Southeastern Pennsylvania Transportation Authority

BID DOCUMENTS

FOR THE

FRANKFORD TRANSPORTATION BUILDING

February 27, 2015

SEPTA PROJECT NO. CCG-FB

PENNONI ASSOCIATES INC.
3001 Market Street
Philadelphia, PA 19104
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SECTION 01010
SUMMARY OF WORK

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK
This specification covers separate prime contracts representing significant elements of work for each Contractor in the

SEPTA
FRANKFORD TRANSPORTATION BUILDING

A. The Work shall be performed concurrently and in close coordination with the respective Prime Contractors and other trades working at the site. The Contractors for this project include:

1. Contractor for General Construction Work (to be known as “General Contractor” - GC).
   a. The GC is responsible for project coordination, demolition, E&S controls, earthwork, soil improvements and recommendations in geotechnical report, foundations, steel and concrete construction, building façade construction, interior fit out, and all items not included in MC and EC contracts. The GC is responsible for all work included in C, S, and A series drawings and related specifications.

2. Contractor for Mechanical Construction Work (to be known as “Mechanical Contractor” - MC).
   a. The Mechanical Contractor is responsible for all fire protection, plumbing, and heating and air conditioning aspects of the project. This includes all work on FP, M, and P series drawings and related specifications.

3. Contractor for Electrical Construction Work (to be known as “Electrical Contractor” - EC).
   a. The Electrical Contractor is responsible for all power and communication to the building and within the building, as well as all Fire Alarm related items. This includes but is not limited to all work contained in E and FA series drawings and related specifications.

1.02 RELATED WORK
A. Agreement

   Section 01011: Summary of Project
   Section 01025: Measurement and Payments
   Section 01041: Project Coordination
   Section 01060: Regulatory Requirements and Safety
   Section 01400: Inspection and Test Plan
   Section 01510: Maintenance and Support of Existing Utilities

1.03 QUALITY CONTROL AND QUALITY ASSURANCE
A. Each prime contractor will assume responsibility for executing a quality control and quality assurance program. This program’s basic form will be specified in his Quality Control Plan as submitted under Section 01400 and will include the tests & inspections called for in the technical sections of the specifications. Each prime contractor shall be responsible for requiring all subcontractors and suppliers to adhere to his quality assurance program and participate in quality assurance activities.

B. If a project is governed by “Buy America” requirements, SEPTA will require documentation to confirm the country of origin of all applicable products and materials. Each prime contractor is responsible for communicating Buy America requirements to his subcontractors and suppliers. The lack of sufficient documentation may be grounds for rejecting a product or material.

C. Quality activities will be documented by the contractor. SEPTA may audit the contractor's quality assurance and quality control activities. Each prime contractor will make his and his subcontractor's, applicable documentation available to SEPTA.

D. Each prime contractor, and their subcontractors, is required to cooperate fully with testing and inspection activities carried out by SEPTA and its agents. The contractor will provide the SEPTA PM with adequate (as determined by the SEPTA PM) notification, for all activities which require testing and/or inspection. For all inspections and testing required by code, work may not proceed until this testing and inspection has been completed.

E. Once a product or material has been accepted through the Submittal process, no substitution of this material or product will be allowed without resubmitting it following the provisions of Section 01300. SEPTA reserves the right to require removal of any non-reviewed material and product.

1.04 CONTRACTOR RESPONSIBILITIES

A. Furnish all materials, tools, equipment, supervision, administration and transportation, and perform all labor and services necessary to furnish, deliver, construct, install, connect and/or to interconnect and test as required to complete all work relating to the project, described in the Specifications and indicated in the Contract Drawings.

Contractor shall be aware of, and be familiar with, the responsibilities and work of the other contractors especially with regard to the sections of Division 1, which pertain to all contracts.

B. Perform all work in strict compliance with all laws, regulations, and/or codes applying, including those of the National Fire Protection Association, OSHA, FTA, the Department of Labor and Industry, Commonwealth of Pennsylvania; and other local codes and any other authority having jurisdiction. Wherever drawings or specifications conflict with such regulations they shall be made to conform, and approval of the Project Manager obtained of such changes as may be involved.

C. No work may commence on site without securing and paying for the necessary approvals including but not limited to:

1. Permits: Following is a partial list of required permits. Provide others as required.
   a. Street openings.
   b. Street closing and diversion of traffic.
   c. Demolition of structures.
   d. Utility shut-off: Water, electric, gas (from pertinent PECO, PGW Dept. of Licenses and Inspections).
   e. Removal and disposal of toxic materials, wastes, both sewage and wastewater.
2. General Work Permit from SEPTA and the City of Philadelphia, to perform work in accordance with the Contract Drawings.
3. Governmental Fees.
4. Licenses.
5. Inspection and Testing Fees.
6. Disposal Fees.

D. Give written notices necessary for, and incidental to, the due and lawful prosecution of the Work.

E. Notify the Project Manager at least fourteen (14) days in advance of the date the individual construction stages will be fully complete and ready for inspection.

F. Notify the Project Manager at least fourteen (14) days in advance of the date the entire work will be substantially complete and ready for inspection.

G. Notify the Project Manager at least twenty-one (21) days in advance of the date the entire work will be complete and ready for final inspection.

H. When applicable, submit to the representative of an agency accepting the work, a copy of the notice sent to the Project Manager as specified in Articles 1.03.E., 1.03.F., and 1.03.G., above.

I. Make arrangements for legally disposing of waste and excess materials off the worksite and pay all costs thereof.

1. Prior to disposing of material outside the work site, obtain written permission from the owner on whose property the disposal will be made. File with the Project Manager said permit, or a certified copy thereof, together with a written release from the property owner absolving SEPTA from any and all responsibility in the connection with the disposal of material on said property.

J. Until final acceptance of the work by SEPTA, assume the charge and care thereof and take every reasonable precaution against injury or damage to any part thereof by the action of the elements, theft, vandalism, or from any other cause, whether arising from the execution or from the non-execution of the work. Each Contractor shall rebuild, repair, restore, and make good, to the satisfaction of the Project Manager, all injuries or damages to any portion of the work occasioned by any of the above causes before final acceptance and shall bear the expense thereof at no cost to SEPTA.

K. Utility Notification

Known existing utilities may be indicated on the Contract Drawings but the contractor may not interpret this information as either complete or accurate. Regardless of those shown on the drawings, the contractor must identify and verify the location of all existing utilities prior to working by following applicable regulations and procedures, such as contacting the PA One Call system and asking SEPTA personnel to identify utilities at the site.

The contractor shall determine ownership of all utilities and notify utility owners prior to intended start work date. Deliver a copy of this notice to the Project Manager within #TBD hours of the submittal of the notification.

L. Protection and Repair of the Work and Adjacent Property

1. Prior to the commencement of Work, the contractor and the SEPTA Project Manager shall examine the site and document the condition of all areas not intended to be
changed by the project. Depending on the scope of work, this may include features such as sidewalks, driveways, roadways and adjacent facilities.

2. The contractor must repair any damage to property caused, directly or indirectly, by the actions of the contractor to the satisfaction of the SEPTA PM (and property owner if the damage is to property not owned by SEPTA) and at no cost to SEPTA.

3. Until Final Acceptance of the Work by SEPTA, the Contractor(s) shall be responsible for maintaining the executed work in its finished condition as determined by the SEPTA PM. All work shall be restored to its finished condition prior to final acceptance at no expense to SEPTA.

M. SEPTA Construction Sustainability Policies

SEPTA has adopted a series of sustainability policies which it expects its contractors to follow. These include but are not limited to the following:

a. Building Site Waste Management - Within 10 days of Notice To Proceed, and before any site work begins, the contractor shall submit a building site waste management plan. The plan shall specify which site debris shall be recycled, reused or otherwise diverted. The goal of this plan shall be to reuse or salvage 75% of the land clearing debris including rock, trees, stumps and associated vegetation and 100% of excavated soils. Any materials which are disposed of off-site must meet all applicable regulations and be specifically approved by the SEPTA project manager. For material which is disposed of off-site, the contractor will be responsible for chain of custody documentation.

b. Material and Waste Management – Within 10 days of Notice to Proceed, and before any site work begins, the contractor shall submit a construction material and waste management plan. The plan shall specify which construction and demolition materials shall be recycled, reused or otherwise diverted. The goal of this plan shall be to divert 50% of nonhazardous materials and waste (measured by weight or volume) from landfills unless the local municipality has designated a greater amount.

c. Sustainability documentation – All sustainability strategies which are fulfilled by the contractor’s actions must be documented to the satisfaction of the SEPTA project manager.

1.05 CONTRACTOR’S FIELD STAFF

A. The Superintendent shall have demonstrated competency in site, structural, architectural, electrical, and mechanical work. The Superintendent shall be the Contractor’s principal representative and be responsible for all communications with SEPTA’s Project Manager.

B. Safety Officer: The Contractor shall assign a designated on-site Safety Officer. The Superintendent may perform the duties of the Safety Officer in addition to his own. The presence of the Safety Officer at the site is mandatory while work is being performed.

C. Quality Manager: The Contractor shall assign a Quality Manager for the duration of the work. For a definition of the responsibilities of this position see section 01400. Those duties can be shared with other duties assigned to a member of the Contractor’s staff.

D. Staff Qualifications

The work of this contract requires specified experience in description of the specialized work of the contract. The positions referenced above in Article 1.03I are considered key personnel and the review of their resumes and experience is a responsibility requirement under paragraph 4d 6) of the Instructions to Bidders. The lowest bidder shall furnish SEPTA with the resumes for
the people who will hold the above positions within five (5) days of receipt of SEPTA’s written request.

If, in the course of the work, these individuals are proposed to be replaced by the Contractor and/or SEPTA deems that their work is no longer satisfactory, the terms of the Paragraph VIII K of the Agreement will be invoked.

1.06 CONTRACTOR’S USE OF WORKSITE

A. General

1. The Contractor(s) shall confine operations at the site to areas permitted by law, ordinances, and permits, according to the schedule and the Contract Documents and shall not unreasonably encumber the site with any materials or equipment.

2. Keep existing entrances serving the site clear and available at all times, except as otherwise specified.

3. Consider the safety of the Work and that of people and property on and adjacent to worksite, when determining amount, location, movement, installation, and use of materials and equipment on worksite.

4. Do not load finished Work with equipment and products that would endanger the integrity of the finished Work.

5. Move stored products as often as necessary that interferes with foreseeable operations of SEPTA, public and private utilities, and other Contractors at no additional expense to SEPTA. Security of stored materials shall be the Contractor’s responsibility. Secure additional storage and work areas needed for construction operations at no additional expense to SEPTA.

6. Protect the general public and SEPTA operations from construction-related activities. Conduct work in a manner, which will ensure that pedestrian and vehicular traffic will either not be obstructed or obstructed to the least possible degree.

1.07 WORK SEQUENCE OR CONSTRUCTION PHASING

A. Work Sequence – The project schedule is 365 days from notice to proceed (NTP) of construction.

1.08 EXISTING CONDITIONS

A. The existing conditions represented in the Contract Drawings are based on the best available information obtained from one or any combination of the following sources: field survey, as-built documents, reference drawings, and/or visual investigation. Every effort has been made to present as much information as is possible to obtain.

B. On the basis of the information presented on the Contract Drawings, visual and physical verifications shall confirm the conditions presented. If verified conditions are close to those represented on the Contract Drawings, the Contractor shall, in addition to reporting the verification to the Project Manager, proceed with the Work at no additional cost to SEPTA. If conditions are significantly different to those presented on the Contract Drawings, the Contractor shall, in addition to reporting the verification to the Project Manager, submit a detailed scheme and associated cost for completing the required work for review and comment. The Contractor shall allow ten (10) days for review and comment.
C. The Contract Documents establish specific criteria and standards of performance. The Contractor shall use its discretion to determine means of compliance and is responsible for coordinating with other Contractors at the site in order to achieve compliance.

END OF SECTION
SECTION 01011

SUMMARY OF PROJECT

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The work of this Contract consists of the construction of the Frankford Transportation Building, as shown on the contract drawings and specifications. This work includes demolition of existing asphalt parking lots, sidewalk, and fencing. Construction includes soil improvements per the geotechnical reports, earth moving, foundations, steel, concrete, fire protection, fire alarm, plumbing, mechanical, architectural features and finishes, and all associated work contained in the contract documents.

1.02 RELATED WORK

Section 01010: Summary of Work
Section 01041: Project Coordination

1.03 ADMINISTRATIVE AND PROCEDURAL SECTIONS

A. Agreement and Exhibit III scheduling requirements.

Section 01025: Measurement and Payments
Section 01060: Regulatory Requirements and Safety
Section 01200: Project Progress Meetings
Section 01300: Submittals
Section 01305: Requests for Information
Section 01400: Inspection and Test Plan
Section 01410: Testing and Inspection Services
Section 01500: Construction Facilities and Temporary Controls
Section 01600: Material and Equipment
Section 01700: Contract Close Out

1.04 TEMPORARY FACILITIES AND SERVICES

Section 01510: Maintenance, Support and Restoration Of Existing Utility Facilities
Section 01570: Maintenance and Protection of Vehicles, Pedestrians and Passengers
Section 01580: Project Identification Signs and Other Construction Signage
Section 01590: SEPTA Field Office.

1.05 GENERAL CONTRACTOR (GC)

A. The General Construction Contract includes architectural and general construction operations traditionally recognized as General Construction. It also includes administrative and coordination responsibilities.

B. Other specific responsibilities of the General Construction Contractor include but are not limited to:

1. Coordination of the project in accordance with Section 01041.
2. Section 01050: Field Engineering.
3. Section 01380: Construction Photographs
4. Section 01500: Construction Facilities & Temporary Controls
5. Section 01590: Septa Field Office.

C. The work under this Prime Contract includes:

1. Work described on the following drawings:
   - All G-Series Drawings, General
   - All A-Series Drawings, Architectural
   - All C series drawings – Civil
   - Improvements contained in the geotechnical reports
   - All S series drawings – Structural

2. The Work required by the following specifications:
   - Division 2: Demolition
   - Division 3: Concrete
   - Division 4: Masonry
   - Division 5: Metal Fabrications
   - Division 6: Wood and Plastics
   - Division 7: Thermal and Moisture Protection
   - Division 8: Doors and Windows
   - Division 9: Finishes
   - Division 10: Specialties
   - Division 12: Furnishings

D. Maintenance: Provide the required maintenance for all materials installed under the General construction contract in “like-new” condition until date of final payment.

1.06 MECHANICAL CONTRACTOR (MC)

A. The work under this Prime Contract includes:

1. Work described on the following drawings:
   - All M series drawings – Mechanical
   - All P series drawings – Plumbing
   - All FP series drawings – Fire Protection

2. The Work required by the following specifications:
   - Division 15: Mechanical
   - Section 13930: Wet Pipe Fire Suppression System

1.07 ELECTRICAL CONTRACTOR (EC)

A. The work under this Prime Contract includes:

1. Work described on the following drawings:
   - All E series drawings – Electrical
   - All FA series drawings – Fire Alarm

   a. The Work required by the following specifications:
      - Division 16: Electrical
      - Section 13852: Digital Addressable Fire Alarm System

END OF SECTION
SECTION 01025

MEASUREMENT AND PAYMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section specifies general requirements for measurement of quantities and schedule of values required to process payment applications according to the provisions set forth in the Agreement.

B. Provide a detailed breakdown of the Contract Sum showing values allocated to each of the various parts of the Work, as specified herein, and as required by other provisions of the Contract Documents.

1.02 RELATED WORK

Exhibit III of the Agreement

1.03 MEASUREMENT OF QUANTITIES

The Work performed under the Contract will not be measured, except to establish percentage of completion for each value line payment item.

1.04 SCOPE OF PAYMENT

Payment for work performed under the Contract will be paid in accordance with the agreement, for the:

FRANKFORD TRANSPORTATION BUILDING

Complete in place and in conformance with the Contract Documents.

1.05 QUALITY ASSURANCE – Not Used

1.06 SCHEDULE OF PAYMENTS

Submit a schedule of values in accordance with the requirements specified in the Agreement.

PART 2 - PRODUCTS
-Not Used-

PART 3 - EXECUTION
-Not Used-

END OF SECTION
SECTION 01041

PROJECT COORDINATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This specification covers project coordination responsibilities of each separate Contractor for this Project.

1. Throughout the progress of the Work, perform coordination responsibilities as defined herein and as noted in related sections of the Specification.

2. Coordinate the Work of its own employees and subcontractor(s).

3. Coordinate the work with the Work of other Contractor(s).

4. Expedite coordination process to assure compliance with the project schedule.

1.02 RELATED WORK

A. Agreement and Exhibit III

B. Division 1:

1. Section 01010 - Summary of Work

2. Section 01011 - Summary of Project

3. Section 01045 - Cutting and Patching

4. Section 01060 - Regulatory Requirements and Safety

5. Section 01400 - Inspection and Test Plan

6. Section 01500 – Construction Facilities and Temporary Controls

C. All Technical Specification Sections

1.03 COORDINATION AND MEETINGS

A. The Coordinating Contractor, as designated under Exhibit III of the Agreement and Section 01011, is hereby assigned the full responsibility to insure that the work to be performed by other Separate Contractors under this Project is coordinated in a manner to eliminate any impact to the schedule, and any installation sequencing conflicts.

B. The Coordinating Contractor shall conduct regular construction coordination meetings, prepare written memoranda regarding coordination activities, including such items as required notices, resolution of conflicting activities reports and attendance at meetings. Distribute such memoranda to each Contractor performing Work at the site and provide copies to SEPTA's Project Manager within five (5) days of the meeting date. In addition to other responsibilities noted elsewhere in this specification, the Coordinating Contractor shall:
1. Establish administrative procedures and distribute these procedures to each Contractor within thirty (30) days from the date of the notice to proceed.

2. Arrange and conduct pre-installation meetings affecting all Contractors at site, as may be required for quality control, access and sequencing.

3. Resolve schedule and installation conflicts among Separate Contractors (see Section 1.04 below).

4. Establish control for the use of site, maintenance of traffic, and Quality Control (QC) monitoring during construction.

5. Monitor and enforce general discipline among the contractors at site concerning safety, site protection and cleaning. The Coordinating Contractor is responsible for coordinating and monitoring activities among the Separate Contractors so as to secure, protect and waterproof unfinished and exposed work.

6. Inform SEPTA’s PM of the time and place of each construction coordination and pre-installation meeting. SEPTA may elect to have a PM’s representative present.

