM F567, maintaining plumb position and alignment of fence posts. Run rail continuously through line post caps, bending to radius for curved runs and terminating into rail end attached to posts or post caps fabricated to receive rail at terminal posts. Provide expansion couplings as recommended in writing by fencing manufacturer.

I. Intermediate and Bottom Rails: Secure to posts with fittings.

J. Chain-Link Fabric: Apply fabric to outside of enclosing framework. Leave 3-inch bottom clearance between finish grade or surface and bottom selvage unless otherwise indicated. Pull fabric taut and tie to posts, rails, and tension wires. Anchor to framework so fabric remains under tension after pulling force is released.

K. Tension or Stretcher Bars: Thread through fabric and secure to end, corner, pull, and gate posts, with tension bands spaced not more than 15 inches o.c.

L. Tie Wires: Use wire of proper length to firmly secure fabric to line posts and rails. Attach wire at one end to chain-link fabric, wrap wire around post a minimum of 180 degrees, and attach other end to chain-link fabric in accordance with ASTM F626. Bend ends of wire to minimize hazard to individuals and clothing.
   1. Maximum Spacing: Tie fabric to line posts at 12 inches o.c. and to braces at 24 inches o.c.

M. Fasteners: Install nuts for tension bands and carriage bolts on the side of fence opposite the fabric side.

3.4 INSTALLATION OF GATES

A. Install gates in accordance with manufacturer's written instructions, level, plumb, and secure for full opening without interference. Attach fabric as for fencing. Attach hardware using tamper-resistant or concealed means. Install ground-set items in concrete for anchorage. Adjust hardware for smooth operation.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests.

B. Prepare test reports.

3.6 ADJUSTING

A. Gates: Adjust gates to operate smoothly, easily, and quietly, free of binding, warp, excessive deflection, distortion, nonalignment, misplacement, disruption, or malfunction, throughout entire operational range. Confirm that latches and locks engage accurately and securely without forcing or binding.

B. Lubricate hardware and other moving parts.

3.7 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain chain-link fences and gates.

END OF SECTION

SECTION 323300

SITE FURNISHINGS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Seating.
2. Bicycle racks.
3. Bollards.

D. Related Requirements:
1. Section 033000 "Cast-in-Place Concrete".

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.

C. Samples for Initial Selection: For units with factory-applied finishes.

D. Samples for Verification: For each type of exposed finish, not less than 6-inch- long linear components and 4-inch-square sheet components.
1. Include full-size Samples of bench and bicycle rack. Approved samples may be incorporated into the Work.

E. Product Schedule: For site furnishings, use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For site furnishings to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Bench Replacement Slats: No fewer than two full-size units for each size indicated.
   2. Anchors: No fewer than two for item.

PART 2 PRODUCTS

2.1 BENCHES

A. As indicated on Drawings.

2.2 BICYCLE RACKS

A. As indicated on Drawings.

2.3 BOLLARDS

A. Bollard Construction:
   1. Pipe OD: Not less than 6 inches.
      a. Steel: Schedule 80 pipe.
   2. Style: As indicated on Drawings.
   3. Overall Height: As indicated on Drawings.
   4. Overall Width: As indicated on Drawings.
   5. Overall Depth: As indicated on Drawings.
   6. Accessories: Galvanized Steel Eye bolts As indicated on Drawings.
   7. Installation Method: As indicated on Drawings.

B. Steel Finish: Color coated.
   1. Color: Yellow, As indicated on Drawings.

2.4 MATERIALS

A. Steel and Iron: Free of surface blemishes and complying with the following:
   1. Plates, Shapes, and Bars: ASTM A36/A36M.
   2. Steel Pipe: Standard-weight steel pipe complying with ASTM A53/A53M, or electric-resistance-welded pipe complying with ASTM A135/A135M.
   3. Tubing: Cold-formed steel tubing complying with ASTM A500/A500M.
   4. Mechanical Tubing: Cold-rolled, electric-resistance-welded carbon or alloy steel tubing complying with ASTM A513/A513M, or steel tubing fabricated from steel complying with ASTM A1011/A1011M and complying with dimensional tolerances in ASTM A500/A500M; zinc coated internally and externally.
   5. Sheet: Commercial steel sheet complying with ASTM A1011/A1011M.

B. Anchors, Fasteners, Fittings, and Hardware: Manufacturer's standard, corrosion-resistant-coated or noncorrodible materials; commercial quality, tamperproof, vandal and theft resistant.
   1. Angle Anchors: For inconspicuously bolting legs of site furnishings to grade substrate; per manufacturer's standards.
   2. Antitheft Hold-Down Brackets: For securing site furnishings to substrate; per manufacturer's standards.

C. Nonshrink, Nonmetallic Grout: Premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C1107/C1107M; recommended in writing by manufacturer, for exterior applications.

D. Erosion-Resistant Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with potable water at Project site to create pourable anchoring, patching, and grouting compound; resistant to erosion from water exposure without needing protection by a sealer or waterproof coating; recommended in writing by manufacturer, for exterior applications.

E. Galvanizing: Where indicated for steel and iron components, provide the following protective zinc coating applied to components after fabrication:
   1. Zinc-Coated Tubing: External, zinc with organic overcoat, consisting of a minimum of 0.9 oz./sq. ft. of zinc after welding, a chromate conversion coating, and a clear, polymer film. Internal, same as external or consisting of 81 percent zinc pigmented coating, not less than 0.3 mil thick.
   2. Hot-Dip Galvanizing: According to ASTM A123/A123M, ASTM A153/A153M, or ASTM A924/A924M.

2.5 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended, so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Factory assemble components to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.6 GENERAL FINISH REQUIREMENTS

A. 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.

2.7 ALUMINUM FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.8 STEEL AND GALVANIZED-STEEL FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester, powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

B. PVC Finish: Manufacturer's standard, UV-light stabilized, mold-resistant, slip-resistant, matte-textured, dipped or sprayed-on, PVC-plastisol finish, with flame retardant added; complying with coating manufacturer's written instructions for pretreatment, application, and minimum dry film thickness.

2.9 IRON FINISHES

A. Powder-Coat Finish: Manufacturer's standard polyester powder-coat finish complying with finish manufacturer's written instructions for surface preparation, including pretreatment, application, baking, and minimum dry film thickness.

2.10 STAINLESS STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Run directional finishes with long dimension of each piece.
   2. Directional Satin Finish: ASTM A480/A480M, No 4.
   3. Dull Satin Finish: ASTM A480/A480M, No. 6.

PART 3 EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and positioned at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

E. Posts Set into Voids in Concrete: Form or core-drill holes for installing posts in concrete to depth recommended in writing by manufacturer of site furnishings and 3/4 inch larger than OD of post. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout, mixed and placed to comply with anchoring material manufacturer's written instructions, with top smoothed and shaped to shed water.

F. Pipe Sleeves: Use steel pipe sleeves preset and anchored into concrete for installing posts. After posts have been 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, with top smoothed and shaped to shed water.

END OF SECTION

SECTION 333115

SITE SANITARY SEWERAGE PIPING

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Standards and specifications of Lower Bucks County Joint Municipal Authority (LBCJMA). In case of discrepancies, LBCJMA standards and specifications shall supersede.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Ductile-iron, pressure pipe and fittings.
2. PVC pipe and fittings.
3. Nonpressure-type transition couplings.
4. Pressure-type pipe couplings.
5. Expansion joints and deflection fittings.
6. Encasement for piping.
7. Manholes.
8. Concrete.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For manholes. Include plans, elevations, sections, details, and frames and covers.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of pipe and fitting.

B. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes in accordance with manufacturer's written rigging instructions.

1.6 QUALITY ASSURANCE

A. Provide materials bearing label, stamp, or other markings of specified testing agency.

1.7 FIELD CONDITIONS

A. Interruption of Existing Sanitary Sewerage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
   1. Notify Construction Manager no fewer than two days in advance of proposed interruption of service.
   2. Do not proceed with interruption of service without Construction Manager's written permission.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Components and installation are to be capable of withstanding the following minimum working pressure unless otherwise indicated:
   1. Sanitary Sewage Piping: 10-ft. head of water.
   2. Sanitary Sewage Piping, Force-Main: 100 psig.

2.2 DUCTILE-IRON, PRESSURE PIPE AND FITTINGS - SANITARY SEWERAGE

A. Source Limitations: Obtain ductile-iron, pressure pipe and fittings from single manufacturer.

B. Piping materials to bear label, stamp, or other markings of specified testing agency.

C. Push-on-Joint Piping:
   1. Pipe: AWWA C151/A21.51.
   2. Standard Fittings: AWWA C110/A21.10, ductile or gray iron.
   3. Compact Fittings: AWWA C153/A21.53.
   4. Gaskets: AWWA C111/A21.11, rubber, of shape matching pipe and fittings.

D. Mechanical-Joint Piping:
   1. Pipe: AWWA C151/A21.51, with bolt holes in bell.
   2. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, with bolt holes in bell.
   3. Compact Fittings: AWWA C153/A21.53, with bolt holes in bells.
   4. Glands: Cast or ductile iron; with bolt holes and high-strength, cast-iron or high-strength, low-alloy steel bolts and nuts.

5. Gaskets: AWWA C111/A21.11, rubber, of shape matching pipe, fittings, and glands.

E. Pipe Outer Coating:
1. Type: Asphaltic.
2. Minimum Uniform Thickness: 1 mil.
3. Comply with AWWA C151/A21.51.

F. Cement Mortar Lining: AWWA C104/A21.4.

G. Seal Coating-Applied Lining:
1. Nominal Pipe Sizes 6 through 12 Inches (150 through 300 mm): 1/8 inch.
2. Nominal Pipe Sizes 14 through 24 Inches (250 through 600 mm): 1/8 inch.

H. Asphaltic Sealcoat Lining:
1. Minimum Uniform Lining: 1 mil.
2. Comply with AWWA C104/A21.4.

I. PE Encasement: Comply with AWWA C105/A21.5.

2.3 PVC PIPE AND FITTINGS

A. Source Limitations: Obtain PVC pipe and fittings from single manufacturer.

B. Piping materials to bear label, stamp, or other markings of specified testing agency.

C. PVC Type PSM Gravity Sewer Piping:
1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: ASTM D3034, PVC with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

D. PVC Pressure Piping:
1. Pipe: AWWA C900, Class 100 PVC pipe with bell-and-spigot ends for gasketed joints.
2. Fittings: AWWA C900, Class 100 PVC pipe with bell ends.
3. Gaskets: ASTM F477, elastomeric seals.

E. PVC Type DWV Piping:
1. Pipe: ASTM D1785 or ASTM D2665, Schedule 40 PVC, with plain ends for solvent-cemented joints.
2. Fittings: ASTM D2466, Schedule 40 PVC, socket type.
3. Adhesive Primer: ASTM F656.
4. Solvent Cement: ASTM D2564.

2.4 NONPRESSURE-TYPE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling; for joining underground nonpressure piping. Include ends of same sizes as piping to be joined and include corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Cast-Iron Soil Pipes: ASTM C564, rubber.
   2. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
   3. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:
   1. Source Limitations: Obtain unshielded, flexible couplings from single manufacturer.
   2. Description: Elastomeric sleeve with[stainless steel shear ring and] corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Shielded, Flexible Couplings:
   1. Source Limitations: Obtain shielded, flexible couplings from single manufacturer.
   2. Description: ASTM C1460, elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

E. Ring-Type, Flexible Couplings:
   1. Source Limitations: Obtain ring-type, flexible couplings from single manufacturer.
   2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

F. Nonpressure-Type, Rigid Couplings:
   1. Source Limitations: Obtain nonpressure-type, rigid couplings from single manufacturer.
   2. Description: ASTM C1461, sleeve-type, reducing- or transition-type mechanical coupling; molded from ASTM C1440, TPE material; with corrosion-resistant-metal tension band and tightening mechanism on each end.