1.04 COORDINATION AMONG CONTRACTORS

A. All Contractors are alerted to the importance of coordination and cooperation among themselves. It is essential to the expeditious and accurate completion of this project that the Contractors meet at an early stage in the work for the purpose of allocating their construction space requirements. In such areas where their installations are in close proximity, or are likely to be in conflict or interfere with one another, it is mandatory that the Coordinating Contractor set up regular meetings as shop drawings are developed. The meetings shall be for the purpose of modifying work schedules to adjust for conflicts and to arrive at an orderly sequence of operations agreeable to all Contractors so delays may be avoided. The meetings are also intended to determine the need to prepare coordination drawings for the use and guidance of each Contractor.

B. The meetings will be arranged through and managed by, the Coordinating Contractor, and shall be separate from, and in addition to, the regular job progress meetings. If it is desired that the Architect/Engineer be present at such meetings, a request to this effect should be directed to SEPTA’s Project Manager. Attendance by all of the separate contractors and their subcontractors/vendors (as needed) is mandatory. The Contractors’ representatives at the meetings shall have the competence and authority to make any necessary decisions and their statements shall commit the Contractors to the agreed procedures, sequence of operations and time schedules.

C. The Coordinating Contractor must insure that coordination drawings and related shop drawings are submitted for SEPTA’s review after the drawings have been reviewed and approved by the other Separate Contractors. Coordinate work with architecture and structural drawings for exact space conditions; where not readily discernable, request information from the Architect/Engineer before proceeding. These coordination drawings must be fully dimensioned including clear dimensions, elevations, and location relative to the building lines and/or baselines, and other adjacent structures. The Coordinating Contractor shall prepare the coordination drawings (in 1/8"inch scale) of equipment, piping, ductwork, etc. to be installed at site, and submit drawings to all other Contractors for review, comments, coordination and approval before any contractor begins work.

D. Where procedures have been agreed upon and coordination drawings accepted by all Contractors concerned, the coordination drawing(s) must be transmitted as a formal shop drawing, and it shall become binding upon all Contractors to follow the coordination drawings
and procedures. A responsible supervisor from the staff of each Contractor shall supervise the work of his contract. Each Contract shall provide its own drafting equipment and supplies.

E. If a structure and/or enclosure is to be constructed over equipment, the Contractor shall deliver, set and protect equipment and materials before erection of confining enclosures. All equipment and materials so confined shall be inspected and tested prior to delivery. Should equipment or materials fail to meet the requirements of the specifications, the Contractor who did not provide the specified testing shall replace equipment or materials and pay all costs, including costs for modifications of completed areas that are required to provide passage.

F. Failure to be represented at any of these meetings shall subject the absent Contractor to liability for any and all damages, delays, costs of alterations, etc., which result from the fact that its representative was not present to coordinate its work with the other contractors.

G. If an interference develops as a result of coordination failure of any Contractor, SEPTA will determine which Work shall be relocated or replaced, regardless of which was installed first, and the cost shall be the sole responsibility of the Contractor(s) who failed to properly coordinate.

1.05 PRE-INSTALLATION MEETINGS

A. The Coordinating Contractor is responsible to coordinate the Work of all separate Contractors at the site to eliminate any scheduling conflicts in the installation of each unit of work.

B. Each Contractor shall schedule and conduct pre-installation meetings with its own subcontractors, suppliers, manufacturers, fabricators and other affected trades for each unit of work affecting the quality or proper sequencing of Work, prior to the construction coordination meeting with the Coordinating Contractor.

C. The pre-installation meetings must at least include following topics of discussions:

1. Requirements of the Contract Documents and the approved shop drawings, product data and quality (see 1.04 above) control samples.

2. Coordination with other contractors. Possible installation conflicts and resolutions with existing and new work not resolved during the construction coordination meetings.

3. Delivery Schedule and Site Access

4. Weather limitation

5. Space and access limitations

6. Regulatory requirements

7. Safety during installation
1.06 COORDINATION WITH OTHER CONTRACTORS AT SITE

A. There may be other active contracts on the project site engaged in activities not directly associated with the Work of this project. The Coordinating Contractor (CC) will consider these other contracts when developing the project schedule. SEPTA’s PM and/or Architect/Engineer will be responsible for the day-to-day coordination of the Work of the other contractors as required.

B. SEPTA will not consider any time extension or monetary compensation for delays or damages as a result of the Coordinating Contractor’s failure to adequately document or communicate the other Contractor’s activities in the integrated schedule or the separate Contractor(s)’ failure to act on the information furnished by the CC. SEPTA may only consider a time extension to the Contract if it is documented by the CC, to the satisfaction of SEPTA that the Contractor has responsibly complied with these coordination requirements.

C. If the damage to the project’s Work occurs as a result of the other contractor’s activities, the Contractor shall promptly settle the matter with the other Contractor so as not to impact the schedule and warranty provisions of this Contract.

END OF SECTION
SECTION 01045
CUTTING AND PATCHING

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included: This section of the Specifications covers general requirements pertaining to cutting (including excavating), fitting, and patching of the work required to:

1. Make the installation fit properly in the existing and new structure;
2. Uncover work to provide for installing, inspecting, or both.
3. Remove and replace work not conforming to requirements of the Contract Documents; and
4. Remove and replace defective work.
5. Coordinate the Work with other separate contractors.
6. Repair holes and cracks caused by removal of accessories and equipment.

B. Responsibilities: Each separate Contractor shall be responsible to perform its own cutting, fitting and patching work except where otherwise specifically noted in the Contract Documents.

1.02 RELATED WORK

Section 01010: Summary of Work
Section 01011: Summary of Project
Section 01041: Project Coordination
Section 01060: Regulatory Requirements and Safety
Section 01300: Submittals
Section 01400: Inspection and Test Plan
Section 01600: Materials and Equipment
Section 06100: Rough Carpentry
Section 09900: Paints and Coatings

1.03 SUBMITTALS

A. Request for Approval: Prior to cutting any element submit written request to the SEPTA Project Manager for permission to proceed with cutting.

B. The request shall include the following:

1. A description of the extent of cutting and patching required, the method for performing the cutting and patching and an explanation for why cutting and patching is required.
2. Description of the anticipated results in terms of changes to existing construction, including related changes to structural elements and functional components as well as changes in the structure’s appearance and other significant visual elements.
3. A list of products to be used and firms or entities that will perform work.
4. An indication of dates when cutting and patching will be performed.

5. Include a list of utilities that will be disturbed or affected, relocated or temporarily out-of-service. If utility service disruption is anticipated, indicate how long service will be disrupted.

1.04 QUALITY ASSURANCE

A. Use adequate numbers of skilled workmen who are thoroughly trained and experienced in the necessary crafts and who are completely familiar with the specified requirements and the methods needed for proper performance of the Work of this Section.

B. Provide a plan for the inspecting/testing of all modified structural components to ensure structural integrity is maintained. This plan shall be stamped by a structural engineer and submitted to the SEPTA PM.

C. The SEPTA PM reserves the right to require an approved mock-up for any cutting and patching work prior to execution of the entire work.

1.05 RESTRICTIONS

A. Structural elements shall not be cut or patched in a manner that would reduce the load carrying capacity or load deflection ratio. All processes which affect structural members must be sealed by a licensed engineer and submitted to SEPTA for review before work begins.

B. Operating elements or safety related components shall not be cut or patched in a manner that would result in reducing their capacity to perform as intended, or result in increased maintenance or decreased operational life or safety.

C. Construction exposed on the exterior or in occupied spaces shall not be cut or patched in a manner that would, in the opinion of the SEPTA Project Manager, reduce the building elements' aesthetic qualities, or result in visual evidence of cutting and patching. The responsible Contractor shall remove and replace work cut and patched in a manner deemed to be visually unsatisfactory by the SEPTA Project Manager.

D. Dispose of all waste in a legal manner following all local codes and regulations.

PART 2 - PRODUCTS

2.01 MATERIALS

Except as otherwise indicated or approved by the SEPTA Project Manager, provide materials for cutting and patching which will result in equal or better work than work being cut-and-patched, in terms of performance characteristics and including visual effect where applicable. Use materials identical with original materials where feasible and where recognized that satisfactory results can be produced thereby.

PART 3 - EXECUTION

3.01 INSPECTION

A. Inspect existing conditions, including elements subject to movement or damage during cutting, excavating, patching, and backfilling:

B. After uncovering the work, inspect conditions affecting installation of the Work.

3.02 DISCREPANCIES

A. If uncovered conditions are not as anticipated, immediately notify the SEPTA Project Manager and secure needed directions;
B. Do not proceed until unsatisfactory conditions are corrected.

3.03 TEMPORARY SUPPORT AND PROTECTION

Provide adequate temporary support to prevent failure of Work to be cut. Do not endanger other Work. Provide adequate protection of other work during cutting and patching, to prevent damage; and to provide protection of the work from adverse weather exposure. If safety of structure appears to be endangered, take immediate precautions to support structure until determination is made for continuing operations. Install temporary support for masonry walls as needed until permanent support of openings in masonry walls can be put in place.

3.04 PERFORMANCE

A. Cut Work so as not to damage Work to be retained and adjoining Work. Where physical cutting is required, cut Work with sawing and grinding tools. Core drill openings through concrete and masonry work. Do not cut with hammer and chipping tools. Use water and adequate ventilation to control dust. The Contractor is to follow the guidelines as shown in the construction documents regarding the outline of the cutting and patching.

B. Patch seams so as to be as durable and as invisible as possible. Restore exposed finished or patched areas in a manner to eliminate evidence of patching.

C. Do not cut and patch operational elements or safety related components in a manner that would result in a reduction of their capacity to perform in the manner intended, or that would result in increased maintenance, or decreased operational life or decreased safety.

D. Where new doorways or openings are shown in existing construction, take the necessary precaution to support the walls above the openings and install new lintels above the openings as shown on the construction documents. Where the wall finish is plaster or CMU, reinforced precast block lintels may be used where approved by the SEPTA Project Manager. New wall materials shall be toothed into existing wall materials. New metal frames shall be anchored and grouted the same as for all new work, as shown on the construction documents.

E. If existing utilities, pipes, and/or conduits are necessary to be relocated by any contractor affecting their work; the affected contractor shall install by-pass services of quality equal to the existing system prior to beginning the work.

3.05 CLEANING

Thoroughly clean areas and spaces where work is performed or used as access to work. Thoroughly clean piping, conduit and similar fixtures before painting or other finishing is applied. Restore damaged pipe covering to its original condition.

END OF SECTION
SECTION 01050
FIELD ENGINEERING

PART 1 - GENERAL

1.01 DESCRIPTION
A. Work included: This Section of the Specifications covers field engineering services as necessary to correctly complete the Work including, but not limited to:

   1. Structural design of steel curbs to support mechanical equipment to be installed on existing steel dunnage atop the Fern Rock Car House Building and other similar items provided by the Contractor as part of the means and methods of construction.

   2. Responsibilities: Each Separate Contractor is responsible to perform its own field engineering work.

1.02 RELATED WORK
A. Section 01300: Submittals
B. Section 01700: Contract Closeout
C. Section 01720: Project As-Built Documentation

1.03 SUBMITTALS
A. Comply with pertinent provisions of Section 01300.

B. Contractors in all cases shall submit:

   1. Data demonstrating qualifications of persons proposed to be engaged for field engineering services.

   2. Documentation detailing the methods that the Contractor proposes to use to achieve and verify required survey accuracy.

   3. Shop drawings and design calculations for all steel framing and fasteners proposed.

1.04 QUALITY ASSURANCE
A. Use adequate numbers of skilled professionals and technicians who are thoroughly trained and experienced in the necessary areas and who are completely familiar with the specified requirements and the methods needed for proper performance of the work of this section.

B. A Professional Engineer (PE) Licensed to Practice in the Commonwealth of Pennsylvania shall perform the engineering design work for the Contractor.

END OF SECTION
SECTION 01060

REGULATORY REQUIREMENTS AND SAFETY

Valid from 07/01/14 to 06/30/15

PART 1 - SAFETY

1.01 DESCRIPTION

A. This Section specifies the safety & environmental requirements for contractor personnel involved in construction, maintenance, and rehabilitation projects on SEPTA property. The Contractor is required to assure that all employees, subcontractors, and suppliers/vendors, while on the Work site comply with the provisions of this Section.

B. At those facilities to remain in operation during construction, or are adjacent to SEPTA right of way, the Contractor shall take every precaution necessary to assure the safe access and egress of all SEPTA customers and employees, the safe and continuous operation of all SEPTA vehicles, ensure the appropriate protection of the environment as well as the safety and general welfare of the public at large. Depending on the configuration of the project, the contractor may be responsible for providing temporary pedestrian access including access which is accessible to those with disabilities. Under no circumstances is the contractor to block or restrict public or SEPTA entrances or the SEPTA vehicle right of way without prior written approval of the SEPTA Project Manager.

1.02 RELATED WORK

Include all applicable sections

Section 01010 Summary of Work
Section 01041 Project Coordination
Section 01063 NHSL Safety Requirements
Section 01065 Railroad Division Safety Requirements
Section 01066 Subway/Elevated Division Safety Requirements
Section 01067 Media/ Sharon Hill Safety Requirements
Section 01068 Maintenance Facilities Safety Requirements
Section 01069 Light Rail Tunnel Division Safety Standards
Section 01090 References
Section 01100 Special Project Procedures
Section 01103A Amtrak Special Project Procedures
1.03 SUBMITTALS

The Contractor shall furnish a copy of the Contractor's project/site specific safety plan (and corporate program if referenced) and protocols to the Project Manager within 30 days from receipt of the Notice to Proceed. The SEPTA Project Manager may prohibit and/or restrict any work on site until this plan has been received and approved.

If these specifications call for certification or licenses from the Commonwealth of Pennsylvania, it is understood that certification or licensure shall be from the state where the work is occurring and in the case of work in multiple states, then licensure from multiple states may be required.

1.04 QUALITY ASSURANCE

A. The Contractor shall be responsible for ensuring compliance with the regulations of all applicable occupational safety and health statutes and regulations of all of the applicable political jurisdictions where the work is being performed including those relating to the U.S. Department of Labor, FRA, FTA, and Occupational Safety and Health Administration (OSHA) standards. The Contractor shall conduct daily monitoring and document the compliance and performance of the requirements set forth in this document and those required by applicable governmental agencies. This documentation will be based on the applicable code requirements and shall be made available upon request of the SEPTA PM.

B. SEPTA Project Managers (SEPTA PM), Authority employees, and SEPTA’s third party consultant staff will monitor compliance with all applicable internal safety and environmental regulations and environmental contract specifications.

C. The Contractor's employee safety program, which must be site specific, shall include but not be limited to the following (as
applicable):

1) Work Site Orientation
   a. Safety and health hazards present in the work assignment and the general work area.

2) OSHA - written programs applicable to scope of work.

3) Required training, licensing or certification, and documentation of same

4) Workers' Compensation Reporting

5) Fall Protection equipment and requirements

6) Personal Protective Equipment

7) Confined Space Procedures

8) Hazardous Materials Handling and Disposal

9) Trenching and Excavation including shoring and sheeting

10) Cranes

11) Electrical Protection

12) Drug and Alcohol prohibitions and testing

13) Public, SEPTA Employee, and Passenger Protection

14) Site Emergency Procedures and Contact Information
   a. Emergency contact numbers
   b. Emergency escape routes and evacuation meeting place.

15) Nearest hospital including directions from the site with route maps

D. The Contractor shall provide a designated qualified safety officer who shall be responsible for all safety-related activities until the completion of the Work. The Contractor is also responsible for all safety related activities for all their subcontractors and suppliers working at the work site.

E. The safety officer shall report all on-the-job injuries at once to the SEPTA Project Manager and submit all paperwork pertaining to such injuries, within 24 hours or as required by the SEPTA PM.

F. The Contractor's safety officer shall, as a minimum hold weekly (tool box) safety meetings with all of the Contractor's personnel. Subjects, time, and location may be set at the Contractor's convenience. At
least three (3) days prior to each meeting, SEPTA requires an agenda be submitted to the SEPTA Project Manager, including the time and location of each meeting. Copies of signed attendance sheets and the meeting minutes shall be submitted to the Project Manager at each regularly-scheduled project coordination meeting.

G. The Contractor is required, by Agreement, to maintain an alcohol and drug free environment. The Contractor shall describe in their employee safety program on how this contract stipulation is to be accomplished and maintained. Please note that SEPTA reserves the right to restrict access to its property, because of the inherent safety hazard to its employees and general public. Any person shall be immediately removed and barred from SEPTA property if in the opinion of SEPTA’s Project Manager, and/or other appropriate SEPTA representative, that person constitutes a safety risk.

1.05 GENERAL SAFETY REQUIREMENTS

A. The Contractor shall supply and furnish all required personal protective equipment (PPE) for their employees. The Contractor is also responsible for ensuring that PPE is worn correctly by all employees while on the work site. The Contractor’s employees shall wear compliant safety equipment including, but not limited to, hard hats, work shoes/boots, safety vests, safety glasses, and fully body cover clothing, including flame retardant (FR) clothing where and when it is required.

1. The minimum PPE standards must be met as outlined below:
   a. Hard hats shall be ANSI-Z89.1 2003, Class E. Hard hats shall be worn at all times while on the work site.
   b. Work shoes (ASTM 2413-11 C75 / I75) shall have non-slip soles. Permanent metal plates or cleats on the sole or heel of shoes are prohibited. Shoelaces are to be kept short so they do not pose a tripping hazard. Athletic shoes, sandals, open-toed shoes, moccasins and/or shoes with heels higher than 1” are not permitted.
   c. Contractor personnel shall wear eye protection at all times on the work site. Eye protection shall be safety glasses with rigid side shields that comply with ANSI Z-87.1. Prescription eyewear shall also meet the same requirements as described above, or the individual shall wear equivalent eye protection over their prescription glasses or contact lenses.
d. The safety vest shall be ANSI 107, Class 2 high-visibility with a yellow-green background and 2-inch retro-reflective striping for work on SEPTA owned property within any public right-of-way, where exposed to vehicular traffic, or otherwise required by rules or regulations. Work in Amtrak territory requires the use of an orange vest subject to approval by Amtrak.

e. The Contractor’s personnel shall wear long pants (without cuffs) and, at a minimum, short sleeve shirts. Sleeveless shirts are prohibited.

f. Approved hearing protection shall be worn in all designated areas identified by signs or when operating high noise level equipment. The contractor is responsible for providing acceptable hearing protection for their employees as outlined in OSHA 29 CFR 1910.95.

g. The Contractor is responsible for providing acceptable respiratory protection for their employees as outlined in OSHA 29 CFR 1926.103.

h. Gloves shall be worn where hand injuries are likely to occur based on the hazard present.

B. The Contractor shall take all necessary precautions and provide protective measures to prevent injury to the public and damage to property of others. To prevent unauthorized access to the work zone and storage areas, the Contractor shall furnish and erect construction fencing or barricades and signage, as specified in the contract documents or as directed by the SEPTA PM, for the safeguarding of the public against accident or damage before commencing operations. The Contractor shall maintain the protective measures and/or construction fencing in good condition as evaluated by the SEPTA PM, until removal.

C. The Contractor shall dismantle, remove and/or relocate construction fencing and barricades when directed by the SEPTA Project Manager.

D. The Contractor must ensure personnel, including subcontractors and vendors, receive the required SEPTA (and Amtrak or other railroad if applicable) Safety Training for the affected mode(s) before starting work. This covers the rules and procedures for personnel and equipment including but not limited to, working in or about stations, yards, tunnels, or adjacent to the track right-of-way. All personnel
who are present at the job site at any time must have this training. All personnel are required to wear / display their safety training card.

E. The Contractor is required to comply with OSHA’s Noise Standard 29 CFR 1910.95 and any local noise ordinances.

F. Where it is permitted to store materials on streets, the Contractor shall place such materials in a secured place in accordance with local jurisdictions so as to cause minimum obstruction to traffic and public safety. The Contractor shall not place materials within 15 feet of fire hydrants nor obstruct drainage gutters and inlets. The Contractor shall obtain and pay for all required permits relative to materials storage.

G. Material stored on site must be secured to prevent vandals from placing debris or material on the right-of-way. Material placed on the right of way must be removed by the contractor immediately upon notification, at any time, at no cost to SEPTA. At no time shall any merchandise, material, or other articles be permitted to remain piled or assembled on the ground or on platforms adjacent to any track at a distance of less than ten feet, (10'-0") from the center line of such track.

H. Copies of Safety Data Sheets (SDS) and the quantity of each chemical must be provided to the SEPTA Project Manager for review and approval before chemicals can be brought to any SEPTA property. The SDS will be reviewed by SEPTA’s System Safety and Risk Management Department for approval.

I. All SDS must comply with OSHA’s Hazard Communication Standard 29 CFR 1910.1200. In addition, all Contractors must be trained per the Hazard Communication Standard. The Contractor is responsible for maintaining all SDS used at the work site.

J. The storage of hazardous and flammable materials on SEPTA property is restricted and permission for each material must be granted by the SEPTA Project Manager. When storing flammable and hazardous materials and hazardous waste, they must be stored in compliance with all applicable regulations. Flammable materials shall not be stored in confined spaces or other similar areas such as tunnels, underground rooms and building basements.

K. If hazardous substances are present, such as wastes, or if the potential for a hazardous release exists, the Contractor is responsible for
following their Site Safety Plan covering policies and procedures to protect workers and the public from the potential hazards.

L. Firearms or any items classified as concealed weapons will not be brought onto SEPTA's property.

M. All tobacco use is prohibited within the construction project and all areas subject to restrictions by SEPTA or by local, state and federal law. Smoking within SEPTA indoor facilities is prohibited.

N. The Contractor may not block or obstruct access to emergency equipment such as first aid kits, AED units, eyewash stations, fire extinguishing equipment, fire hydrants, transformers, or emergency generators. Emergency equipment must not be disconnected or relocated by the Contractor without permission from SEPTA’s Project Manager.

O. All electronic devices must be turned OFF or placed in airplane mode when working within the fouling envelope of the right of way. If an individual must make a phone call, they must first step outside the fouling envelope of the right of way to make or receive the call or otherwise use an electronic device. The contractor and his personnel are liable for all fines assessed by the Federal and/or state regulators for a violation of this regulation. Violation of this regulation can result in the individual being prohibited from working on the project.

P. The use of head phones, ear buds, etc. are prohibited while in a construction area.

1.06 ACCIDENT AND INJURY REPORTING

A. The Contractor is responsible for reporting and investigating all work related accidents and incidents. This shall be completed in a timely manner with recommendations for corrective actions to prevent similar accidents or incidents. Accidents and incidents include:

a. Personal Injury
b. Property Damage
c. Near Misses
d. Actual or potential exposure to toxic substances
e. Hazardous material spills and releases
f. Fires
B. The Contractor must notify the SEPTA Project Manager for all accidents and incidents that occur on SEPTA property immediately.

C. SEPTA reserves the right to conduct an independent investigation of all accidents and incidents that occur on the work site with the full cooperation of the contractor, subcontractor and employees.

D. At accident locations where conditions are immediately dangerous to life and health, work shall be suspended until corrective actions are taken to the satisfaction of the appropriate SEPTA representative.

1.07 EMERGENCY PROCEDURES

A. The Contractor shall set up emergency procedures and prepare written guidelines discussing such procedures for the following categories:

1. Fire
2. Injury to contractor’s and/or SEPTA employees
3. Injury to general public
4. Property damage, including property of utilities, i.e., gas, water, sewage, electrical, telephone or pedestrian and vehicle routes.
5. Hazardous/toxic material spill, discharges and/or exposure.
6. Site evacuation.

B. Copies of all guidelines for emergency procedures shall be written and posted prior to the initiation of actual construction. Posting shall include emergency telephone numbers and directions to and from the nearest hospital. The Contractor shall have standing arrangements for the transportation and hospital treatment of any employees who may be injured, are exposed to hazardous material, or who may become ill. These guidelines shall be included in the Contractor's written safety program and shall be submitted to SEPTA.

C. The Contractor shall provide a fully equipped first aid kit at the site. This kit will be made available to the SEPTA PM for their inspection and approval at any time.

D. The Contractor must discuss site emergency procedures at the beginning of the project, with the addition of a new worker to the site,
and at least monthly with all personnel at tool box safety meetings. Any changes to the work site emergency procedures must be documented and employees, vendors and the SEPTA Project Manager notified.

E. SEPTA operational emergencies will be handled by the senior SEPTA Operations personnel present. This individual, designated “The Incident Commander” is responsible for summoning the number of persons required by the situation and assignment of all recommended procedures.

1.08 PROTECTION OF SEPTA FACILITIES

A. The Contractor shall be cognizant of and bound by SEPTA's safety rules and regulations specified herein and conduct operations in strict accordance with same.

B. SEPTA shall be the sole judge of protection necessary for the safe operation of its facilities. SEPTA reserves the right to alter this protection at any time.

C. SEPTA’s Facilities and/or Structures shall not be utilized by the Contractor for temporary scaffolding and/or support for the construction effort without permission. A Contractor may request SEPTA’s consideration for such action. The Contractor shall provide a detailed plan to utilize SEPTA’s Facilities and/or Structures. The plans will be submitted for SEPTA’s review and approval prior to the initiation of any work. SEPTA also reserves the right to have the drawings and supporting calculations sealed by a Professional Engineer registered in the Commonwealth of Pennsylvania, or appropriate jurisdiction, at no cost to SEPTA.

D. Before any work is done in the vicinity of an existing structure, SEPTA must be notified and may require a plan for stabilizing and underpinning the structure prepared and sealed by a Professional Engineer licensed in Pennsylvania, or appropriate jurisdiction, at no expense to SEPTA.

1.09 CRANE, MATERIAL HANDLING, AND ERECTION SAFETY

A. The Contractor shall take care to prevent any structure from being loaded with a weight, for any duration, which will endanger its stability, or the safety of persons.
B. The contractor shall adhere to all Local, State, and Federal laws pertaining to crane operations.

C. All cranes must be inspected annually as well as monthly. The most recent reports shall be submitted to SEPTA prior to the use of the cranes on any work site. SEPTA's Project Manager must ensure that daily safety inspections are completed. The monthly reports for the crane must be submitted to the SEPTA Project Manager on a predetermined schedule as long as the crane is operating on the project.

D. The Contractor shall ensure all crane operators and riggers are trained and competent in the use of such equipment. The Contractor shall provide a competent person to oversee and/or perform lifting operations as required by OSHA. Personnel qualifications will be made available to SEPTA upon request.

E. The Contractor shall submit for review to the Project Manager, sketches defining the operations of all cranes, material handling equipment, and erection activities used in support of construction during periods of train operations. The Contractor shall submit, at the Project Manager's request, similar information for cranes or other equipment in use and capable of encroachment.

1. These sketches shall include planned locations and movements of the equipment, calculations demonstrating the adequacy of the capacity of the crane for the loads, the interface between the footprint of the equipment the movement of the boom and loads relative to the existing structure and surrounding buildings, the support grillages and the protection of existing utilities and facilities, and any other pertinent details required by the Project Manager.

2. The following data shall be required for all hoisting operations adjacent to active SEPTA operations and facilities and shall be prepared by and sealed by a Professional Engineer licensed in Pennsylvania.

   a Plans and sections showing locations of cranes, horizontally and vertically, operating radii, with delivery of disposal locations shown. The location of the SEPTA Right of Way and all active facilities shall also be shown.

   b Crane rating sheets showing cranes to be adequate for 150% of the actual weight being lifted. A complete set of crane charts, including crane, counterweight, and boom nomenclature is to be submitted.
c A location plan showing all obstructions such as wires, poles, adjacent structures, etc., and that the proposed lifts are clear of these obstructions.

d A data sheet shall be prepared listing the type, size, and arrangements of slings, shackles, or other connecting equipment, all to be designed for 150% of the actual weight being lifted. Copies of a catalog or information sheets for specialized equipment shall be included.

e A complete procedure is to be included, indicating the location and order of lifts and any repositioning or re-hitching of the crane or cranes.

f Temporary support of any components or intermediate stages is to be shown and detailed.

g A time schedule of the various stages must be shown as well as a schedule for the entire lifting procedure.

F. Specialty slings and hooks shall not be used to set steel or move materials over workers. All sling and crane load line hooks shall have safety latches installed or shall be moused, except for specialty slings and hooks such as sorting or shake out slings or self-adjusting pipe slings.

G. The Contractor shall not leave suspended loads unattended. When moving loads, the operator shall ensure a clear path free of personnel or other barriers.

H. The Contractor shall establish a restricted work area using barricades and other appropriate controls to minimize the hazards to personnel, customers, and equipment from swinging or falling objects.

1.10 SNOW REMOVAL

A. The Contractor shall remove all snow and ice within the project site as required for the proper protection and prosecution of the Work, and to protect SEPTA employees and the public. The Contractor shall at all times provide and maintain adequate protection against weather so as to preserve all Work, materials, equipment, apparatus, and fixtures free from damage.

B. The Contractor shall not use sodium chloride (or any chloride) on any facilities adjacent to SEPTA electric rail lines where the possibility
exists that melting mixture may leach onto the contact rail within the Right of Way.

1.11 WELDING, CUTTING AND OTHER HOT WORK

Gas or electric cutting, burning, or welding shall be done in accordance with the guidelines of NFPA 51 B, the International Fire Code, federal, state, and local rules and regulations, or the provisions below, whichever is more restrictive.

A. If hot work is to be executed at a job site, the prime contractor’s safety officer must have a copy of the current version of NFPA 51B at the job site.

B. The prime contractor’s safety officer shall act as a Permit Authorizing Individual (PAI) and complete the checklist to fulfill the requirements of by 51 B for all torch work. The contractor shall obtain the current copy of SEPTA’s “Hot Work Checklist” for this purpose.

C. The SEPTA PM shall be notified at least 48 hours in advance of any hot work on site. A copy of each checklist completed for that period shall be delivered to the SEPTA PM at the next job progress meeting.

D. Spark shields and a fire watch must be posted when executing hot work and for a period of at least four hours after all activity has been completed. The SEPTA PM reserves the right to extend the duration of the fire watch in special circumstances. A supply of water and an approved fire extinguisher shall be readily available to the location where the work was done.

E. All oxygen/acetylene bottles must be removed and stored outside of all tunnels, underground stations and other confined spaces at the end of the workday. While in use in a tunnel, underground station or other confined space, they shall be attended at all times. At no times when not in use shall oxygen and acetylene bottles be stored together.

E. Anti-flashback devices must be installed on the fuel side of all gas and oxygen cutting torches

1.12 GAS CYLINDERS

A. Compressed gas cylinders shall be handled and properly supported and secured in an upright position away from heat or flame sources.
Cylinders that are not being transported must have their caps in place.

B. Regulators, hoses, and torch assemblies must be in working order and checked for leaks prior to initial use or installation. If a leak is discovered, the cylinder must be removed to a safe location.

C. Cylinders must be labeled and stored according to compatibility with signs posted.

D. Oxygen and acetylene cylinders, empty or full, shall not be stored together. Full oxygen cylinders must be separated from acetylene cylinders or other fuel-gas cylinders or combustible materials a minimum distance of 20 feet or by a noncombustible barrier at least 5 feet high having a fire-resistance rating of at least one-half hour.

E. All cylinder valves must be closed when cylinders are not in use and the hose pressure bled down.

F. All cylinders must be removed from confined spaces at the end of each work day.

1.13 UTILITIES

A. Before any excavation begins, the Contractor must determine the location of all utility installations such as but not limited to sewer lines, telephone lines, fuel lines, underground electric lines, water lines, or any other underground installations that may be present during excavations.

B. As per 73 P.S., § 176, et seq., the Contractor is required to notify utilities prior to all excavations. The Contractor shall be held responsible for any damage done to any utility in the prosecution of the Work. The Contractor shall exercise any precautions necessary to prevent damage in working underneath or adjacent to any underground structure. If it becomes necessary for a utility company, through emergency procedures or because of unforeseen conditions, to repair, reconstruct, relay or relocate utilities within the contract area, after work has commenced by the Contractor, then the said utility company and the Contractor shall make suitable arrangements to overcome such interference. All work shall be accomplished at no extra cost or charge to SEPTA. No compensation shall be allowed the Contractor for the disruption to his work. A no-cost time extension may be granted in accordance with the Contract to the Contractor by SEPTA for the delay that has occurred.

1.14 HOUSEKEEPING
A. The Contractor shall maintain their work area in an orderly manner.

B. The Contractor shall provide containers for trash and scrap metal unless prearranged with the SEPTA Project Manager before the start of the project.

C. The Contractor is responsible for the proper disposal of hazardous, flammable, trash, and/or excess waste material. All waste must be removed or secured on site daily. See SEPTA’s Contractor Environmental Safety Requirements for more information on hazardous waste.

D. The Contractor is responsible for maintaining all disposal records, including chain of custody records for hazardous or untested material, and providing copies to the SEPTA Project Manager where applicable.

E. No on site burning or burying of waste or material is permitted.

1.15 ELECTRICAL

A. The Contractor directly involved with electrical work, or work adjacent to electrical hazards shall do so only after details of the work has been planned and approved by SEPTA.

B. All electrical work shall comply with OSHA 29 CFR 1926.400 (Electrical Standard), OSHA 29 CFR 1910.147 (Lockout/Tagout), The National Electric Code (NEC), NFPA 70E (latest editions), and any SEPTA standards.

C. All equipment and cords must be free from damage. Frayed or cut electrical cords, or cords with damaged plugs or missing ground plugs shall immediately be removed from service, rendered unusable, and removed from the work site.

D. All electrical tools and equipment must be grounded.

E. Before working on a de-energized circuit, it must be electrically tested to ensure it is de-energized.

F. The Contractor must complete lockout/tagout procedures for all machines, equipment, and systems that require service or maintenance as required by 29 CFR 1910.147.
1. A lock or tag can only be removed by the individual or their designee.

G. After the Contractor performs repairs, maintenance or installations, and before SEPTA employees attempt to re-energize the electrical equipment, verification shall be performed in the presence of the SEPTA PM to ensure that the electrical equipment components are operationally intact and that no electrical hazard is present up on re-energizing.

1.16 CONFINED SPACE

A. The Contractor shall be required to have competent and trained personnel for restricted or confined space entry work.

B. All confined spaces at SEPTA are permit required spaces and the Contractor is required to utilize SEPTA’s confined space permit.

C. Confined spaces refer to a space which by design has limited openings for entry and exit but large enough to enter to perform work, the potential for toxic atmosphere or one that can produce a toxic atmosphere, and is not designed for continuous occupancy. Confined spaces at SEPTA can include, but not limited to, storage tanks, boilers, trenches, manholes, lift stations, and valve pits.

D. The Contractor shall coordinate and obtain approval from the SEPTA Project Manager for all confined and restricted space activities.

E. The Contractor must provide emergency rescue based on the work being conducted. Documentation on the rescue procedures, authorized rescuers, training and equipment must approved by SEPTA and be available on site prior to conducting confined space entries.

1.17 EXCAVATION AND TRENCHES

A. The Contractor shall provide training to all personnel required for safe trenching and excavation projects on SEPTA property and comply with OSHA Excavation Standard 29 CFR 1926 Subpart P.

B. Prior to any excavations or trenching, the Contractor shall be responsible for utility marking to ensure the area impacted is free from underground hazards.

C. Excavations and trenches over 4-feet must have appropriate
protective systems such as but not limited to sloping, trench shields, and shoring, if soil conditions are unstable excavations less than 4 feet must have protection. This requirement is in addition to any other regulatory requirements including OSHA requirements.

D. Daily inspections of excavations, adjacent areas, and protective systems must be made by the Contractor to ensure safety systems are functional and effective.

E. The Contractor shall place warning signage and barricades or fencing to prevent unauthorized or accidental access to the site.

F. The Contractor shall cease work immediately and contact the SEPTA Project Manager if suspect material such as strong odors, discolored soils, pipes, pipe covering or other material indicating the potential presence of asbestos, or other hazardous materials is encountered.

1.18 LADDER SAFETY

A. All ladders and their use must comply with OSHA 29 CFR 1926.1053 and ANSI specifications.

B. Metal or other conductive ladders are prohibited.

C. Ladders must be inspected before use and must be in good condition and free of any broken or defective parts. Defective ladders must be removed from service.

D. The Contractor must provide training to all employees using ladders in their proper use, how to recognize ladder hazards and how to correct identified safety hazards.

E. Job fabricated ladders are prohibited.

1.19 FALL PROTECTION

A. The Contractor shall provide fall protection and proper training for its employees, as required by 29 CFR 1926.500. Fall protection is required in areas where the fall hazard is 6 feet or greater from the worker’s foot level.