2.5 PRESSURE-TYPE PIPE COUPLINGS

A. Source Limitations: Obtain pressure-type pipe couplings from single manufacturer.

B. Standard: AWWA C219.

C. Description: Tubular-sleeve coupling with center sleeve, gaskets, end rings, and bolt fasteners.

D. Metal, bolted, sleeve-type, reducing or transition coupling; for joining underground pressure piping. Include 200 psig minimum pressure rating and ends of same sizes as piping to be joined.

E. Center-Sleeve Material: Manufacturer's standard.

F. Gasket Material: Natural or synthetic rubber.

G. Metal Component Finish: Corrosion-resistant coating or material.

2.6 EXPANSION JOINTS AND DEFLECTION FITTINGS

A. Ductile-Iron, Flexible Expansion Joints:
   1. Source Limitations: Obtain ductile-iron, flexible expansion joints from single manufacturer.
   2. Standards:
      a. AWWA C110/A21.10.
      b. AWWA C153/A21.53.
   3. Description: Compound fitting with combination of flanged and mechanical-joint ends. Include two gasketed ball-joint sections and one or more gasketed sleeve sections, rated for 250 psig minimum working pressure and for offset and expansion indicated.

B. Ductile-Iron Deflection Fittings:
   1. Source Limitations: Obtain ductile-iron deflection fittings from single manufacturer.
   2. Standards:
      a. AWWA C110/A21.10.
      b. AWWA C153/A21.53.
   3. Description: Compound coupling fitting with ball joint, flexing section, gaskets, and restrained-joint ends. Include rating for 250 psig minimum working pressure and for up to 15 degrees of deflection.

2.7 ENCASEMENT FOR PIPING

A. Standards: ASTM A674 or AWWA C105/A21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: Black.

2.8 MANHOLES

A. Standard Precast Concrete Manholes:
   1. Standard: ASTM C478/C478M.
   2. Description: Precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   3. Diameter: 48 inches minimum unless otherwise indicated.
   4. Ballast: Increase thickness of precast concrete sections or add concrete to base section, as required to prevent flotation.
   5. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section; with separate base slab or base section with integral floor.
   6. Riser Sections: 4-inch minimum thickness, of length to provide depth indicated.
   7. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated; with top of cone of size that matches grade rings.
   8. Joint Sealant: ASTM C990, bitumen or butyl rubber.
   9. Resilient Pipe Connectors: ASTM C923/C923M, cast or fitted into manhole walls, for each pipe connection.

10. Steps: ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP; wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 48 inches.
11. Adjusting Rings: Interlocking HDPE rings, with level or sloped edge in thickness and diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended in writing by ring manufacturer.
12. Grade Rings: Reinforced-concrete rings, 3- to 12-inch total thickness, with diameter matching manhole frame and cover, and with height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:
1. Description: Ferrous; 24-inch ID by 7- to 12-inch riser, with 4-inch-minimum-width flange and 26-inch-diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "SANITARY SEWER."
2. Material: ASTM A536, Grade 60-40-18 ductile or ASTM A48/A48M, Class 35 gray iron unless otherwise indicated.

2.9 CONCRETE

A. Description: Cast-in-place concrete complying with ACI 318, and the following:
1. Cement: ASTM C150/C150M, Type II.
2. Fine Aggregate: ASTM C33/C33M, sand.
3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
a. Invert Slope: 1 percent through manhole.
2. Benches: Concrete, sloped to drain into channel.
a. Slope: 4 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

PART 3 EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling per LBCJMA requirements or as indicated on the Drawings.

3.2 INSTALLATION OF PIPING

A. General Locations and Arrangements: Drawing plans and details to indicate general location and arrangement of underground sanitary sewer 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 in accordance with manufacturer's written instructions for using lubricants, cements, and other installation requirements.

C. Install manholes 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. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure, drainage piping in accordance with the following:
   1. Install piping pitched down in direction of flow, at minimum slope of 1 percent unless otherwise indicated.
   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 48-inch minimum cover.
   4. Install hub-and-spigot, cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   5. Install hubless cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   6. Install ABS sewer piping in accordance with ASTM D2321 and ASTM F1668.
   7. Install PVC Type PSM sewer piping in accordance with ASTM D2321 and ASTM F1668.
   8. Install PVC Type DWV gravity sewer piping in accordance with ASTM D2321 and ASTM F1668.
   9. Install fiberglass sewer piping in accordance with ASTM D3839 and ASTM F1668.
   10. Install nonreinforced-concrete sewer piping in accordance with ASTM C1479/C1479M and ACPA's "Concrete Pipe & Box Culvert Installation Manual."
   11. Install reinforced-concrete sewer piping in accordance with ASTM C1479/C1479M and

ACPA's "Concrete Pipe & Box Culvert Installation Manual."

G. Install force-main, pressure piping in accordance with the following:
   1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place-concrete supports or anchors.
   2. Install piping with 48-inch minimum cover.
   3. Install ductile-iron pressure piping in accordance with AWWA C600 or AWWA M41.
   4. Install ductile-iron special fittings in accordance with AWWA C600.
   5. Install PVC pressure piping in accordance with AWWA M23 or to ASTM D2774 and ASTM F1668.

H. Install corrosion-protection piping encasement over the following underground metal piping in accordance with ASTM A674 or AWWA C105/A21.5:
   1. Hub-and-spigot, cast-iron soil pipe.
   2. Hubless cast-iron soil pipe and fittings.
   3. Ductile-iron pipe and fittings.
   4. Expansion joints and deflection fittings.