B. The Contractor shall isolate work areas to protect persons from falling objects and to prevent unauthorized access to the work site.
C. The Contractor shall perform documented inspections of their fall protection equipment before each use.

D. Work being conducted within six feet of a floor opening (skylight, hole, open hatch, etc.) requires the appropriate fall protection.

E. Work being conducted on a roof within six feet of the edge requires the appropriate fall protection. The Contractor shall not work on or access roofs without prior approval from SEPTA Project Manager.

1.20 SCAFFOLDS

A. All scaffolding, staging, and work platforms must satisfy OSHA 29 CFR 1926.450 and the manufacturer's requirements.

B. The Contractor shall ensure that scaffolding be erected and inspected by trained personnel.

C. The Contractor shall perform documented pre-use inspections for erected scaffolding.

1.21 POWERED EQUIPMENT/WORK PLATFORMS

A. The Contractor shall not use SEPTA owned or leased powered equipment or aerial work platforms unless approved by the SEPTA Project Manager.

B. The Contractor shall ensure only trained and authorized personnel operate any powered equipment such as but not limited to forklifts, extendable boom lift, scissor lifts, and cranes.

C. The Contractor shall perform documented inspections of equipment prior to each day’s use to ensure safe operating condition. Defective equipment must be segregated and not be used on the work site.

D. The Contractor must ensure all its employees and subcontractors have had appropriate and effective training in compliance with OSHA 29 CFR 1910.178 (Powered Industrial Vehicles) and 29 CFR 1926.453 (Aerial Lifts) and the manufacturer’s recommendations.

1.22 FIRE SAFETY

A. The Contractor’s personnel should be familiar with the location of fire
alarm pull stations, portable fire extinguishers and exit routes from the
work area. The Contractor shall not obstruct access to exits, exit
routes, or fire equipment or prop-open stair well doors.

B. Fires shall be reported by activating the nearest fire alarm station and
calling 911.

C. The Contractor’s personnel shall be trained in the proper use of a
portable fire extinguisher in the event fire watch duties are required.

D. Flammable and combustible materials at a minimum must be labeled,
properly stored, and disposed of. Please see the Contractor
Environmental Requirements.

E. The Contractor must follow requirements listed in the “Welding,
Cutting and Other Hot Work” section of this document, if welding,
torch cutting, soldering or other forms of “hot work” will be performed.

F. The Contractor must take precautions to prevent damage to fire
protection systems. All damage must be reported immediately to the
SEPTA Project Manager.

G. The Contractor must not disable a fire protection system (sprinklers,
fire alarm system components, etc.) unless prior approval has been
provided by the SEPTA Project Manager and local fire department. If
a system is disabled, fire watch personnel must be present until that
system is reconnected or other arrangements have been made and
approved by the SEPTA PM.

H. Materials or equipment must not be temporarily or permanently
suspended on sprinkler pipes, valves, or supports.

1.23 PROTECTION OF EXISTING WATER AND SEWER LINES

A. When the equipment axle load exceeds 15 tons, the Contractor shall
provide and work from timber mats placed over existing underground
water lines and sewer lines.

B. SEPTA reserves the right to require additional protection and/or
protection plans sealed by a professional engineer.

PART 2 - ENVIRONMENTAL

2.01 SUBMITTALS
A. The Contractor shall furnish for review by SEPTA the Contractor's Environmental and/or Waste Management Program within thirty (30) days from receipt of the Notice to Proceed (see Section 2.04.B).

B. Prior to the start of work, Contractor shall furnish for review by SEPTA a Means and Methods Plan describing the day-to-day activities the contractor will employ to complete construction in accordance with the specification requirements. The Means and Methods Plan shall include the following:

1. A detailed, stepwise description of the construction process organized sequentially;

2. A description of any specialized equipment to be utilized to complete the work;

3. Identification of potential hazards in the construction process; and

4. A description of the construction mitigation measures that the contractor will implement to mitigate identified hazards.

C. Prior to the start of work, Contractor shall furnish for review by SEPTA a copy of asbestos and lead survey findings/reports. If asbestos abatement or lead removal is conducted, Contractor shall further furnish to SEPTA prior to the start of those activities, all relevant submittals including but not limited to notifications, work plans, and health and safety plans. Within thirty [30] days of completion of work, waste disposal records documenting disposal at a SEPTA-approved facility shall also be submitted to SEPTA (see Section 2.07.H).

2.02 QUALITY ASSURANCE

A. The Contractor shall daily monitor and document the compliance and performance of the requirements set forth in this Section consistent with appropriate SEPTA Work rules and Federal, Commonwealth of Pennsylvania, and Local rules and regulations. The Contractor shall document the Contractor's compliance with applicable codes and regulations.

B. The Contractor's Environmental and/or Waste Management Program, as a minimum, shall include but not be limited to the following as applicable to the Work:

1. Sustainability and Recycling
2. Waste Management and Disposal

3. Hazardous Materials

4. Soils Management

5. Erosion and Sedimentation Control

6. Noise Control (if applicable)

C. The Contractor shall provide a qualified environmental safety officer who shall be responsible for all environmental safety-related activities until the completion of the Work. The environmental safety officer shall report all on-the-job environmental incidents at once to the Project Manager and submit all paperwork pertaining to such incidents as required.

2.03 EMERGENCY PROCEDURES

A. The Contractor shall set up emergency procedures and prepare written guidelines discussing response and notification actions related to hazardous/toxic material spills, discharges, or releases. Such guidelines shall be incorporated into one or more Contractor's required site-specific plan submittals, such as the Health and Safety Plan, Work Plan, Contingency Plan, or Environmental/Waste Management Program.

2.04 STORAGE AND HANDLING OF MATERIALS

A. Materials Handling:

1. All scrap material of any kind, type, or nature shall be placed into designated confined areas or containers specifically supplied for this purpose. Containers shall be removed from the job site when full.

2. The Contractor shall assure that all chemicals, paints, solvents, and cleaners are maintained per OSHA's hazard standards. Discarded chemicals shall be disposed of in accordance with applicable Commonwealth of Pennsylvania Department of Environmental Protection (PaDEP) and/or Environmental Protection Agency (EPA) requirements. Copies of all Material Safety Data Sheets (MSDS), OSHA Form 20, and the Product Use sheets shall be given to SEPTA's Project Manager before or at the
time of material delivery. All training shall be done in accordance with OSHA's Hazard Communication Standard.

3. Materials handling shall be conducted in accordance with the Contractor's Environmental / Waste Management Program (see Section 2.04).

2.05 ENVIRONMENTAL PROTECTION

A. Environmental protection considerations consist of, but are not limited to, the following factors:

1. Natural resources, including air, water, and land.

2. Solid Waste disposal.


4. Control of toxic substances, hazardous materials, and radiation.

5. The presence of chemical, physical, and biological elements and agents that adversely affect and alter ecological balances.

6. Degradation of the aesthetic use of the environment.

7. Historical, archaeological, and cultural resources.

B. General Requirements:

1. The Contractor shall provide and maintain environmental protection as defined herein or as required by regulation, whichever is more restrictive.

2. The Contractor's operation shall comply with all applicable Federal, Commonwealth and Local laws, ordinances, and regulations pertaining to environmental protection.

3. Compliance of subcontractors and suppliers with the provisions of this and all other sections of these Specifications shall be the responsibility of the Contractor.

4. The Contractor shall not use equipment from which factory-installed antipollution and noise control devices have been removed, altered or rendered ineffective intentionally or through lack of proper maintenance.
5. Unless the Contractor has tested and established the safety of existing paints and coverings, he shall provide adequate pollution controls for painting and surface preparation in compliance with the PaDEP Regulations.

C. Protection of Natural Resources:

1. General
   a. It is intended that the natural resources within the project boundaries and outside the limits of permanent Work performed shall be preserved in their existing condition or be restored to an equivalent of the existing condition, as approved by the Project Manager upon completion of the Work. The Contractor shall confine its on-site construction activities to areas defined by the Contract Drawings and Specifications or as directed by the Project Manager.

2. Protection of Project Site and Existing Roadways:
   a. Debris or rubbish of any kind shall not be dumped onto the site or roadways. This shall include paint splatters, cleaning, stripping and surface preparation chemicals and spillage during painting operations. Care shall be taken to prevent damage and injury to personnel, vessels, and vehicles using roadways, or areas accessible to pedestrians. Devices shall be provided and maintained by the Contractor as required to prevent such occurrences. Material or items falling onto roadways shall be promptly removed at the Contractor's expense. All damage to third party property shall be restored by the contractor to the owner’s satisfaction at no cost to SEPTA.

   b. The operator shall remove from the site, recycle, or dispose of all building materials and wastes in accordance with the PaDEP solid waste management regulations at 25 pa code 260.1 et seq., 271.1 et seq. The contractor shall not illegally bury, dump, or discharge any building material or wastes at this site.

3. Land Resources:
   a. Except in areas indicated to be cleared or excavated, the Contractor shall not remove, cut, deface, injure, or destroy trees, shrubs, or vegetation. No ropes, cables, or guys shall be fastened or attached to any existing nearby trees for anchorage unless specifically permitted by the Project Manager. Where such use is permitted, the Contractor shall
be responsible for any resulting damage.

b. The use of pesticides or herbicides is not permitted unless approved in writing by the SEPTA PM.

c. The Contractor shall submit a plan for protecting existing trees and vegetation that are to remain and that may be injured, bruised, defaced, or otherwise damaged by construction operations. Rocks that are displaced into uncleared areas shall be removed. Monuments, markers, and works of art shall be protected prior to the start of the operations. A preconstruction survey, including photographs, shall be performed by the Contractor in the presence of the SEPTA PM, and a written report of the survey shall be furnished to SEPTA within five (5) days of its request by the Project Manager.

d. Repair and Restoration: All trees, vegetation and other man made or natural landscape features that are to remain and become scarred or damaged by the Contractor’s equipment or operations shall be repaired and restored to their original condition at the Contractor’s expense. The Project Manager shall approve the repair and restoration program prior to its initiation and after completion.

4. Water Resources: At all times, measures shall be taken to prevent oil, gasoline and other hazardous substances and pollutants from entering the ground, drainage areas, sewers, streams, and other local bodies of water.

5. Wildlife Resources: The Contractor shall not disturb native habitat adjacent to the project construction area.

D. Erosion and Sediment Controls:

1. Site burning of any kind, including ground vegetation, is not permitted.

2. The Contractor shall conform to all applicable requirements of the PaDEP and the County with respect to erosion and sediment control measures to prevent discharge into storm water discharge systems and active waterways.

E. Toxic Substances:
1. The Contractor shall comply with the Toxic Substance Control Act, P.L. 94-469 (TSCA).

   a. No toxic chemical substance, mixture, equipment, container, sealant, coating, or dust-control agent shall be used except in accordance with all provisions of the TSCA as interpreted by the rules and regulations of 40 CFR 761.

   b. Any toxic chemical substance, mixture, equipment, container, sealant, coating, or dust-control agent found stored within the project area shall be immediately reported to the Project Manager in writing and work shall be stopped in the area. The Project Manager shall make arrangements for the removal of the toxic materials, will ensure that the area is safe for the Contractor to continue work in the area.

F. Control and Disposal of Chemical and Sanitary Wastes:

1. Trash shall be picked up and placed in containers that shall be emptied on a regular schedule. Handling and disposal shall be so conducted as to prevent contamination of the site and other areas, and shall not be disposed of in wetlands or burned on the right-of-way. On completion, the area shall be left clean and in natural condition.

2. Disposal of rubbish and debris shall be as follows: The Contractor shall transport all waste, including excess excavated material, off the site and dispose of it in a manner that complies with the Federal, Commonwealth of Pennsylvania, and Local requirements. The Contractor shall secure a permit or license prior to transporting any material off the site. Waste materials shall not be burned on the site. The Contractor shall be responsible for the disposal of waste material to a pickup point or disposal area.

4. Chemical waste shall be stored in corrosion-resistant containers, removed from the project site, and disposed of as necessary, as but not less frequently as monthly. Disposal of chemical waste shall be in accordance with standard established practices as approved by the Project Manager. Fueling and lubricating of equipment and motor vehicles on the site shall be conducted in a manner that affords the maximum protection against spills and evaporation. Lubricants to be discarded, including burned oil, shall be disposed of in accordance with approved procedures meeting Federal, Commonwealth of Pennsylvania, and Local regulations. For oil and hazardous material spills that may violate Federal, Commonwealth of Pennsylvania, or Local regulations, the Project
Manager shall be notified immediately.

G. Dust Control:

1. Airborne dust shall be minimized at all times, including non-working hours, weekends, and holidays. Soil at the site, station platforms, haul roads, and other areas disturbed by the Contractor's operations and materials stockpiled for the project shall be treated with dust suppressors or covered to control dust. Dry power brooming shall not be permitted. Vacuuming, wet mopping, wet sweeping, or wet power brooming shall be used instead. Air blowing shall be permitted only for cleaning off non-particle debris, such as that from reinforcing bars. Sandblasting shall not be permitted except as otherwise specified elsewhere. Only wet cutting of concrete block, concrete, and asphalt shall be permitted.

2. The Contractor shall comply with all applicable provisions of the National Emission Standards (40 CFR 61).

3. The Contractor shall inspect all vehicles for dirt prior to their leaving the construction site. Dirt, soil, and rubble likely to be dislodged during transit shall be removed from the trucks and other vehicles prior to leaving the site.

4. The Contractor shall ensure that equipment transporting material to and from the site that may become airborne is covered.

5. The Contractor shall not cause or permit fugitive particulate matter to be emitted into the outdoor atmosphere from any source such that emissions are visible beyond the project property line.

G. Noise Control:

1. The Contractor shall research and determine the applicable jurisdiction requirements for noise control in the project area. In the event a project site lies in two or more jurisdictional areas and the requirements conflict, the strictest will govern. City of Philadelphia Air Management regulations govern for any work within Philadelphia. In absence of specific jurisdictional instructions regarding noise control, OSHA 29 CFR §1910 will apply.

H. Asbestos and Lead Containing Materials

1. Prior to the commencement to work, Contractor shall coordinate
performance of a survey of the project area for asbestos containing materials and lead-based paint by asbestos and lead inspectors/investigators properly licensed and certified to perform such work in Pennsylvania (and the City of Philadelphia where applicable). Contractor shall submit to the SEPTA Project Manager with a copy of the findings/report (see Section 2.03.C). Given the age of many SEPTA properties it is always possible to encounter suspicious material.


3. All asbestos abatements shall be conducted by licensed abatement Workers and Supervisors and air monitoring shall be conducted by third party licensed Building Inspector and/or Asbestos Project Inspector (depending on location as determined by System Safety) and the specification shall be written by a licensed Asbestos Project Designer.

4. All submittals including but not limited to notifications, work plans, and health and safety plans shall be submitted to SEPTA for review prior to the commencement of work. Within thirty [30] days of completion of work, waste disposal records documenting disposal at a SEPTA-approved facility shall also be submitted to SEPTA (see Section 2.03.C).

5. All newly installed materials shall be asbestos and lead free.

END OF SECTION
SECTION 01068

MAINTENANCE FACILITIES SAFETY REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

This Section specifies the regulatory and safety requirements governing the Contractor's activities. The Contractor shall take every precaution necessary to assure the safe access and egress of all SEPTA patrons, vehicles and employees, the safe and continuous operation and maintenance of trains, as well as the safety and general welfare of the public at large.

1.02 RELATED WORK

Section 01010: Summary of Work
Section 01060: Regulatory Requirements and Safety
Section 01400: Inspection and Test Plan
Section 01500: Construction Facilities and Temporary Controls

1.03 QUALITY ASSURANCE

Refer to Section 01060 - 1.04.

1.04 SAFETY REQUIREMENTS

A. Contractor employed supervisor's forepersons and gang watchpersons shall be responsible for the safety, safety instructions and safe performance of all employees under their immediate supervision. Inexperienced employees must be instructed by immediate supervisors of safety methods in performing their duties.

B. No work shall be started or prosecuted until approval has been obtained. However, such approval of the Engineer or his duly authorized representative will not be considered as a release from responsibility for any damage to the Authority by the acts of the Contractor, its employees, and/or its subcontractor's employees.

C. The responsibility for cooperation in the maintenance of SEPTA traffic will be entirely upon the Contractor and no claims may be made against SEPTA for delay or any other interference that may have caused the Contractor's operations to be delayed in connection with any work under this contract.

1. While concrete breaking or cutting is done, suitable barriers must be erected to protect passengers, passers-by, SEPTA employees and others from flying debris, dust and rubble. When masonry saw cutting is done, a water washdown must be run simultaneously.

2. Before crossing traffic lanes or vehicle storage areas, STOP and look for vehicles approaching in either direction. Do not cross traffic lanes, tracks or vehicle storage areas with oncoming vehicle movement.

3. During a period of material delivery by the contractors onto SEPTA property, Contractor shall provide a traffic flagperson, which will be utilized to control movement of vehicles and other equipment. A Contract flagperson must also be present during periods of construction, which may adversely affect passenger and employee safety as well as transit vehicles.
D. Barricades and Other Protection:

1. When it is necessary to maintain public use of work areas involving sidewalks, entrances to building and vehicular roadways, the Contractor shall protect the public with appropriate guardrail barricades, temporary fences, and/or other devices approved by SEPTA. Such protection shall guard against flying materials, falling or moving material, equipment, hot or poisonous materials, flammable or toxic liquids, gases, open flames, energized electrical circuits or other harmful exposures.

2. All open excavations must be properly barricaded and shall be lighted at the end of each workday and shall be illuminated from sunset to sunrise.

3. Remove and dispose of all project temporary facilities and controls used in conjunction with the work. All costs for such removal and disposal shall be borne by the Contractor who furnished the temporary facility or control.

END OF SECTION
SECTION 01200

PROJECT PROGRESS MEETINGS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work included: To enable orderly review during progress of the Work, and to provide for systematic discussion of problems. The Project Manager or a designee will conduct project meetings throughout the construction period. The progress meetings are in addition to the coordination, pre-construction and scheduling meetings noted elsewhere in the Contract Documents.

B. The Contractor's relations with its subcontractors, and discussions relative thereto, are the Contractor's responsibility and are not agenda items in the project progress meetings.

C. The discussions and minutes of meeting shall exclude any claims related issues not directly impacting the progress of the Work, and other items for which SEPTA has provided clarifications/directives/ change order(s), but remain disputed by the Contractor.

1.02 RELATED WORK

A. Agreement and Division 1.

1.03 SUBMITTALS

A. Agenda items:

1. To the maximum extent practicable, Contractor shall advise the Project Manager at least 48 hours in advance of project meetings regarding items to be discussed during the meeting.

2. Technical questions requiring Architect/Engineer’s response shall be submitted in writing, at least three (3) days prior to the project meeting.

B. Minutes:

1. The Project Manager will compile minutes of each project meeting, and will furnish one copy to the Contractor.

2. The Contractor may copy and distribute other copies as required.

1.04 QUALITY ASSURANCE

A. Contractor’s Superintendent shall attend and participate in each project meeting and shall represent the Contractor consistent with Contract and commit the Contractor to solutions agreed upon during the project meetings.

PART 2 - PRODUCTS – Not Used
PART 3 - EXECUTION

3.01 MEETING SCHEDULE

A. Project meetings will be held every two (2) weeks.

B. The Project Manager will coordinate as required to establish a mutually acceptable meeting schedule.

3.02 MEETING LOCATION

The Project Manager will determine meeting location. To the maximum extent practicable, meetings will be held at the job site.

3.03 PROJECT MEETINGS

A. Attendance:

1. Contractor's Superintendent shall attend and participate in each project meeting and shall represent the Contractor consistent with Contract and commit the Contractor to solutions agreed upon during the project meetings.

2. Subcontractors, and others may be invited to attend those project meetings in which their aspect of the Work is involved.

3. If notified three (3) business days in advance, the SEPTA PM will request the attendance of the appropriate members of the design team to participate in technical discussions.

B. Minimum agenda for each meeting:

1. Safety

2. Review and revise, the minutes of previous meetings.

3. Review progress of the Work since last meeting, including status of submittals for approval.

4. Presence of hazardous materials and other environmental issues.

5. Contractors provide progress and status of coordination and installation meetings with other prime and subcontractors engaged in the work of the project.

6. Identify problems, which impede planned progress.

7. Develop corrective measures and procedures to regain planned schedule, if applicable.

8. The status of Requests for Information (RFI) and all Potential Change Orders (PCO) shall be discussed and updated. The Contractor's PCO listing shall conform to SEPTA's listing.

9. Contractor shall provide and discuss "30 day look ahead" activity schedule if the work is not progressing per the early start/finish activity dates as noted in the latest update of the approved schedule.

10. Review status of all outstanding non-conformance items.
11. Discuss and review As-Built Drawings/Specification Status.

12. Complete other current business

C. Revisions to minutes:

1. Unless published minutes are challenged in writing, within five (5) working days of the distribution date they will be accepted as properly stating the activities and decisions made at the meeting.

2. Any individual challenging published minutes shall provide proper supporting documentation acceptable to the Project Manager to verify that the challenged item was truly discussed during the subject meeting.

3. Challenge to minutes shall be settled as priority portion of "old business" at the next regularly scheduled meeting. SEPTA's Project Manager decisions concerning challenged item(s) shall be binding on the Contractor.

END OF SECTION
SECTION 01300

SUBMITTALS

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section of the Specifications covers all submittals including shop drawing submission and concurrence requirements, and further complements the requirements of Paragraph VIII.N. of the Agreement. Make submittals required by the Contract Documents, and revise and resubmit as necessary to establish compliance with the specified requirements.

B. The following products require only the submittals, and no further review is required except for interface within Work.

1. Products specified by reference to standard specifications such as ASTM and similar standards;

2. Products specified by manufacturer's name and catalog model number.

3. Other items at the SEPTA Project Manager’s discretion including but not limited to any of the following:
   
   a. Products list
   b. Test Section
   c. Manufacturer's installation instructions
   d. Manufacturers’ certificates
   e. Shop Drawing
   f. Manufacturer’s Samples
   g. Certifications
   h. Testing
   i. Warranties
   j. Equipment

C. Submittals that are not required will not be reviewed.

D. The Contractor may require subcontractors to provide drawings, installation diagrams, and similar information to help coordinate the Work, but such data shall remain between the Contractor and the subcontractors and will not be reviewed unless it is required by other pertinent sections of the Specifications.

E. The contractor is required to submit all information in an electronic format as approved by the SEPTA PM.

1.02 RELATED WORK

Section 01010 - Summary of Work
Section 01011 - Summary of Project
Section 01041 - Project Coordination
Section 01400 - Inspection and Test Plan
Section 01700 - Contract Closeout
1.03 SUBMITTALS

A. The Contractor, within two weeks of the receipt of the Architect and/or Engineer’s computerized listing of Contractor(s) submittals shall review, revise and/or amend, if applicable, and resubmit the revised listing of submittals. Long lead items shall be identified.

B. After checking and verifying all field measurements and, after complying with the applicable procedures of the Contract, the Contractor shall submit shop drawings, catalog cuts, samples and substitution(s) for review and action.

The Contractor shall coordinate between the Contractor/Fabricator/Detailer and SEPTA for each complex submittal requiring detailed coordination’s, including all structural items.

This coordination may be conducted by a meeting. The purpose of the meeting(s) shall be to establish guidelines for details and information necessary to prepare the shop drawings.

The Contractor is responsible for determining the need for such meeting(s).

C. All submittals will be sent directly to the SEPTA PM unless the PM specifically directs the contractor to do otherwise.

D. The results of review of submittals will be designated as follows:

NO EXCEPTIONS TAKEN

PROCEED AS NOTED;

PROCEED AS NOTED; REVISE AND RESUBMIT

DO NOT PROCEED; REVISE AND RESUBMIT

REJECTED

NOT APPLICABLE

E. Submittals not in compliance with the Contract will be returned to the Contractor for revision. Any losses of time and additional costs associated with resubmittal(s) are the Contractor’s responsibility.

F. Each submission and re-submission shall give specific written notice on the transmittal of each variation that the shop drawings or samples may have from the requirements of the Contract Documents and, in addition, shall cause a specific notation to be made on each shop drawing submitted for review and approval of each such variation.

G. Each resubmission(s) shall clearly identify and make specific notation(s) on each shop drawing concerning the:

1. Changes that are made as a result of comments on the previous submittal(s).

2. Changes that are not made, but commented on the previous submittal(s). The Contractor shall provide detailed explanations and justifications as to why the comments are not addressed.

3. Changes that are solely made by the Contractor, but were not commented on the previous submittal(s). The Contractor shall provide a detailed explanation and justification for such changes.
H. Submittals that are "Proceed as Noted" are for the purpose of expediting procurement/fabrication/Installation of the intended work. If re-submittal of the document is required, the Contractor shall incorporate all corrections and resubmit original sepias and required copies of drawings to SEPTA, within 30 days. If re-submittal is not required then it is understood that the Contractor will proceed in accordance with the comments.

For "Proceed as Noted" items that require re-submittal, payment for completed work that is related to these items will not be made until the corrected and final resubmittal is accepted in writing by SEPTA.

1.04 QUALITY ASSURANCE

A. SEPTA reserves the right to require mock ups of any material and/or assembly, at any time during the construction process. Once approved, the mock-up will set a minimum standard of performance and/or appearance for the work. Mock-ups will be provided at no cost to SEPTA. The approved mock-up may, at the discretion of the SEPTA project manager become part of the work.

B. Electronic Submittals

1. SEPTA uses software to track submittals. The Contractor's forms, e.g. transmittal etc., will be submitted in a form compatible with this software.

2. For its records, SEPTA requires that all approved submittals be converted to electronic format (at no additional cost to SEPTA) for SEPTA's document retention purposes.

Coordination of Submittals:

1. Prior to making each submittal, the Contractor shall carefully review and coordinate all aspects of each item being submitted. Shop drawings of systems containing closely related items and components must be submitted, as a single submission showing the interrelationship of the components required for that system.

2. The Contractor shall verify prior to submission that each shop drawing is well prepared and that the submittal conforms in all respects with the specified requirements. The drawings shall provide complete information regarding proper fabrication and installation.

3. The Contractor shall sign each submittal and affix a stamp with specific written indication that the Contractor has satisfied all responsibilities under the Contract Documents with respect to review of the submission.

4. Shop drawings shall be tailored to the specific project need including coordination of various trades and should include material descriptions, quantities, dimensions, design criteria and similar data to enable review information as required. The shop drawings must show clear and complete information for the fabrication and installation of materials.

5. Orient the plan(s) on the shop drawing(s) in the same manner as the plans on the Contract Drawings.

6. Shop drawings with reproduction(s) of the Contract Drawings will not be accepted.

7. Structural fabrication and erection drawings shall be prepared, checked, signed and sealed, by a Professional Engineer licensed in the Commonwealth of Pennsylvania with proven qualifications and similar experience.
Unless the Contract Documents indicate specific steel connections, the Contractor shall design and provide sufficient details for the SEPTA’s review and approval.

C. Responsibility:

The Contractor is solely responsible and accountable for:

1. Means, methods, techniques, sequences and procedures of construction including fabrication, assembly, installation/erection, safety precautions and programs incidental to any submittal.
2. Accuracy of all submittals and shop drawings and final installation.
3. Arranging submittals and shop drawing standards review meetings with SEPTA.
4. Converting all approved submittals to an agreed on electronic format (PDF unless otherwise noted) and providing these files to SEPTA at no cost to SEPTA.

1.05 SUBSTITUTIONS

A. "Or Equals" Substitutions:

1. Restricted Items - Where the contract documents specifically require the use of certain equipment and/or materials they will indicate that substitutions will be allowed.

2. Equals Considered – Unless otherwise noted, whenever a material or article required is specified or shown on the plans by using the name of the proprietary product or of a particular manufacturer or vendor, any material or article which will perform adequately the duties imposed by the general design, will be considered equal and satisfactory provided material or article so proposed is of equal properties and function in the opinion of SEPTA's Project Manager. It shall not be purchased or installed without SEPTA's Project Manager's written approval.

The Contractor shall document each request with complete data substantiating compliance of the proposed Substitution with the Contract Documents. "Or Equal" requests will be considered only when substantiated by the Contractor's submittal of data documenting the "or equal" nature of material or article within thirty-five (35) calendar days after the date of receipt of Notice to Proceed. A request constitutes a representation that the Contractor:

a. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.

b. Shall provide the same warranty for the substitution as for the specified product.

c. Shall coordinate installation and make changes to other work, which may be required for the Work to be complete with no additional cost to SEPTA.

d. Shall waive claims for additional costs or time extension, which may subsequently become apparent.

e. Shall reimburse SEPTA (if applicable) for review or redesign services associated with review and approval by SEPTA, if the substitution is rejected as not being equivalent.
B. Other Substitutions

1. The contractor may ask permission to substitute a material or assembly which is not fully equal to the one specified. This will be processed as a change order (a no cost change order only if there is no cost difference compared to the original specified material). All substitutions will be evaluated following Value Engineering principles. The results of SEPTA’s evaluation will be final, and SEPTA is has the right to make a final determination over which items are judged to be acceptable.

The Contractor shall document each request with complete data substantiating compliance of proposed Substitution with Contract Documents. A request constitutes a representation that the Contractor:

a. Has investigated the proposed product and determined that it meets or exceeds the quality level of the specified product.

b. Shall provide the same warranty for the substitution as for the specified product.

c. Shall coordinate installation and make changes to other work, which may be required for the Work to be complete with no additional cost to SEPTA.

d. Shall waive claims for additional costs or time extension, which may subsequently become apparent.

2. The Contractor shall provide substitutions in a timely manner and in accordance with the construction contract, so as to not have a negative impact on the construction schedule.

PART 2 - PRODUCTS

2.01 SHOP (FABRICATION/INSTALLATION) DRAWINGS

A. Shop drawings shall be based on field dimensions and other information gathered by the contractor and his agents. When SEPTA or the designer of record takes no exceptions to the drawings or directs the contractor to proceed as noted, it is only claiming that there are no apparent deviations from the contract document. Final fit and placement may be dependent on tolerances and trades beyond the control of the SEPTA and the designer of record, and remain the sole responsibility of the contractor. Language placing this responsibility on SEPTA or the designer of record is strictly prohibited.

B. Scale and measurements: Shop drawings shall be made accurately to a scale sufficiently large to show all pertinent aspects of the item and its method of connection to the Work. Review of those aspects of submittal that pertain to the construction process including fabrication, assembly, and installation/erection will be complimentary.

C. Required Copies: Electronic copies will be acceptable, unless otherwise specified. There will be an internet sharing site set up for this purpose.

D. Review comments will be shown electronically and returned to the contractor.

2.02 MANUFACTURERS' LITERATURE (INCLUDING CATALOG CUTS)

A. The Contractor shall submit the original printed literature and product data sheets available from the manufacturer(s) and as many copies as are required. SEPTA will keep the original copy of all items submitted.
B. Where contents of submitted literature from manufacturers include data not pertinent to the submittal, the Contractor shall clearly show which portions of the contents are being submitted for review.

2.03 SAMPLES

A. The Contractor shall provide sample(s) identical to the precise article proposed to be provided. Identify as described under "Identification of submittals" below.

B. Number of samples required:

1. Unless otherwise specified, the Contractor shall submit samples in the quantity, which is required to be returned, plus one, which will be retained.

2. By prearrangement in specific cases, a single sample may be submitted for review and, when approved, be installed in the Work at a location agreed upon by SEPTA.

2.04 COLORS AND PATTERNS

Unless the precise color and pattern is specifically called out in the Contract Documents, and whenever a choice of color or pattern is available in the specified products, the Contractor shall submit accurate color and pattern charts for selection.

PART 3 - EXECUTION

3.01 IDENTIFICATION OF SUBMITTALS

A. The Contractor shall consecutively number all submittals

1. Each separate submittal subject to approval must receive a separate number not shared by any other component, information or process. Only one approval/rejection will be given per submittal number.

2. Each submittal must be dated.

3. Each submittal number should include the specification section that the submittal most applies to.

4. When resubmittal(s) is made for any reason, the Contractor shall transmit under a new letter of transmittal with a new transmittal number in the form of the original number plus the letters a,b,c and so on for each subsequent resubmittal.

B. The Contractor shall maintain an accurate submittal log for the duration of the Work, showing current status of all submittals at all times. The Contractor shall make the submittal log available for review upon request.

3.02 GROUPING OF SUBMITTALS

A. Unless otherwise specified, the Contractor shall make submittals in groups (with separate numbers) containing all associated items to assure that information is available for checking of each item when it is received.

B. Each grouping shall be accompanied by a dated transmittal letter which lists each transmittal by number.
C. Partial, confusing and poorly prepared submittals will be rejected as not complying with the requirements of the Contract. The Contractor will be liable for delays so occasioned.

3.03 TIMING OF SUBMITTALS

A. The Contractor shall make submittals consistent with early start dates shown on the approved baseline schedule, but sufficiently in advance of early scheduled dates for installation to provide the necessary time required for reviews, for securing necessary approvals, for possible revisions and resubmittals, and for placing orders and securing delivery.

B. In scheduling, the Contractor shall allow fourteen (14) calendar days for review and processing by SEPTA following its receipt of the submittal.

This review time will be increased for the submittal(s) that are so extensive that fourteen (14) calendar days of turn around period is unreasonable as determined by SEPTA. This determination shall be binding on the Contractor.

C. Continued submission of material and repetitious submittals which clearly fail to meet the requirements of the Contract Documents which may cause delays in the completion of the Contract and any such delays be the sole responsibility of the Contractor.

3.04 SEPTA'S REVIEW

A. Review and Processing shall not relieve the Contractor from responsibility for errors, which may exist in the submitted data.

B. SEPTA does not confirm dimensions or make any representation that parts will fit together properly if fabricated in the sizes shown on the shop drawings. SEPTA requires that the contractor take all necessary site measurements and that the shop drawings represent an accurate documentation of these dimensions.

C. The contractor assumes responsibility to exercise control over all construction tolerances and insure these tolerances do not result in construction which violates regulations, codes or clearances.

D. Revisions:

1. The Contractor shall make required revisions as noted on initial the submittal.

2. If the Contractor considers any required revision to be a change, it shall so notify SEPTA as provided for in the Agreement.

Such notification shall be made no later than 10 calendar days from the date of return of such submittals by SEPTA to the Contractor.

3. The review of the shop drawings waives the original contract requirements of the Contract Documents only if the Contractor submits this data as a substitution as specified in section 1.05 above. Other deviations from the contract documents will be understood to be contractor errors and have no effect on the contract.

3.05 FINAL ELECTRONIC SUBMISSION

A. As part of the Contractor’s Closeout Documentation requirements, the Contractor shall submit to the SEPTA PM all approved submittals and other documentation in an electronic format (PDF files unless otherwise approved by the SEPTA PM).

END OF SECTION
SECTION 01305

REQUESTS FOR INFORMATION

PART 1 - GENERAL

1.01 DESCRIPTION

A. This section stipulates procedural requirements for processing of Contractor Request(s) for Information (RFI) and complements the requirements of the Contract Agreement, Paragraphs V.B and VIII.B.

B. An RFI is a written communication originated by a construction Contractor to request clarification of the intent of the Construction documents.

1.02 RELATED WORK

A. Agreement
   Section 01010 – Summary of Work
   Section 01011 – Summary of Project
   Section 01041 – Project Coordination
   Section 01300 – Submittals
   Section 01500 – Construction Facilities and Temporary Controls
   Section 01700 – Contract Closeout
   Section 01720 – Project As-Built Documents
   Attachment – Request for Information Form

1.03 SUBMITTALS

A. The Contractor shall comply with the provisions of Section 01300.

B. The Contractor shall submit RFIs using the attached RFI form and shall provide specific reference to the section of the Construction documents to which the RFI refers. RFIs that are incomplete, unsigned or otherwise not submitted in compliance with the Contract, will be returned to the Contractor.

C. Any losses of time and/or additional costs associated with frivolous RFI submittals are the responsibility of the Contractor.

1.04 QUALITY ASSURANCE

A. All RFIs will be signed by the Contractor's representative and submitted to SEPTA in "hard" copy.

B. The primary purpose of an RFI is to clarify the Contract Documents

1. The Contractor has the responsibility to be familiar with the Contract documents. RFIs that request clarification of items that in the judgment of the PM, are clearly evident in the Contract documents, shall be rejected by SEPTA.

2. The Contractor shall not use RFIs for the following:
   a. To facilitate construction coordination between contractors and subcontractors/vendors.
   b. To initiate substitutions in material, methods and or systems.

Requests for Information 01305 - 1
c. To transfer their responsibility for reviewing Contract documents to SEPTA and/or the Architect/Engineer.