I. Clear interior of piping and manholes of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed. Place plug in end of incomplete piping at end of day and when work stops.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure, drainage piping in accordance with the following:
   1. Join hub-and-spigot, cast-iron soil piping with gasket joints in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
   2. Join hub-and-spigot, cast-iron soil piping with caulked joints in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum caulked joints.
   3. Join hubless cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
   4. Join ABS sewer piping in accordance with ASTM D2321 for elastomeric-seal joints.
   5. Join PVC Type PSM sewer piping in accordance with ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasket joints.
   6. Join fiberglass sewer piping in accordance with ASTM D4161 for elastomeric-seal joints.
   7. Join nonreinforced-concrete sewer piping in accordance with ASTM C14 and ACPA's "Concrete Pipe & Box Culvert Installation Manual" for rubber-gasket joints.
   8. Join reinforced-concrete sewer piping in accordance with ACPA's "Concrete Pipe & Box Culvert Installation Manual" for rubber-gasket joints.
   9. Join dissimilar pipe materials with nonpressure-type, flexible or rigid couplings.

B. Join force-main, pressure piping in accordance with the following:
   1. Join ductile-iron pressure piping in accordance with AWWA C600 or AWWA M41 for push-on joints.
   2. Join ductile-iron special fittings in accordance with AWWA C600 or AWWA M41 for push-on joints.
   3. Join PVC pressure piping in accordance with AWWA M23 for gasketed joints.
   4. Join dissimilar pipe materials with pressure-type couplings.

C. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
   1. Use nonpressure flexible couplings where required to join gravity-flow, nonpressure sewer piping unless otherwise indicated.
      a. Unshielded flexible or rigid couplings for pipes of same or slightly different OD.
      b. Unshielded, increaser/reducer-pattern, flexible or rigid couplings for pipes with different OD.
      c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.
   2. Use pressure pipe couplings for force-main joints.

3.4 INSTALLATION OF MANHOLES

A. General: Install manholes complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants in accordance with ASTM C891.

C. Form continuous concrete channels and benches between inlets and outlet.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 3 inches above finished surface elsewhere unless otherwise indicated.

E. Install manhole-cover inserts in frame and immediately below cover.

3.5 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318.

3.6 CONNECTIONS

A. Connect nonpressure, gravity-flow drainage piping to building's sanitary building drains specified in Section 221316 "Sanitary Waste and Vent Piping."

B. Make connections to existing piping and underground manholes.
   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye fitting plus 6-inch overlap with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   2. Protect existing piping and manholes to prevent concrete or debris from entering while making tap connections. Remove debris or other extraneous material that may accumulate.

3.7 CLOSING ABANDONED SANITARY SEWER SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
   1. Close open ends of piping with at least 8-inch-thick, brick masonry bulkheads.
   2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes: Excavate around manhole as required and use either procedure below:
   1. Remove manhole and close open ends of remaining piping.
   2. Remove top of manhole down to at least 36 inches below final grade. Fill to within 12 inches of top with stone, rubble, gravel, or compacted dirt. Fill to top with concrete.

C. Backfill to grade in accordance with LBCJMA requirements or as indicated on the Drawings.

3.8 IDENTIFICATION

A. Arrange for installation of green warning tapes directly over piping and at outside edges of underground manholes.
   1. Use detectable warning tape over ferrous piping.
   2. Use detectable warning tape over nonferrous piping and over edges of underground manholes.

3.9 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 report 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 in accordance with LBCJMA requirements and the Contract Documents.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.

4. Submit separate report for each test.
5. Hydrostatic Tests: Test sanitary sewerage in accordance with requirements of authorities having jurisdiction and the following:
   a. Fill sewer piping with water. Test with pressure of at least 10-ft. head of water, and maintain such pressure without leakage for at least 15 minutes.
   b. Close openings in system and fill with water.
   c. Purge air and refill with water.
   d. Disconnect water supply.
   e. Test and inspect joints for leaks.
6. Air Tests: Test sanitary sewerage in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:
   a. Test plastic gravity sewer piping in accordance with ASTM F1417.
   b. Test concrete gravity sewer piping in accordance with ASTM C1628.
7. Force Main: Perform hydrostatic test after thrust blocks, supports, and anchors have hardened. Test at pressure not less than one and one-half times the maximum system operating pressure, but not less than 150 psig.
   a. Ductile-Iron Piping: Test in accordance with AWWA C600, "Hydraulic Testing" Section.
   b. PVC Piping: Test in accordance with AWWA M23, "Testing and Maintenance" Chapter.
8. Manholes: Perform hydraulic test in accordance with ASTM C969.

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.

3.10 CLEANING

A. Clean dirt and superfluous material from interior of piping.

END OF SECTION

SECTION 334200

STORMWATER CONVEYANCE

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section, as applicable.

B. "Pennsylvania Erosion and Sediment Pollution Control Program Manual" Pennsylvania Department of Environmental Protection, Latest Edition.

C. National Pollutant Discharge Elimination System (NPDES) permit for Stormwater Discharges from Construction Activities, Latest Edition.

D. Specification Section 31 25 00 "Erosion and Sedimentation Control."

E. Project Geotechnical Engineering/Foundation Report/Memorandum.

1.2 SUMMARY

A. Work Results:

B. Principal Products:

C. Section Includes:
1. Corrugated-PE pipe and fittings.
2. PVC pipe and fittings.
3. Concrete pipe and fittings.
4. Nonpressure transition couplings.
5. Expansion joints and deflection fittings.
6. Cleanouts.
7. Drains.
8. Concrete trench drain forming system.
9. Encasement for piping.
10. Manholes.
11. Polymer-concrete, channel drainage systems.
12. Plastic, channel drainage systems.
13. Catch basins.
14. Stormwater inlets.
15. Stormwater retention/detention/infiltration systems.
16. Pipe outlets.

1.3 DEFINITIONS

A. DI: Ductile iron.

B. PE: Polyethylene.

C. PVC: Polyvinyl chloride.

D. RCP: Reinforced concrete pipe.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings:
1. Precast Structures: Include plans, elevations, sections, details, frames, covers/grates.
2. Non-precast Structures. Include plans, elevations, sections, details, frames, covers/grates, and product literature.
3. Stormwater Retention/Detention/Infiltration Structures/Systems: Include plans, elevations, sections, details, frames, covers, and design calculations.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials are to bear label, stamp, or other markings of specified testing agency.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Do not store plastic manholes, pipe, and fittings in direct sunlight.