3. RFIs, which fail to reference the specific Contract documents in question, will be rejected. If the Contractor uses an RFI for the purposes described above in 1.04 B2 it will also be rejected. In these cases, the Contractor will be directed to meet the requirements specified in Section 01300 by the PM.

PART 2 - PRODUCTS – Not Used

PART 3 - EXECUTION

3.01 IDENTIFICATION OF REQUEST(s) FOR INFORMATION

The Contractor shall consecutively number all RFIs. For projects with separate contracts, each Contractor shall include a prefix (G, E, M etc.) in their numbering sequence to designate the submittal as originating from the “General”, Electrical” or “Mechanical” Contractor. RFIs shall be submitted using the attached form. When an RFI must be resubmitted for any reason it shall be sent using a new RFI number with reference provided to the previous RFI.

3.02 TIMING OF REQUEST(s) FOR INFORMATION

A. The Contractor shall submit RFIs sufficiently in advance of early construction schedule “Start” dates for fabrication and/or installation activities in order to provide the necessary time required for reviews, possible revisions and subsequent resubmittals.

B. For scheduling purposes, the Contractor shall allow five (5) calendar days for review and response by the Architect/Engineer and/or SEPTA following their receipt of the RFI.

This review time will be increased for RFIs that are sufficiently extensive or complex that the above turnaround period is unreasonable as determined by the Architect/Engineer and SEPTA. This determination shall be binding on the Contractor.

C. The Contractor shall be solely responsible for delays in the completion of the Contract that result from the submission of RFIs which clearly fail to meet the requirements of this Section.

3.03 SEPTA’S REVIEW

A. The Architect/Engineer is responsible to review Contractors’ RFIs and provide clarifications and/or interpretations as they relate to design documents. SEPTA is responsible to provide clarifications and/or interpretations to RFIs that are related to the Agreement or SEPTA operational issues and service. A clarification will not result in a change to the Construction Contract cost. SEPTA is responsible for coordinating all RFI clarifications with the Contractor.

B. If the Contractor considers any clarifications to an RFI to be a change; it shall so notify SEPTA in the manner provided for in the Agreement.

Such notification shall be made no later than five (5) calendar days from the date of the return of such clarifications by the Architect/Engineer or SEPTA to the Contractor.
REQUEST FOR INFORMATION (RFI)

1. RFI Number | Responsible Contractor | Date |
--- | --- | --- |
Description: |  |  |

Requested By (Signature):  
Due Date:  

2. A/E Response, or SEPTA Comments (if applicable):  

A/E (Signature):  
Date:  
Contract Document Impact:  
Revisions Attached:  

3. Transmitted to Contractor  

CD&C PM (Signature):  
Date:  

4. PCO  
   Yes  
   No Impact  

PCO Number:  

RFI FORM

Requests for Information  
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Key Points

01: This section is to be completed by the Contractor. The SEPTA Project Manager (PM) shall provide RFI Forms to the Contractor(s) at the Pre-construction Meeting.

02: This section is to be completed by the A/E. All technical inquiries are to be responded to by the A/E. The section must be signed and dated within the contractual time frame. The SEPTA PM may use this space to add comments or directly respond to non-technical queries, involving contractual matters or SEPTA Operational issues.

03: This section is to be completed by SEPTA project staff to return the RFI to Contractor. The distribution must include the Project File.

04: This section is to be completed by SEPTA project staff. The RFI response will be reviewed for its potential to result in a Change Order. This box should be appropriately completed as a result of this review.

END OF SECTION
SECTION 01380

CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall provide professional quality construction record photographs periodically during course of the Work as determined by the SEPTA PM

B. In addition to photographs generally describing the progress of the work, the SEPTA PM may require specific components and processes be documented.

C. SEPTA reserves the right to require that an approved professional photographer be used if, in the opinion of the SEPTA PM the photographs submitted at any time are inadequate in quality or coverage.

D. The PM may wish to define period of specific coverage and/or required sequence of photographs.

1.02 RELATED WORK

Section 01010 - Summary of Work
Section 01011 - Summary of Project
Section 01720 - Project As-Built Documents

1.03 PHOTOGRAPHY REQUIRED

A. The Contractor shall provide SEPTA with the photographs taken. Photographs shall only be used for the purpose of fulfilling the requirements of this section. Other uses, without written permission from SEPTA’s Project Manager, are prohibited. The contractor may not take photographs for any other purpose on SEPTA property without the written consent of SEPTA.

B. Views and Quantities Required

1. As specified above, the Contractor shall photograph the project from 8 different views as directed by SEPTA on a bi-weekly basis.

2. The Contractor shall provide 2 prints of each view, enclosed in two separate binders with double faced plastic sleeves

C. Ownership of Electronic Files

1. The prints and electronic files shall be furnished to SEPTA at the Contractor’s expense and all images collected during the course of the contract shall become the sole property of SEPTA. The contractor shall turn over all copyright rights to SEPTA in a written document to be approved by SEPTA.
PART 2 - PRODUCTS

2.01 PRINTS

A. Prints shall be provided in glossy finish color. Date encoded of sufficient quality to render detail in a satisfactory manner as determined by the SEPTA PM.

1. Size: 8 X 10 in. or as directed by the SEPTA PM.

B. The Contractor shall identify each print on back, listing:

1. Southeastern Pennsylvania Transportation Authority
2. FTA Project Number
3. SEPTA Project Number
4. Project Name
5. Bi-weekly progress photographs
6. Date: _______________________
7. Description/Key Plan
   a. Orientation of view
   b. Date and time of exposure
   c. Key plan in lower right hand corner permanently affixed.
8. Name and address of photographer.

PART 3 - EXECUTION

3.01 TECHNIQUE

A. Paramount importance shall be given to factual detailed presentation with maximum depth of field, proper exposure with adequate shadow and highlight detail and minimum distortion.

B. The photographer will be required to use fill in electronic flash technique to adequately light high contrast scenes and assemblies. Electronic flash shall also be used at all interior locations and other locations where the available light is not adequate for recording appropriate detail.

C. Camera capture (non-enhanced) must provide a minimum image size of 3500 x 2500 pixels unless otherwise determined by the SEPTA PM.

D. Take views as directed and in the presence of SEPTA’s representative.

3.02 DELIVERY OF PRINTS AND FINAL DELIVERY OF ELECTRONIC FILES

A. The Contractor shall deliver two sets of prints and JPG files of adequate quality as determined by the SEPTA PM with each Application for Payment.

B. At the conclusion of the project the contractor will provide a complete set of all electronic files delivered in a medium as directed by the SEPTA PM.

END OF SECTION
SECTION 01400
INSPECTION AND TEST PLAN

PART 1 - GENERAL

1.01 SUMMARY
A. Work included: The Contractor shall establish and maintain a project specific Quality Assurance/Quality Control (QA/QC) system and management program manual for the work furnished and installed under the Contract Documents. The Contractor shall have the “primary” responsibility for the quality of all its work. The manual shall include organization, personnel, procedures, instructions and records/documentation to properly maintain the quality of the Work.

B. The Contractor, with the approval of SEPTA’s Project Manager may alternatively develop and explain Inspection and Test Plans (ITPs) and procedures for all elements of the Work. ITPs shall be based on the inspection and test requirements of each technical specification and shall include reference to the attribute(s) of the item(s) to be tested and/or inspected, the frequency (as applicable), the person or organization responsible for the activity and the method of documentation, if required. The Contractor(s) shall monitor implementation of ITPs to the extent necessary to control the quality of the work.

1.02 RELATED WORK
Requirements of the Agreement:
Section 01300: Submittals
Section 01410: Testing and Inspection Services
Section 01700: Contract Closeout

1.03 SUBMITTALS
A. The Contractor shall develop and explain a Quality Assurance Program (QAP) which includes methods to verify that inspection, testing activities have been performed and documented to assure that shop manufacturing, fabrication and construction activities comply with the highest quality standards. The Contractor's QA Program shall be submitted within 15 working days of the Notice to Proceed (NTP).

B. The Contractor may develop and explain inspection and test plans (ITPs) and procedures for all elements of the Work in lieu of a formal QA system. ITPs shall be based on the requirements of each section of the technical specifications. ITPs shall address inspection and test activities at the both the source of manufacture, at receipt and during installation at the project site. The complete set of ITPs for a given project will constitute the Contractor's Quality Control Plan (QCP) for the Work. This QCP shall be submitted within 15 working days of the NTP.

C. SEPTA’s review of a Contractor’s QAP/QCP shall not relieve the Contractor from its primary responsibility for the quality of the work.

1.04 QUALITY ASSURANCE
A. The following definitions pertain to requirements of this section.

1. Quality Assurance (Q/A): QA is a program of policies, procedures and outline of detailed responsibilities to provide adequate confidence through approved surveillance and audit requirements that the Contractor will meet the highest quality standards.
2. Quality Control (Q/C): Quality Control is the act of examining, witnessing, inspecting, checking and testing of in-process or completed work to determine conformity with specified requirements and documenting the results.

3. Calibration: Comparison of two instruments or measuring devices, one of which is of known accuracy traceable to national standards, to detect, correlate, report or eliminate by adjustment any discrepancy in the accuracy of the instrument or measuring device being compared with the standard.

4. Inspection: A phase of Quality Control, which by means of examination, observation, or measurement, determines the conformance of materials, supplies, components, parts, appurtenances, systems, processes, installation, or structures to predetermined quality requirements.

5. Source Inspection: Source inspection consists of review, monitoring, observation, and/or inspection, random or consistent, or at selected stages of manufacture or construction, of manufacturer or sub-manufacturer's personnel, material, equipment, processes, or tests.

6. Site Inspection: Site Inspection consists of reviewing, monitoring, observing and inspecting the Work at the project site.

1.05 SOURCE QUALITY ASSURANCE

A. Engage an adequate number of skilled professionals who are thoroughly trained, experienced and familiar with the specific requirements and methods needed for the proper performance of the Work.

B. Establish technical and administrative surveillance methods to ensure the highest degree of quality, and to correct potential problems if and, as they occur so as not to affect the Contract schedule.

C. Verify that the required quality control inspection, testing and documentation activities have been performed to assure that the equipment, materials and construction comply in all respects to the requirements of the Contract Documents.

D. Monitor quality control of suppliers, manufacturers, fabricators, products, services, site conditions, workmanship and installation to produce work of the highest quality.

E. Take corrective actions in a timely manner to identify undesirable conditions affecting the quality of Work.

F. Use only appropriately scaled and calibrated measuring and test equipment to perform inspections and tests. Calibration records shall be traceable to national standards and shall reflect the as-found condition of the equipment at the point of calibration.

G. All test results shall clearly include a statement that the item tested or analyzed conforms or fails to conform to the contract requirements. Each report shall be conspicuously stamped on the cover sheet in large red letters a minimum of ½ inch high "CONFORMS" or "DOES NOT CONFORM" to the Specifications as the case may be.

H. All test reports shall be signed by a testing laboratory's authorized person and counter signed by the Contractor. The Contractor shall provide all tests, reports, certifications and other documentation to the Project Manager promptly after the completion of tests.

I. Promptly reject work which does not comply with the requirements of the Contract Documents.
1.06  SOURCE QUALITY CONTROL

A. The contractor shall provide required documentation that each material, manufactured product and/or fabricated item is produced and tested to comply with highest quality standards.

B. Do not deliver material, manufactured product and/or fabricated items until associated quality assurance documents are accepted by SEPTA.

C. Factory test/inspection schedules shall be submitted to SEPTA a minimum of twenty-one (21) days prior to the test/inspection.

D. SEPTA reserves the right to source inspect any material, manufactured product or fabricated item. Any and all costs related to re-inspection of an unsatisfactory item shall be the responsibility of the Contractor.

E. Certified quality assurance documents shall identify and include any changes made to the material, manufactured product or fabricated item as compared to the Contract requirements and approved shop drawings. The Contractor shall describe as to how each change will affect the installation, and subsequent operations.

F. SEPTA's review of certified quality assurance documents and inspections shall not relieve the Contractor from its "primary" responsibility for the quality of work.

1.07  SITE QUALITY CONTROL

A. The Contractor shall identify an individual (CQC) within its organization at the site of the work, who shall be responsible for overall management of contract Quality Control matters. The CQC shall be experienced in the performance and supervision of the inspections and tests required by the specification. The CQC shall be on the work site at all times with complete authority to take any action necessary to ensure conformance with the Contract. The CQC shall be appointed by letter.

B. The CQC shall inspect and document material arriving at site to ensure conformance to contract requirements. Nonconforming and damaged material shall be segregated from conforming material to prevent its use until such time as it is removed from site.

C. All materials and equipment shall be protected from rust, corrosion and similar damages by either factory applied or field applied protective coatings. Clean and touch-up such protected surfaces that become scratched marred or otherwise damaged and make surfaces ready for field painting. All materials shall be neatly stored on site & protected against physical & natural damage. Items shall be stored on pallets, per manufacturer’s written instructions and tarped or protected with other approved coverings. Items that are temperature or humidity sensitive shall be stored in a climate controlled environment.

D. Unless specifically allowed elsewhere in the contract, do not deliver reconditioned material at site. Protect all stenciled markings, labels and any other type of identification(s) to clearly identify the originality of the material.

E. As soon as the material arrives at site, (but before beginning installation) provide to SEPTA the original Bill of Lading and Certification that the material complies with the requirements of the contract documents.

F. Do not begin installation until all installation related shop drawings have been reviewed by SEPTA. Installation shall comply with conformed shop drawings.

G. Perform necessary and specified tests upon receipt and document the results. Replace material that fails the tests.

Inspection and Test Plan 01400 - 3
H. Remove and replace new or existing material that is damaged in storage or in the performance of Work unless specifically accepted in writing by SEPTA's Project Manager.

I. No Work shall be performed at the site if Contractor's Superintendent or his authorized representative, as approved by SEPTA, is not present at the location where Work is being performed.

J. Install field samples at the site as required by individual specification sections for SEPTA approval.

K. Submit final reports and test(s) data to SEPTA as required by Section 01300.

END OF SECTION
SECTION 01410

TESTING AND INSPECTION SERVICES

PART 1 - GENERAL

1.01 DESCRIPTION OF WORK

A. The Contractor shall employ a testing and inspection agency fully licensed and competent in the field of testing and inspecting specific elements of the project. The Contractor shall submit such testing agencies and their qualifications for SEPTA's prior written approval.

B. The Contractor shall pay for all necessary testing and inspection services.

1.02 RELATED WORK

Agreement:
Section 01400: Inspection and Test Plan
Section 02210: Earth Moving
Section 03300: Cast in Place Concrete
Section 05120: Structural Steel
Section 07511: Built-Up Hot Asphalt Roofing

1.03 SUBMITTALS

A. Prior to start of Work, submit testing and inspection agency name, address, and telephone number, and names of full time registered Engineer and responsible officer.

B. Submit copy of report of the agency's laboratory facilities inspection made by Materials Reference Laboratory of National Bureau of Standards during most recent inspection, with memorandum of remedies of any deficiencies reported by the inspection.

C. Provide schedule of agency's activities commitment with the Contractor(s) schedule and work to be provided.

D. Reports

1. After each inspection and test, promptly submit (4) copies of results report to SEPTA PM, and to Contractor.

2. The report shall include the following information:

   a. Date issued,
   b. Project title and number
   c. Name of inspector,
   d. Date and time of sampling or inspection,
   e. Identification of product and specifications section,
   f. Location in the Project,
   g. Type of inspection or test,
   h. Date of test or inspection,
   i. Results of tests or inspection,
   j. Conformance with Contract Documents.
3. When requested by SEPTA or the contractor, provide interpretation of test/inspection results.

1.04 QUALITY ASSURANCE

A. The testing and inspection agency shall be approved by SEPTA.
B. The Laboratory shall comply with requirements listed in the applicable specifications sections.
C. Laboratory: Authorized to operate in the Commonwealth of PA.
D. Laboratory Staff: Maintain a full time registered Engineer on staff to review services.
E. Testing Equipment: Calibrated at reasonable intervals with devices of accuracy traceable to either National Bureau of Standards or accepted values of natural physical constants.
F. Testing, when required, shall be the strictest of all pertinent codes and regulations, including selected standards of the American Society for Testing and Materials.
G. All site testing and taking of the specimens and samples shall be performed in the presence of the Contractor's Superintendent.
H. No testing required by these specifications may be waived or altered without the written permission of the Senior Director of Capital Construction or the Chief Engineer.

1.05 PRODUCT HANDLING

A. The Contractor shall comply with pertinent provisions of Section 01600.
B. The Contractor shall promptly process and submit required copies of test reports and related instructions to assure necessary retesting and replacement of materials without any possible delay in the progress of the Work.

1.06 CONTRACTOR’S RESPONSIBILITIES

A. Representatives of the testing and inspection agency shall have access to the Work at all times and at all locations including manufacturing facilities where the Work is in progress. Testing and Inspection Services 01410-3 The Contractor shall provide facilities for such access to enable the agency to perform its functions properly.
B. By advance discussion with the agency, the Contractor shall determine the time required for the agency to perform its tests and inspections and to issue each of its findings.
C. The Contractor shall provide all required time within the approved construction schedule.
D. Deliver to agency at designated location, adequate samples of materials proposed to be used which require testing, along with proposed mix designs.
E. Provide incidental labor and facilities:
   1. To provide access to Work to be tested or inspected,
   2. To obtain and handle samples at the site or at source of Products to be tested,
   3. To facilitate tests and inspections,
   4. To provide storage and curing of test samples.
F. Notify Architect and/or Engineer, SEPTA, and agency 72 hours prior to expected time for operations requiring inspecting and testing services.

G. When initial tests indicate non-compliance with the Contract Documents, subsequent retesting occasioned by the non-compliance shall be performed by the same testing agency, at no additional cost to SEPTA.

H. Inspecting and testing performed exclusively for the Contractor's convenience shall be the sole responsibility of the Contractor.