B. Protect pipe, pipe fittings, and seals from dirt and damage.

C. Handle manholes and structures in accordance with manufacturer's written rigging instructions.

1.8 FIELD CONDITIONS

A. Interruption of Existing Storm Drainage Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service in accordance with requirements indicated:
1. Notify Owner, or their representative, no fewer than three business days in advance of proposed interruption of service.
2. Do not proceed with interruption of service without Owner's written permission.

PART 2 PRODUCTS

2.1 DUCTILE-IRON, CULVERT PIPE AND FITTINGS

A. Pipe: ASTM A716, for push-on joints.

B. Standard Fittings: AWWA C110/A21.10, ductile or gray iron, for push-on joints.

C. Compact Fittings: AWWA C153/A21.53, for push-on joints.

D. Gaskets: AWWA C111/A21.11, rubber.

2.2 CORRUGATED-PE PIPE AND FITTINGS

A. Source Limitations: Obtain corrugated-PE pipe and fittings from single manufacturer.

B. Corrugated-PE Drainage Pipe and Fittings NPS 3 to NPS 10 (DN 80 to DN 250): AASHTO M 252, Type S, with smooth waterway for coupling joints.

C. Corrugated-PE Pipe and Fittings NPS 12 to NPS 60 (DN 300 to DN 1500): AASHTO M 294, Type S, with smooth waterway for coupling joints.

D. Corrugated-PE Soil-tight Couplings: AASHTO M 294, corrugated, matching pipe and fittings.

2.3 PVC PIPE AND FITTINGS

A. Source Limitations: Obtain PVC pipe and fittings from single manufacturer.

B. NSF Marking: Comply with NSF 14, "Plastics Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-drain" for plastic storm drain and "NSF-sewer" for plastic storm sewer piping.

C. PVC Type PSM Sewer Piping:
   1. Pipe: ASTM D3034, SDR 35, PVC Type PSM sewer pipe with bell-and-spigot ends for gasketed joints.
   2. Fittings: ASTM D3034, PVC with bell ends.
   3. Gaskets: ASTM F477, elastomeric seals.

D. Adhesive Primer: ASTM F656.

2.4 NONPRESSURE TRANSITION COUPLINGS

A. Comply with ASTM C1173, elastomeric, sleeve-type, reducing or transition coupling, for joining underground non-pressure piping. Include ends of same sizes as piping to be joined, and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Sleeve Materials:
   1. For Concrete Pipes: ASTM C443, rubber.
   2. For Cast-Iron Soil Pipes: ASTM C564, rubber.
   3. For Fiberglass Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
   4. For Plastic Pipes: ASTM F477, elastomeric seal or ASTM D5926, PVC.
   5. For Dissimilar Pipes: ASTM D5926, PVC or other material compatible with pipe materials being joined.

C. Unshielded, Flexible Couplings:
   1. Source Limitations: Obtain unshielded, flexible couplings from single manufacturer.
   2. Description: Elastomeric sleeve with stainless steel shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.

D. Ring-Type, Flexible Couplings:
   1. Source Limitations: Obtain ring-type, flexible couplings from single manufacturer.
   2. Description: Elastomeric compression seal with dimensions to fit inside bell of larger pipe and for spigot of smaller pipe to fit inside ring.

2.5 CLEANOUTS

A. Cast-Iron Cleanouts:
   1. Source Limitations: Obtain cast-iron cleanouts from single manufacturer.
   2. Description: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside caulk or spigot connection and countersunk, tapered-thread, brass closure plug.
   3. Top-Loading Classification(s):
      a. Light Duty (Non-traffic Area).
      b. Medium Duty, 16,000 lb. minimum load rating (Traffic Area).
   4. Sewer Pipe Fitting and Riser to Cleanout: ASTM A74, Service class, cast-iron soil pipe and fittings.

B. PVC Cleanouts:
   1. Source Limitations: Obtain PVC cleanouts from single manufacturer.
   2. Description: PVC body with PVC threaded plug. Include PVC sewer pipe fitting and riser to cleanout of same material as sewer piping.

2.6 ENCASEMENT FOR PIPING

A. Standard: ASTM A674 or AWWA C105/A21.5.

B. Material: Linear low-density polyethylene film of 0.008-inch minimum thickness.

C. Form: Sheet or tube.

D. Color: natural.

2.7 MANHOLES

A. Standard Precast Concrete Manholes:
   1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   2. Diameter: 48 inches minimum unless otherwise required by manufacturer to accept pipe connections shown on Plans.
   3. Ballast: Increase thickness of precast concrete sections or add concrete to base section as required to prevent flotation.
   4. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor, as required manufacturer to achieve specified loading.
   5. Riser Sections: 4-inch minimum thickness or as required manufacturer to achieve specified loading, and lengths to provide depth required by inverts noted on Plans.
   6. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated or required, and top of cone of size that matches grade rings.
   7. Joint Sealant: ASTM C990, bitumen or butyl rubber.
   8. Resilient Pipe Connectors: ASTM C923, cast or fitted into manhole walls, for each pipe connection.
   9. Steps: ASTM A615/A615M, deformed, 1/2-inch Grade 60 steel reinforcing rods encased in ASTM D4101, Polypropylene Plastic wide enough to allow worker to place both feet on one step (13-inch minimum) and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-inch intervals. Omit steps if total depth from floor of manhole to finished grade is less than 60 inches.
   10. Adjusting Rings: Interlocking HDPE rings with level or sloped edge in thickness and diameter matching manhole frame and cover, and of height required to adjust manhole frame and cover to indicated elevation and slope. Include sealant recommended by ring manufacturer.
   11. Grade Rings: Reinforced-concrete rings, 3- to 12-inch total thickness, to match diameter of manhole frame and cover, and height as required to adjust manhole frame and cover to indicated elevation and slope.

B. Manhole Frames and Covers:
   1. Description: Ferrous; 24-inch ID by 7- to 9-inch riser with 4-inch minimum width flange and 26-inch diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER" or as required by AHJ.
   2. Material: ASTM A48/A48M, Class 35 gray iron unless otherwise indicated.

2.8 CONCRETE

A. General: Cast-in-place concrete in accordance with ACI 318, ACI 350, and the following:
   1. Cement: ASTM C150/C150M, Type II.
   2. Fine Aggregate: ASTM C33/C33M, sand.
   3. Coarse Aggregate: ASTM C33/C33M, crushed gravel.
   4. Water: Potable.

B. Portland Cement Design Mix: 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio.
   1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

C. Manhole Channels and Benches: Factory or field formed from concrete. Portland cement design mix, 4000 psi minimum, with 0.45 maximum water/cementitious materials ratio. Include channels and benches in manholes.
   1. Channels: Concrete invert, formed to same width as connected piping, with height of vertical sides to three-fourths of pipe diameter. Form curved channels with smooth, uniform radius and slope.
      a. Invert Slope: 2 percent minimum through manhole.
   2. Benches: Concrete, sloped to drain into channel.
      a. Slope: 8 percent.

D. Ballast and Pipe Supports: Portland cement design mix, 3000 psi minimum, with 0.58 maximum water/cementitious materials ratio.
   1. Reinforcing Fabric: ASTM A1064/A1064M, steel, welded wire fabric, plain.
   2. Reinforcing Bars: ASTM A615/A615M, Grade 60 deformed steel.

2.9 PLASTIC, CHANNEL DRAINAGE SYSTEMS

A. General Requirements for Plastic, Channel Drainage Systems:
   1. Modular system of plastic channel sections, grates, and appurtenances.
   2. Designed so grates fit into frames without rocking or rattling.
   3. Number of units required to form total lengths indicated.

B. HDPE or PE Trench Drains.
   1. Source Limitations: Obtain HDPE or PE channel drainage systems from single manufacturer.
   2. Description: Modular system of channel sections, grates, and appurtenances; designed so grates fit into channel recesses without rocking or rattling.
   3. Channel Sections: Interlocking-joint, HDPE or PE modular units, with end caps. Include flat, rounded, or inclined bottom, with level invert and with outlets in number, sizes, and locations indicated.
      a. Dimensions: As indicated on the Drawings. Include number of units required to form total lengths indicated.
   4. Grates: With slots or perforations and widths and thickness that fit recesses in channel sections.
      a. Material: As indicated on the Drawings.
   5. Supports, Anchors, and Setting Devices: Manufacturer's standard unless otherwise indicated.
   6. Channel-Section Joining and Fastening Materials: As recommended by system manufacturer.

2.10 CATCH BASINS

A. Standard Precast Concrete Catch Basins:
   1. Description: ASTM C478, precast, reinforced concrete, of depth indicated, with provision for sealant joints.
   2. Base Section: 6-inch minimum thickness for floor slab and 4-inch minimum thickness for walls and base riser section, and separate base slab or base section with integral floor.
   3. Riser Sections: 4-inch minimum thickness, 48-inch diameter, and lengths to provide depth indicated.
   4. Top Section: Eccentric-cone type unless concentric-cone or flat-slab-top type is indicated. Top of cone of size that matches grade rings.
   5. Joint Sealant: ASTM C990, bitumen or butyl rubber.
   6. Adjusting Rings: Interlocking rings with level or sloped edge in thickness and shape matching catch basin frame and grate. Include sealant recommended by ring manufacturer.
   7. Grade Rings: Include two or three reinforced-concrete rings, of 3- to 12-inch total thickness, that match 24-inch-diameter frame and grate.
   8. Steps: ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP, wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-inch intervals. Omit steps if total depth from floor of catch basin to finished grade is less than 48 inches.
   9. Pipe Connectors: ASTM C923, resilient, of size required, for each pipe connecting to base section.

B. Rectangular Frames and Grates: ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Include flat grate with small square or short-slotted drainage openings.
   1. Size: 24 by 24 inches minimum unless otherwise indicated.
   2. Grate Free Area: Approximately 50 percent unless otherwise indicated.

C. Round Frames and Grates (If Specified): ASTM A536, Grade 60-40-18, ductile iron designed for A-16 (AASHTO HS20-44), structural loading. Include 24-inch ID by 7- to 9-inch riser with 4-inch- minimum width flange, and 26-inch-diameter flat grate with small square or short-slotted drainage openings.
   1. Grate Free Area: Approximately 50 percent unless otherwise indicated.

2.11 STORMWATER INLETS

A. Curb Inlets: Made with vertical curb opening, of materials and dimensions in accordance with utility standards.

B. Gutter Inlets: Made with horizontal gutter opening, of materials and dimensions in accordance with utility standards. Include heavy-duty frames and grates.

C. Frames and Grates: Heavy duty, in accordance with utility standards.

2.12 STORMWATER DETENTION STRUCTURES

A. Cast-in-Place Concrete, Stormwater Detention Structures: Constructed of reinforced-concrete bottom, walls, and top; designed in accordance with ASTM C890 for A-16 (AASHTO HS20-44), heavy-traffic, structural loading; of depth, shape, dimensions, and appurtenances indicated.
   1. Ballast: Increase thickness of concrete as required to prevent flotation.
   2. Grade Rings: Include two or three reinforced-concrete rings, of 6- to 9-inch total thickness, that match 24-inch-diameter frame and cover.
   3. Steps: ASTM A615/A615M, deformed, 1/2-inch steel reinforcing rods encased in ASTM D4101, PP wide enough to allow worker to place both feet on one step and designed to prevent lateral slippage off step. Cast or anchor steps into sidewalls at 12-inch intervals. Omit steps if total depth from floor of structure to finished grade is less than 48 inches.

B. Manhole Frames and Covers: ASTM A536, Grade 60-40-18, ductile-iron castings designed for heavy-duty service. Include 24-inch ID by 7- to 9-inch riser with 4-inch-minimum width flange, and 26-inch- diameter cover. Include indented top design with lettering cast into cover, using wording equivalent to "STORM SEWER."