END OF SECTION
SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Work Included:

The Contractor shall provide temporary facilities and controls needed for the performance of its Work including, but not necessarily limited to:

1. Temporary utilities such as heat, water, electricity, and telephone;
2. Field office for the Contractor's personnel;
3. Sanitary facilities
4. Enclosures such as tarpaulins, escalator barricades and canopies;
5. Temporary signage located in the vicinity of the Temporary Barricades
6. First-aid facilities (by General Contractor)
7. Temporary fencing and other safety devices for pedestrian and vehicular traffic as well as isolating the construction area.
8. Entry Control
9. Personnel Identification
10. Site Access
11. Parking

1.02 RELATED WORK

A. Agreement

Section 01010: Summary of Work
Section 01011: Summary of Project
Section 01041: Project Coordination
Section 01060: Regulatory Requirements and Safety
Section 01500: Construction Facilities and Temporary Controls
Section 01580: Project Identification Signs and Other Construction Signage
Section 01590: SEPTA Field Office

1.03 SUBMITTALS

A. The Contractor shall comply with pertinent provisions of section 01300

B. The Contractor shall provide shop drawings including means, methods and procedures related to all temporary facilities.
1.04 PRODUCT HANDLING

The Contractor shall maintain and protect all temporary facilities and controls in proper and safe condition throughout progress of the Work.

1.05 TEMPORARY UTILITIES AND SERVICES

A. Water (GC):
   1. The coordinating Contractor shall provide drinking water from an approved source, so piped or transported as to keep it safe and fresh and served from single service containers or satisfactory types of drinking stands or fountains. All such facilities and services shall be furnished in strict accordance with existing governing health regulations.
   2. Refer to the Agreement, Paragraph VIII.D. The Contractor shall protect pipes from freezing during inclement weather and any vandalism.

B. Sanitary facilities (GC):
   1. Refer to the Agreement Paragraph VIII.D.
   2. The Contractor shall furnish for the work force on this project, the necessary toilets, secluded from public observation. The toilets shall be kept in a clean, sanitary condition and shall comply with the requirements and regulations of the agencies having jurisdiction.

C. Power and Lighting (GC):
   1. The Contractor shall provide, maintain and pay for all costs of temporary electrical and lighting services required at the site for the proper performance and inspection of work. The level of lighting shall not be less than the existing. Remove services and lighting after completion of work and repair of all damages.
   2. The Contractor shall provide area distribution boxes so located that the individual trades may furnish and use 100 ft. maximum length extension cords to obtain power and lighting at points where needed for work, inspection, and safety.
   3. The Contractor shall provide all necessary items such as breakers, transformers, panel boards, and cable required for the service. The Contractor shall provide a complete distribution system expanded as required during the construction including wiring devices, outlets, distribution panels, transformers, cable and other related work necessary to provide a temporary power system for use during construction.
   4. The Contractor shall pay all costs associated with the utility tie-ins, physical plant, maintenance of system throughout construction, removal of same at project completion and any other items necessary in providing temporary power and light.
   5. The temporary power and lighting system shall at all times conform with the applicable codes and regulations of OSHA, NEMA, UL, and the local municipality.

D. Telephones (GC):
   1. The Contractor shall make necessary arrangements and pay costs for installation, maintenance and operation of direct line (non-pay type) telephone services in SEPTA’s field office at the site.
E. Heating (GC):

1. The Contractor shall provide and maintain heat necessary for proper conduct of operations.

1.06 ACCESS ROADS

A. The Contractor shall provide unimpeded access for emergency vehicles.

B. The Contractor shall provide and maintain obstruction free access to fire hydrants and control valves.

1.07 FIELD OFFICES AND SHEDS

A. General:

1. The Contractor (GC) shall establish a construction compound in which the Contractor (GC) provided SEPTA field trailer will be located adjacent to the GC’s field trailers. The physical location of the compound will require written approval of SEPTA's Project Manager.

2. The Contractor shall submit to the Project Manager a plan layout of the Compound within ten (10) days after Notice to Proceed (NTP).

3. The GC shall coordinate the provision of utility services for all trailers and be responsible for all installation charges, removal costs at Project completion, and any periodic or other charges incidental to the provision of those utility services.

4. Upon final acceptance of the Work, the GC shall clean up the work areas and leave them in a neat and orderly condition. The Contractor shall dismantle and remove all temporary fencing and barricades and other temporary items installed, unless otherwise directed by the Project Manager. Repair damaged areas to their original condition.

B. Contractors Field Offices:

1. Furnish and maintain a field office with a telephone at the site during the entire period of construction. The Contractor's superintendent shall be present at said office at all times while its work is in progress. Keep readily accessible, at the field office, copies of both the Contract Documents and the latest approved shop and working drawings.

2. Submit for SEPTA's written acceptance, working drawings showing proposed locations and size of offices and shops.

C. Field Office Security (GC):

1. The Contractor shall provide all necessary security for this compound area.

2. The GC shall Guard against unauthorized or illegal entry and protect the field office against vandalism, theft and mischief. The GC shall be responsible for the replacement and/or compensation for any items owned by SEPTA or SEPTA employees, which are related to the subject work, which are removed or damaged as the result of vandalism, theft, mischief or illegal entry to the field office.

3. The Contractor shall provide all necessary keys to SEPTA's Project Manager so as to provide access to the compound at any time.
4. Upon project completion, the Contractor shall assume ownership of and remove temporary field offices and appurtenances from the job site, except as otherwise noted.

1.08 PARKING AREAS

A. The Contractor (GC) shall provide a minimum of two (2) parking spaces adjacent to the SEPTA trailers within the compound for SEPTA vehicles.

B. The Contractor shall provide temporary parking areas to accommodate construction personnel.

C. The Contractor shall provide site space when it is not adequate, providing additional off-site parking.

D. The Contractor shall limit the use of existing on-site streets and driveways for construction traffic. Tracked vehicles are not allowed on public roads.

1.09 TEMPORARY BARRICADES, ENCLOSURES AND FENCING

A. The Contractor shall provide all temporary barricades required by the Phasing Plans, including barricades for designated Contractor work areas, Contractor laydown areas, and public access for areas that must remain open during a phase. Where barricades are required outside a designated work area for the exclusive use of a Contractor that Contractor shall provide them.

B. Submit drawings of the proposed temporary barricades for SEPTA's review. Do not install barricades until the drawings for them have been reviewed by SEPTA.

C. Temporary Barricades:

1. General: Each Contractor shall furnish, erect and maintain any necessary temporary barricades, warning, danger, and detour signs, suitable and adequate lights and take all other precautions to protect the work, employees, and the public. Barricades shall enclose and prevent entry into the work area and shall be full height and dustproof.

2. The Contractor is required to enclose areas required by SEPTA for access and maintenance. If these areas are in public areas they shall be secured with temporary barricades and doors in accordance to 1.08.C6 and 1.08.C7 below. The Contractor shall take all means to alleviate any or all tripping and falling hazards both within the work site but also in public areas. Areas where the general public or passengers may fall shall be secure and covered.

3. Barricades shall be painted on all solid surfaces exposed to public view.

4. Traffic cones and/or stakes with ribbons shall not be used in SEPTA Stations to differentiate construction areas in lieu of barricades.

5. On a daily basis, the Contractor shall maintain the temporary barricades in a “like new” condition. The Contractor shall remove graffiti and restore surfaces on a continual maintenance basis. Maintenance shall continue until the barricades are removed.

6. Construction: Barricades shall be constructed of materials suitable for location. Wood construction shall conform to the AFPA “National Design Specification for Wood Construction”, the latest edition. As a minimum, the barricades shall be constructed of 5/8 “thick APA rated exterior grade plywood. Framing members shall be Spruce-Pine-Fir No.2 or better, a minimum of 2” x 4” and larger sizes as necessary, spaced at a maximum 16” on center to provide a rigid temporary structure to resist all applicable loads.
7. Temporary Doors: The temporary barricades shall have a reasonable number of hollow metal doors and frames, with locksets, at locations acceptable to SEPTA. The locksets on the doors requiring SEPTA access for operational and safety reasons shall be keyed to SEPTA’s Standard Lock System.

D. Construction Fencing:

1. Before commencing operations, the General Contractor shall furnish and erect construction fencing as required for the safeguarding of the public and SEPTA employees against accident resulting from the Contractor's operations, and as required to prevent unauthorized access to the Work. Maintain the construction fencing until removal.

2. Employ either chain link fencing or wood frame/studs and plywood.

1.10 TEMPORARY SIGNAGE (CONSTRUCTION)

A. Reference Section 01580: Project Identification Signs and Other Construction Signage.

1.11 PROTECTION OF NEW WORK

A. Protect newly installed work until project is fully complete and turned over to SEPTA.

1.12 DUST AND NOISE CONTROL

A. Reference Section 01060: Regulatory Requirements and Safety.

1.13 SECURITY

A. The Contractor shall provide adequate security measures to protect material, equipment, and work from incidental and intentional damage or theft at project site locations, staging areas and fabrication yards.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Provide materials as required for the specified controls.

PART 3 - EXECUTION

3.01 PROTECTION OF PROPERTY

A. Existing Surfaces and Facilities

1. Take positive action to protect all existing surfaces and facilities from any damage resulting from construction operations unless modifications to the surfaces or facilities are required as part of the Contract.

2. Protect all paving from damage caused by mobile and stationary equipment including vehicles delivering materials to the site.

3. Provide and maintain adequate protection for all adjacent structures. When required by law or for the safety of the Work, shore, brace, underpin, or otherwise protect those portions of adjacent structures, water channels, and fences that may be affected by the
Work. The Contractor, before commencement of any part of the Work, shall give any notices required to be given to an adjoining landowner or other parties.

4. All damages to existing surfaces and facilities, other than modifications required as work of this Contract, shall be repaired by the Contractor at no additional cost to SEPTA.

3.02 SITE CLEANING DURING CONSTRUCTION

A. General:

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

2. Do not allow the accumulation of scrap, debris, waste material, and other items not required for construction of this Work.

3. Wet down dry areas, as appropriate, to lay dust and prevent blowing dust.

4. Provide adequate storage for all construction debris and materials awaiting removal from the job site, observing all requirements for fire protection and protection of the environment.

5. Store combustible waste, scrap, rubbish, etc. in adequately-sized metal containers (with metal covers where practical) pending removal from the premises.

6. Daily, and more often if necessary, inspect the site and move all scrap, debris and waste material to a place designated for its storage.

7. At least once a week and more often if necessary, the General Contractor shall completely remove and legally dispose of all scrap, debris and waste material generated by Work of all Contracts and personal debris discarded by workers.

B. Buildings:

1. Twice a week, and more often if necessary, inspect the structures and move all scrap, debris, and waste material to designated storage areas.

2. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

3.03 TEMPORARY FACILITIES AND CONTROLS REMOVAL

A. Remove and dispose of all project temporary facilities and controls used in conjunction with the Work. All costs for such removal and disposal shall be borne by the Contractor.

B. Unless the Project Manager requests that a facility or control be maintained for a longer period of time, remove each temporary control and facility promptly when the need for it or a substantial portion of it has ended, or when it has been replaced by the authorized use of a permanent facility, or no later than substantial completion. Complete, or if necessary, restore permanent Work that may have been delayed because of interference with the temporary control or facility. Repair damaged Work, clean exposed surfaces and replace work that cannot be satisfactorily repaired.

1. Materials and facilities that constitute temporary controls and facilities are and remain the property of the Contractor. SEPTA reserves the right to take possession of the project identification signs.

END OF SECTION
SECTION 01510

MAINTENANCE, SUPPORT AND RESTORATION OF EXISTING UTILITY FACILITIES

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies the coordination, maintenance, support, protection and restoration requirements of existing public and private utilities affected by construction.

B. Existing Utility Facilities: Existing utility facilities include, but are not limited to the following:

1. PECO Energy
   2301 Market Street
   Philadelphia, PA 19101

2. Philadelphia Water Department (PWD)
   ARAMARK Tower
   1101 Market Street, 4th Floor
   Philadelphia, PA 19107

3. Philadelphia Gas Works
   800 West Montgomery Avenue
   Philadelphia, PA 19122

4. Verizon Pennsylvania Inc.
   1717 Arch Street
   Philadelphia, PA 19103

1.02 RELATED WORK

Section 01010: Summary of Work
Section 01011: Summary of Project
Section 01041: Project Coordination
Section 01060: Regulatory Requirements and Safety
Section 01300: Submittals
Section 02667: Water Distribution
Section 02730: Sanitary Sewerage

1.03 SUBMITTALS

A. Shop Drawings and Working Drawings:

1. If work by the contractors affects the existing facilities of any Utilities, the Contractor shall submit working and shop drawings indicating its plan and schedule for performance of work to the appropriate Utility Company for review and approval. A copy of this submittal shall be furnished to SEPTA and or Architect/Engineer in accordance with the requirements of Section 01300 by the Contractor.

2. The Contractor’s Work Drawings shall detail the actual location of existing facilities, including aerial interference which these facilities present to new work, as well as
proposed method of proceeding with actual construction and details of proposed support systems.

3. Do not commence work until written approval has been received from the affected Utilities and the Project Manager.

B. Documentation:

1. Notice of commencement of work:
   
a. The Contractor shall provide to the Utility notice as required, prior to date of intended commencement of operations to parties having surface, subsurface or overhead structures in the construction area.
   
b. The Contractor shall comply with the provisions of 73 P.S. 176 et seq., which sets forth PA's "One Call System".
   
c. Provide copies of notices to the Project Manager.

1.04 JOB CONDITIONS

A. Location of Facilities:

1. Prior to start of any Work, contact the Pennsylvania-One-Call System (POCS) at 1-800-242-1776 in order to provide for locating and marking underground facilities.

2. Locations of existing facilities shown are plotted from available records; however, these locations are not guaranteed.

3. Verify locations of facilities by field investigation within and adjacent to limits of the project which may be affected by construction operations. Avoid damage or disruption of facilities during operation.

4. Upon encountering an existing facility, which is not shown, or upon ascertaining that a facility differs from that shown, determine ownership, use and disposition of such facility and proceed as follows:
   
a. If the facility is abandoned or is to be abandoned, perform necessary work for either condition as shown or specified.
   
b. If facility is to remain in service, perform support and restoration work in accordance with these specifications.

B. Responsibilities of Contractor:

1. Maintain and protect facilities.

2. Give notice of commencement of Work as specified.

3. Notify the Project Manager and the Utility of damage to facilities caused by construction operations. Repair or reimbursement for repair of such damage is the responsibility of the Contractor. Damaged electrical cables will be repaired or replaced as determined by the Utility with all costs borne by the Contractor.

4. Provide access for inspection of facilities and for emergencies involving utility services.

5. Permit free and clear access to utility personnel for purposes of inspection, maintenance, providing additional service and construction of new facilities, if required.
6. When approved working drawing or shop drawings show a temporary facility provided for the Contractor's benefit, the Contractor shall supply necessary materials and perform this work, at no cost to SEPTA.

7. The Contractor is responsible for direct payment to the Utility for work accomplished by the Utility at the request of the Contractor for the Contractor's convenience or for preferred method and means of the Contractor.

PART 2 - PRODUCTS

-Not Used-

PART 3 - EXECUTION

3.01 GENERAL

A. The Contractor shall maintain complete in-place continuity of all utility service, and provide proper support and protect utility facilities in accordance with the Specifications of the Utility affected.

B. Support facilities so as not to expose them to undo vibrations. Support and maintenance of these facilities will be subject to inspection by the Utility.

C. Repair or replace public utilities damaged during construction at no cost to SEPTA, to the satisfaction of the Utility.

D. Assume the cost for repair or replacement of private utilities damaged during construction, which will be repaired or replaced, by the private Utility.

E. Conform to the specifications and standard practices of the affected utility owners. Coordinate with utility owners, which work, shall be done by Contractor and which work shall be done by the Utility owner.

F. Provide, install, and maintain all temporary facilities required to provide interim utility service when a utility facility is to be relocated and when a utility facility to be replaced is abandoned prior to replacement.

END OF SECTION
SECTION 01570

MAINTENANCE AND PROTECTION OF VEHICLES, PEDESTRIANS AND PASSENGERS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work specified in this Section shall be provided by the Contract General Construction Contractor and consists of furnishing, installing, maintaining, and subsequently removing temporary traffic control devices, and temporary traffic striping and markings; furnishing flagmen; controlling, warning, guiding, and protecting vehicular and pedestrian traffic on streets and sidewalks affected by construction of the Project, and that adjacent to worksite; ensuring unimpeded access to buildings adjacent to the worksite; closing portions of streets and sidewalks and prohibiting stopping and parking of vehicles on streets adjacent to worksite; all as specified and directed by the Contract Documents and the Project Manager.

1.02 CONTRACTOR'S RESPONSIBILITY

A. The traffic control details in the Contract Drawings are provided to serve as a guide for the Contractor. The Contractor shall submit Traffic Control Plans (TCP), to the City of Philadelphia, Department of Streets for approval. The Contractor shall prepare working drawings showing proposed traffic control devices and shall apply to the City of Philadelphia, Department of Streets for permits to work in the public right-of-way. The traffic control plan shall be shown on working drawings prepared by the Contractor and shall be submitted as specified in Article 1.04 below. A copy of the proposed and approved drawings shall be transmitted to the Project Manager.

B. Prior to submitting bid, contact the City of Philadelphia and Commonwealth of Pennsylvania, Department of Transportation (PennDOT) to determine their requirements. Costs, direct or indirect not reflected in bid, resulting from failure to reasonably anticipate such costs will not be considered for payment.

1.03 QUALITY ASSURANCE

A. Referenced Standards:


2. Commonwealth of Pennsylvania, Department of Transportation (PennDOT), Publication No. 203M, "Work Zone Traffic Control".

3. City of Philadelphia, Department of Streets "1997 Standard of Construction Items".

1.04 SUBMITTALS

A. Submit Traffic Control Plan (TCP) to the City of Philadelphia, Department of Streets for approval (copy to the Project Manager) before starting Work; submit an updated TCP to the City of Philadelphia, Department of Streets (copy to the Project Manager) every time it becomes necessary to modify traffic operation or undertake a construction activity which creates a different traffic impact. Prepare TCP in accordance with the requirements of PennDOT.
Publication No. 203M "Work Zone Traffic Control" for both highways and city streets. TCP shall show and describe proposed locations and time durations of the following:

1. Pedestrian, passenger and public vehicular traffic routing.
2. Traffic blockage and lane reductions anticipated to be caused by construction operations.
3. Allowable on-street parking within immediate vicinity of worksite.
4. Access to buildings immediately adjacent to worksite.
5. Driveways which will, and those which will not, be blocked by construction operations.
6. Temporary traffic control devices required on streets and sidewalks affected by construction.
7. Temporary commercial and industrial loading and unloading zones.

B. Submit proposed bus loading zone relocation plan to SEPTA Operations Division prior to beginning work. Working drawings shall indicate proposed locations and the time duration that the temporary location will be used.