2.13 PIPE OUTLETS

A. Head Walls: Cast-in-place reinforced concrete, with apron and tapered sides.

B. Riprap Basins: Broken, irregularly sized and shaped, graded stone in accordance with Plans.

2.14 STORMWATER DISPOSAL SYSTEMS

A. Chamber Systems:
   1. Source Limitations: Obtain chamber systems from single manufacturer.
   2. Storage and Leaching Chambers: Molded PE with perforated sides and open bottom. Include number of chambers, distribution piping, end plates, and other standard components as required for system total capacity.
   3. Alternative may be considered if contractor provides proof of equivalency sufficient for Field Change per PADEP/County Conservation District including but not limited to stage storage calculations.

B. Piping Systems: Perforated manifold, header, and lateral piping complying with AASHTO M 252 for NPS 10 and smaller, AASHTO M 294 for NPS 12 to NPS 60. Include proprietary fittings, couplings, seals, and filter fabric.
   1. Source Limitations: Obtain pipe systems from single manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION OF PIPING

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 in accordance with manufacturer's written instructions for use of lubricants, cements, and other installation requirements.

C. Install manholes 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. When installing pipe under streets or other obstructions that cannot be disturbed, use pipe-jacking process of microtunneling.

F. Install gravity-flow, nonpressure drainage piping in accordance with 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 48-inch-minimum cover.
   4. Install hub-and-spigot, cast-iron soil piping in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   5. Install hubless cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook."
   6. Install ductile-iron piping and special fittings in accordance with AWWA C600 or AWWA M41.
   7. Install corrugated-steel piping in accordance with ASTM A798/A798M.
   8. Install corrugated-aluminum piping in accordance with ASTM B788/B788M.
   9. Install ABS sewer piping in accordance with ASTM D2321 and ASTM F1668.
   10. Install PE corrugated sewer piping in accordance with ASTM D2321.
   11. Install PVC cellular-core piping in accordance with ASTM D2321 and ASTM F1668.
   12. Install PVC sewer piping in accordance with ASTM D2321 and ASTM F1668.
   13. Install PVC profile gravity sewer piping in accordance with ASTM D2321 and ASTM F1668.
   14. Install PVC water-service piping in accordance with ASTM D2321 and ASTM F1668.
   15. Install fiberglass sewer piping in accordance with ASTM D3839 and ASTM F1668.
   16. Install nonreinforced-concrete sewer piping in accordance with ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."
   17. Install reinforced-concrete sewer piping in accordance with ASTM C1479 and ACPA's "Concrete Pipe Installation Manual."

G. Install force-main pressure piping in accordance with the following:
   1. Install piping with restrained joints at tee fittings and at horizontal and vertical changes in direction. Use corrosion-resistant rods, pipe or fitting manufacturer's proprietary restraint system, or cast-in-place concrete supports or anchors.
   2. Install piping with 48-inch-minimum cover.
   3. Install ductile-iron pressure piping in accordance with AWWA C600 or AWWA M41.
   4. Install ductile-iron special fittings in accordance with AWWA C600.
   5. Install PVC pressure piping in accordance with AWWA M23, or ASTM D2774 and ASTM F1668.
   6. Install PVC water-service piping in accordance with ASTM D2774 and ASTM F1668.

H. Install corrosion-protection piping encasement over the following underground metal piping in accordance with ASTM A674 or AWWA C105/A21.5:
   1. Hub-and-spigot, cast-iron soil pipe and fittings.
   2. Hubless cast-iron soil pipe and fittings.
   3. Ductile-iron pipe and fittings.
   4. Expansion joints and deflection fittings.

3.2 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping in accordance with the following:
   1. Join hub-and-spigot, cast-iron soil piping with gasketed joints in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
   2. Join hub-and-spigot, cast-iron soil piping with caulked joints in accordance with CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead and oakum caulked joints.
   3. Join hubless cast-iron soil piping in accordance with CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-coupling joints.
   4. Join ductile-iron culvert piping in accordance with AWWA C600 for push-on joints.
   5. Join ductile-iron piping and special fittings in accordance with AWWA C600 or AWWA M41.
   6. Join corrugated-steel sewer piping in accordance with ASTM A798/A798M.
   7. Join corrugated-aluminum sewer piping in accordance with ASTM B788/B788M.
   8. Join ABS sewer piping in accordance with ASTM D2321 for elastomeric-seal joints.
   9. Join corrugated-PE piping in accordance with ASTM D3212 for push-on joints.
   10. Join PVC cellular-core piping in accordance with ASTM D2321 and ASTM F891 for solvent-cemented joints.
   11. Join PVC corrugated sewer piping in accordance with ASTM D2321 for elastomeric-seal joints.
   12. Join PVC sewer piping in accordance with ASTM D2321 and ASTM D3034 for elastomeric-seal joints or ASTM D3034 for elastomeric-gasketed joints.
   13. Join PVC profile gravity sewer piping in accordance with ASTM D2321 for elastomeric-seal joints or ASTM F794 for gasketed joints.
   14. Join fiberglass sewer piping in accordance with ASTM D3839 for elastomeric-seal joints.
   15. Join nonreinforced-concrete sewer piping in accordance with ASTM C14 and ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
   16. Join reinforced-concrete sewer piping in accordance with ACPA's "Concrete Pipe Installation Manual" for rubber-gasketed joints.
   17. Join dissimilar pipe materials with nonpressure-type flexible couplings.

B. Join force-main pressure piping in accordance with the following:
   1. Join ductile-iron pressure piping in accordance with AWWA C600 or AWWA M41 for push-on joints.
   2. Join ductile-iron special fittings in accordance with AWWA C600 or AWWA M41 for push-on joints.
   3. Join PVC pressure piping in accordance with AWWA M23 for gasketed joints.
   4. Join PVC water-service piping in accordance with ASTM D2855 for solvent-cemented joints.
   5. Join dissimilar pipe materials with pressure-type couplings.

3.3 INSTALLATION OF CLEANOUTS

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade. Use cast-iron soil pipe fittings in sewer pipes at branches for cleanouts and cast-iron soil pipe for riser extensions to cleanouts. Install piping so cleanouts open in direction of flow in sewer pipe.
   1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
   2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
   3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
   4. Use Extra-Heavy-Duty, top-loading classification drains in roads.

B. Set cleanout frames and covers in earth in cast-in-place concrete block as indicated on the Drawings. Set with tops 1 inch above surrounding earth grade.

C. Set cleanout frames and covers in concrete pavement and roads with tops flush with pavement surface.

3.4 INSTALLATION OF DRAINS

A. Install type of drains in locations indicated.
   1. Use Light-Duty, top-loading classification drains in earth or unpaved foot-traffic areas.
   2. Use Medium-Duty, top-loading classification drains in paved foot-traffic areas.
   3. Use Heavy-Duty, top-loading classification drains in vehicle-traffic service areas.
   4. Use Extra-Heavy-Duty, top-loading classification drains in roads.

B. Embed drains in 4-inch-minimum concrete around bottom and sides.

C. Fasten grates to drains if indicated.

D. Set drain frames and covers with tops flush with pavement surface.

E. Assemble trench sections.

F. Embed trench sections in 4-inch minimum concrete around bottom and sides or per manufacturer guidance.

3.5 INSTALLATION OF MANHOLES

A. General: Install manholes, complete with appurtenances and accessories indicated.

B. Install precast concrete manhole sections with sealants in accordance with ASTM C891.

C. Where specific manhole construction is not indicated, follow manhole manufacturer's written instructions.

D. Set tops of frames and covers flush with finished surface of manholes that occur in pavements. Set tops 2 inches above finished surface elsewhere unless otherwise indicated.

3.6 INSTALLATION OF CATCH BASINS

A. Construct catch basins to sizes and shapes indicated.

B. Set frames and grates to elevations indicated.

3.7 INSTALLATION OF STORMWATER INLETS/OUTLETS

A. Construct inlet head walls, aprons, and sides of reinforced concrete, as indicated.

B. Construct riprap of broken stone, as indicated.

C. Install outlets that spill onto grade, anchored with concrete, where indicated.

D. Install outlets that spill onto grade, with flared end sections that match pipe, where indicated.

E. Construct energy dissipaters at outlets, as indicated.

3.8 CONCRETE PLACEMENT

A. Place cast-in-place concrete in accordance with ACI 318.

3.9 INSTALLATION OF CHANNEL DRAINAGE SYSTEMS

A. Install with top surfaces of components, except piping, flush with finished surface.

B. Assemble channel sections to form slope down toward drain outlets. Use sealants, adhesives, fasteners, and other materials recommended by system manufacturer.

C. Embed channel sections and drainage specialties in 4-inch- minimum concrete around bottom and sides or as manufacturer recommends.

D. Fasten grates to channel sections if indicated.

E. Assemble channel sections with flanged or interlocking joints.

F. Embed channel sections in 4-inch minimum concrete around bottom and sides r as manufacturer recommends.

3.10 INSTALLATION OF STORMWATER DISPOSAL SYSTEMS

A. Chamber Systems: Excavate trenches of width and depth, and install system and backfill in accordance with chamber manufacturer's written instructions. Include storage and leaching chambers, filtering material, and filter mat.

B. Piping Systems: Excavate trenches of width and depth, and install piping system, filter fabric, and backfill, in accordance with piping manufacturer's written instructions.

3.11 CONNECTIONS

A. Connect non-pressure, gravity-flow drainage piping in building's storm building drains specified in Section 221414 "Storm Drainage Piping" or Project Plumbing Plans.

B. Make connections to existing piping and underground manholes.
   1. Use commercially manufactured wye fittings for piping branch connections. Remove section of existing pipe; install wye fitting into existing piping; and encase entire wye fitting, plus 6-inch overlap, with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   2. Make branch connections from side into existing piping, NPS 4 to NPS 20. Remove section of existing pipe, install wye fitting into existing piping, and encase entire wye with not less than 6 inches of concrete with 28-day compressive strength of 3000 psi.
   3. Make branch connections from side into existing piping, NPS 21 or larger, or to underground manholes and structures 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, manhole, or structure wall, 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.
   4. 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.

C. Connect to sediment interceptors specified in Project Plumbing Plans.

D. Pipe couplings, expansion joints, and deflection fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.
   1. Use non-pressure-type flexible couplings where required to join gravity-flow, non-pressure sewer piping unless otherwise indicated.
      a. Unshielded flexible couplings for same or minor difference OD pipes.

b. Unshielded, increaser/reducer-pattern, flexible couplings for pipes with different OD.
c. Ring-type flexible couplings for piping of different sizes where annular space between smaller piping's OD and larger piping's ID permits installation.

3.12 CLOSING ABANDONED STORM DRAINAGE SYSTEMS

A. Abandoned Piping: Close open ends of abandoned underground piping indicated to remain in place. Include closures strong enough to withstand hydrostatic and earth pressures that may result after ends of abandoned piping have been closed. Use either procedure below:
   1. Close open ends of piping with at least 8-inch thick, brick masonry bulkheads or as specified by Project Structural Engineer.
   2. Close open ends of piping with threaded metal caps, plastic plugs, or other acceptable methods suitable for size and type of material being closed. Do not use wood plugs.

B. Abandoned Manholes and Structures: Excavate around manholes and structures as required and use one procedure below:
   1. Remove manhole or structure and close open ends of remaining piping.
   2. Remove top of manhole or structure, including all existing masonry, down to at least 36 inches below final grade. Backfill to grade in accordance with local requirements or as indicated on the Drawings within 12 inches of top, compacting in 6-inch lifts.

3.13 IDENTIFICATION

A. Materials and their installation as indicated on the Drawings. Arrange for installation of green, detectable warning tape directly over piping and at outside edge of underground structures.

3.14 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 in accordance with 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 in accordance with requirements of authorities having jurisdiction, UNI-B-6, and the following:
    a. Exception: Piping with soil tight joints unless required by authorities having jurisdiction.
    b. Option: Test plastic piping in accordance with ASTM F1417.

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.

3.15 CLEANING

A. Clean interior of piping of dirt and superfluous materials to Owner's satisfaction.

END OF SECTION