C. Submit individual lane and sidewalk closure plans for City of Philadelphia, Department of Streets for approval, (copy to Project Manager) not less than 15 work days before actual lane and sidewalk closing. Plans shall show and describe proposed location, hours and time duration of closure, vehicular and pedestrian traffic routing and management, traffic control devices for implementing pedestrian and vehicular movement around the affected closure, dates closure will start and be reopened, and details of barricades and protecting closure.

D. Submit copies of Licenses and Inspections Towing Permit for all trucks to be used, for towing illegally parked and disabled vehicles.

E. Notices:
   1. Notify City of Philadelphia, Department of Streets, in writing, not less than 14 days before prohibiting stopping and parking of vehicles is required; submit copy of each notice to Project Manager.
   2. Notify City of Philadelphia, Department of Streets, in writing, not less than 14 days before work is required to be performed by that jurisdiction; submit copy of each notice to Project Manager.

1.05 JOB CONDITIONS

A. Work of this Contract will require relocation of bus passenger loading zones. The Contractor shall contact SEPTA for requirements for bus loading facilities and signage at the 33rd & Cecil B. Moore location, and provide such facilities and signage to the approval of the Project Manager.

PART 2 - PRODUCTS

2.01 TEMPORARY TRAFFIC CONTROL DEVICES

A. Conform to the Regulations for Official Traffic Control Devices, 67 Pa. Code 211; Pa. Code 203; and, if required, as follows:
1. PennDOT Publication 408/2000, Section 627.2, Temporary Concrete Barrier.


B. High-rise warning flag unit: Have three flags mounted 2,750 mm above the base.

C. Warning lights and flares: Capable of alerting approaching traffic to hazards, unsafe conditions, and variances to normal traffic patterns.

D. Signs: As indicated on the Contract Drawings and the referenced PennDOT Publications.

E. Temporary traffic signals: In accordance with the City of Philadelphia Department of Streets, “1997 Standard Construction Items”.

2.02 FLAGMEN SIGN

A. 610 mm, octagonal, and attached to a 1500 mm handle. One side of sign shall be a stop sign, and other side of sign shall be a slow sign.

B. Stop Sign: Have white reflectorized letters, not shorter than 200 mm, spelling STOP on a reflectorized, red, octagonal background.

C. Slow Sign: Have black letters, not shorter than 200 mm, spelling SLOW on a reflectorized, orange, diamond background. Area between diamond and edge of flagmen sign shall be black.

PART 3 - EXECUTION

3.01 TEMPORARY TRAFFIC CONTROL DEVICES

A. Temporary traffic control devices shall include drums, cones, high-rise warning flag units, barricades, temporary concrete barrier, and temporary impact attenuating devices. Temporary traffic control devices shall be installed at the locations indicated on the reviewed and accepted TCP, and in accordance with the applicable sections of PennDOT Publication 408/2011 and as noted herein.

B. Post devices before diverting traffic, and where indicated on reviewed and accepted TCP. Place temporary control devices in those locations which will enable traffic to enter, traverse, and leave project area without hazard, and without abrupt and unwarranted changes in direction. Place drums as indicated. Place cones on not more than 7.5 m centers. Operate warning lights between sunset and sunrise; place if approaching traffic needs to be alerted to hazards, unsafe conditions, and variances to normal traffic patterns. Place high-rise warning flag units where motorists’ visibility of existing and temporary warning devices, traffic signals and pedestrian crosswalks will be either limited or obscured. Place barricades, cones, and similar protective devices if personnel and equipment will be working within 1500 mm of edge of a traffic lane which will be bearing traffic. Either repair or clean devices damaged, defaced, and otherwise rendered unfit or replace those devices with new devices within 24 hours after such damage, defacement or unfitness.

C. When erecting or resetting temporary concrete barrier, work in the direction of traffic flow. When removing temporary concrete barrier, work in the direction opposite to traffic flow.

D. Install temporary impact attenuators at exposed blunt ends of concrete barrier, and at locations conforming with City of Philadelphia Standards. Maintain attenuators in accordance with the manufacturer’s instructions.
E. Temporary Traffic Signals

1. Furnish, install and maintain temporary traffic signals at locations where construction operations damage or interfere with an existing traffic signal. Temporary traffic signals shall be installed and maintained in accordance with the City of Philadelphia Department of Streets, “1997 Standard Construction Items,” until permanent traffic signals can be reinstalled and written acceptance is provided by the Project Manager.

2. Reinstall permanent traffic signals to their original location in accordance with City of Philadelphia Department of Streets, “1997 Standard Construction Items.”

3. Following acceptance and written notification by the Project Manager for the reinstallation of permanent traffic signals, temporary signals shall be removed and remain the property of the Contractor.

F. Remove traffic control devices as soon as construction activities have been completed.

3.02 FLAGMEN

A. Furnish flagmen, with signs as specified in Article 2.02 herein, where opposing vehicular traffic must be diverted onto single traffic lanes, where traffic must change lanes abruptly, where construction equipment either enters or crosses traffic lanes and sidewalks, where construction equipment may intermittently encroach on traffic lanes and unprotected sidewalks and crosswalks, where construction operations would affect public safety and convenience, and where traffic regulation is needed because of the rerouting of vehicles around the worksite.

3.03 CONTROLLING VEHICULAR, PEDESTRIAN AND PASSENGER FLOW ADJACENT TO WORKSITE

A. Ensure that construction operations will not impede vehicular and pedestrian traffic to the extent that public safety will be threatened and passage of emergency vehicles will be restricted. Do not obstruct public ways, including streets, sidewalks, and accesses to public and private properties and bus stops. Do not reduce carrying capacity, except as indicated on reviewed and accepted TCP. Maintain pavement surfaces in a smooth riding plane where vehicular and pedestrian traffic is routed. Backfill excavations in those areas and install temporary pavement immediately after backfill has been placed. Restore each section of permanent pavement and sidewalk as soon as is practicable after completion of work for which that section of pavement and sidewalk was removed. Replacement and maintenance of pavement for traffic operations shall be an expense incurred as a part of the work effort which disrupted pavement. Restore obstructed public ways, including streets, sidewalks, and accesses to public and private properties, to public and private uses when obstruction thereto is no longer necessary for prosecution of Project. Existing traffic signal operation shall remain in continuous operation.

B. Provide such precautions as required to prevent pedestrian access to the work site. These precautions may include but are not necessarily limited to, construction of fences and barricades and the use of flagging and security personnel.

3.04 CLOSING SIDEWALKS

A. In accordance with reviewed and accepted TCP.

B. Install sidewalk closure signs in an advanced location of the closed portion of the sidewalk in order to permit safe crossing of the street at a crosswalk.
3.05 PROHIBITING STOPPING AND PARKING OF VEHICLES

A. Prohibiting stopping and parking of vehicles on streets adjacent to portion of worksite at which construction is being prosecuted shall be in effect during working hours. Erect NO PARKING and NO STOPPING signs at intervals of not more than 15 m along public streets adjacent to Project; messages shall include times and days of no parking and no stopping.

1. Notify the City of Philadelphia, Traffic Engineering Division, 48 hours prior to need for posting signs.
   a. Traffic Engineering Division will notify respective Police Inspector in whose district the signs have been posted.
   b. District Police shall verify that signs have been posted and follow Police Directive No. 116 “Temporary Stopping Signs”. Cardboard signs will not be permitted.
   c. Remove signs at the end of the posted time limit. If additional work is required beyond the posted dates, change signs to reflect the new dates and times. The Contractor shall be responsible for changing in a timely manner the dates and/or times on posted signs if for any reason work will not be performed as stated. If any changes are required, the Contractor will notify Traffic Engineering, the Divisional Inspector, and Police Tow Squad.

3.06 TRAFFIC CONTROL DEVICES

A. Place devices along traveled ways where construction activities occur as indicated on TCP, maintain as required throughout construction period, modify as shown on updated plans, and remove as soon as construction activities have been completed.

B. Construction Signs:

   1. The Contractor shall furnish and erect, move and remove, as required and as directed by the Project Manager, signs to adequately and safely inform and direct the motorist and to satisfy legal requirements.

   2. All signs shall be kept clean, mounted at the required height on adequate supports and placed in proper position and alignment so as to give maximum visibility both night and day. All wood support and backs of plywood sign panels shall be painted with two coats of white paint. All signs and markers shall indicate actual existing conditions and shall be moved, removed, relocated or changed immediately as directed by the Project Manager.

   3. All signs shall be mounted in accordance with the referenced codes. All signs shall be mounted at a height of at least 1500 mm. Under special conditions, signs may be mounted at a greater height to fit the situation on an approved TCP submission or directed by the Project Manager to fit the situation.

   4. All signs shall be the property of the Contractor and shall be maintained in good condition for the duration of the contract and removed from the work site when the contract is accepted.

   5. Place name of contractor someplace on the sign for purpose of owner identification only.

3.07 EXISTING TRAFFIC SIGNS

A. Support and protect traffic signs, including street name signs, bus stop signs, regulatory and directional signs within the Right-of-Way, unless otherwise shown. Repair or replace such items if damaged by construction operations or as directed by the Project Manager.
B. Where removal of traffic signs is required during construction, remove, store, and ultimately reinstall signs using hardware approved by the appropriate agency.

3.08 TRAFFIC SIGNALS

A. In case it is required by the City of Philadelphia, adjust the timing and phasing of all affected traffic signals during detour and at other times during the Project, as indicated on the Contract Drawings and as directed by the Project Manager. Adjustments of traffic signals shall be coordinated with the appropriate jurisdictional authority and Municipality.

3.09 TEMPORARY PAVEMENT MARKINGS

A. Apply temporary pavement markings in accordance with the requirements of PennDOT Publication 408/2011, Section 961.

B. Remove existing pavement markings in accordance with PennDOT Publication 408/2011, Section 963.

3.10 BUS LOADING ZONE SIGNS

A. Where existing bus loading zones will be temporarily relocated post signs indicating time and new location of Bus loading zones, at locations given by the Project Manager. If required the Contractor shall post signs at temporary closed stair towers indicating where the nearest stair tower is opened.

END OF SECTION
SECTION 01580

PROJECT IDENTIFICATION SIGNS
AND OTHER CONSTRUCTION SIGNAGE

PART 1 - GENERAL

1.01 DESCRIPTION

The work specified in this Section consists of furnishing and installing project identification signs and temporary construction signs as described below and required by the Contract Documentation.

1.02 RELATED SECTIONS

Section 01300 Submittals
Section 01500 Construction Facilities and Temporary Controls
Attachments:
- SEPTA Starburst Sign
- No Trespassing Sign

1.03 SUBMITTALS

A. In accordance with Section 01300, submit the following:

1. Shop drawings of each sign scheduled to be utilized during construction. Indicate materials, size, location, fonts and colors proposed for use.

2. After consultation with the Project Manager, submit the following sign information for review and approval by SEPTA.
   a. Sketch and narrative description identifying the location, orientation and mounting height of each sign.
   b. Total quantity of each sign to be utilized
   c. Name, address, telephone number and key contact person of the company responsible for the fabrication of the sign.

3. Hardware and mounting details for erection of each sign.

1.04 JOB CONDITIONS

A. Signs shall be commercial quality and approved by SEPTA prior to fabrication.

1. Install Project Identification Signs within forty-five (45) calendar days after the Notice to Proceed.

2. The No Trespassing Sign is to be installed within the Contractor’s Project compound and other areas to be determined by the Project Manager.

3. Install temporary Operational, Directional and Safety signs at least fifteen (15) working days in advance of any work that necessitates the interruption or detour of operations.
B. Prohibited Signs:

Signs of personal nature, such as business advertisements or labor union notices will not be permitted.

PART 2 - PRODUCTS

2.01 PROJECT IDENTIFICATION SIGN MATERIAL

A. Sign Material

Cut sign from a standard 4’ x 8’ x ¾” thick, waterproof exterior. A-B grade plywood with a smooth, finished surface. Round edges to a 1/8” radius. Joints will not be permitted.

B. Mounting Material:

1. General: Provide mounting frames and hardware of such quality to be able to support the sign under all weather conditions for the duration of the project.
   a. Unless surface mounted, support signs with frames constructed with pressure treated dimension lumber, or other approved non-conductive material, of sufficient size to brace against weather conditions.
   b. Secure surface mounted signs using anchoring devices approved by SEPTA.

2. Hardware:

   a. Galvanized screws or bolts with nuts and washers.
   b. Paint all hardware, visible in the finished assembly, to match the adjoining surface of the sign or mounting.

3. Posts:

   a. Pressure treated dimensional lumber or other non-conductive material acceptable to SEPTA.

C. Paint:

1. Paint sign surfaces, posts and mounting frames with one coat of primer sealer and two coats of white semi-gloss enamel on all sides and edges.

2. Use paint manufactured for exterior use by a manufacturer acceptable to SEPTA.

D. Acceptable Fabricator:

Company specializing in and having documented experience in the fabrication of graphic signs.

E. SEPTA Project Sign:

1. Provide for a minimum of two (2) SEPTA Project Signs, at location(s) to be determined in the field, as approved by the SEPTA Project Manager. Sample SEPTA Project Sign is shown on Sketch # SEPTA-1, attached at the end of this Section.

   Size: 4’ x 6’
2. SEPTA will provide the Contractor with a proof copy of the information to be displayed on the SEPTA Project Sign at the Pre-Construction Meeting.

3. Obtain the services of a graphic sign company to transfer the information contained on the SEPTA provided computer disk onto 0.1 mm pressure sensitive vinyl with Weather-All Fluorinated Polyurethane Coating, or approved equal film. The vinyl shall be mounted onto the sign surface.

4. Available graphic sign companies include, but are not limited to, the following:
   a. Berry & Homer, Inc., Philadelphia, PA;
   c. Liberty Graphic Systems, Inc., Feasterville, PA; or
   d. Ridgeway's, Philadelphia, PA.

5. Do not include information on the SEPTA Project Signs except that contained on the computer disk provided by SEPTA.

6. The Contractor is responsible for advising the Project Manager of any problems that occur during the production of the SEPTA Project Sign.

2.02 TEMPORARY SIGNS

A Temporary signs are considered to be any sign not included in Article 2.01 above that is required to be erected during the construction phase of the project and removed at the completion of the construction phase of the project. These signs include, but are not limited to, Field Office Signs, and Safety and instructional signs for workers and visitors.

1. Pedestrian way finding signs
   a. Each sign not to exceed 750 sq. in.
   b. Signs shall be black Helvetica bold letters on white background with key information in red.
   c. All signs must meet ADA guidelines
   d. Total sign count not to exceed 18 signs per phase
   e. Signs may be reused phase to phase with approval of PM

B Other Temporary Signs:

1. Operational, directional and safety signs.

2. Size: Keep dimensions of the signs to a minimum, but provide a sufficient size to include all pertinent information and/or directions in a concise and comprehensive manner.

3. Use block type lettering of sufficient size to be legible from 100 feet away.

C No Trespassing Sign

1. Sign base will be white baked enamel aluminum, 12" wide, 18" high and .062" thick. Additional prints of two colors will be used; fire red and black. 1" border on the top and both sides and ½ " border on the bottom.

Sign Information
a. 1” down from the top is a 10” wide x 2.75” high fire red block with reversed out white copy at 1.5” Helvt. Med. Acct. A. K. Rev. M that reads: WARNING centered in caps.

b. 5” down from the top is the baseline for 0.75” Helvt. Med. Acct. A. K. Rev. M, black copy to read: NO TRESPASSING centered in caps.

c. 8.75” down from top is the center of a 6” fire red outlined circle .5” thick with a diagonal 45 degree slash from the upper left to the lower right of the circle. Behind the circle and slash is a 4.5” pictograph of a walking pedestrian.

d. 13” down from the top is the baseline for 0.75” Helvt. Med. Acct. A. K. Rev. M, in black copy to read: AUTHORIZED centered in caps.

e. 14.125” down from the top is the baseline for 0.75 Helvt. Med. Acct. A. K. Rev. M, in black copy to read: PERSONNEL ONLY centered in caps.

f. 16.5” down from the top is the baseline for 0.375” Helvt. Med. Acct. A. K. Rev. M, broken down in 4 lines of black copy to read:

   All Others Will Be Prosecuted In
   Accordance With the Penalties Provided
   In Section 3503 OF The Pennsylvania
   Crimes Code.

g. 17.5” down from the top, flush right, is the base line for 0.5” SEPTA logo in black.

2. Fasteners are not incorporated in the sign. Contractors can drill holes in the signs to mount them on fencing, walls, and barricades not to obstruct the message of the sign.

D Field Office Signs:

1. Size: 4’ x 5’ wide.

2. Letter with black enamel paint, using block letters at least 4” high, with the Contract name. Contract number, and the words “CONTRACTOR’S FIELD OFFICE” or “SEPTA’S FIELD OFFICE” as appropriate with each word painted on a separate line.

3. Where the field offices to be identified are not readily visible from the work site entrance, paint a directional arrow on the sign and locate the sign near the entrance. In this case, provide additional signs of reduced size with the words “ CONTRACTOR’S FIELD OFFICE” or “ SEPTA’S FIELD OFFICE” as necessary to direct traffic to, and identify the field office location(s).

PART 3 - EXECUTION

3.01 INSPECTION

A. Prior to erection, examine all signs to verify that the size, material and wording is in accordance with the approved shop drawings.

B. Examine areas and conditions under which the signs are to be located. Prior to erection, notify the Project Manager of any conditions that may differ from the information identified on the sign submission.
3.02 ERECTION

A. Install signs in accordance with approved shop drawings and as directed by the Project Manager. Support all non-surface mounted signs on a minimum of two posts, anchored into the ground at a depth sufficient to provide rigid support of the sign during all weather conditions.

B. Provide Project Signs and SEPTA’s Field Office Signs at places designated by SEPTA.

C. No Trespassing signs shall be posted on every side at 40’ spacing on all temporary fences and walls, barricades and compound fencing.

D. Provide and install other temporary signs deemed necessary for the project by SEPTA.

E. Sign Maintenance: Maintain all signs throughout the course of construction from installation until contract completion, keeping them clean, free from graffiti, in good repair and free of obstruction. Provide and maintain adequate protection against weather so as to preserve all work, materials, equipment, apparatus, and fixtures free from injury or damage. Maintain all signs free of all unrelated signs, posters, painting, advertising and defacement of any kind. Within five days of notice, the Contractor shall clean, repair or replace signs as necessary to maintain them in a “like-new” condition.

F. Within five days of final acceptance of the project by SEPTA, remove and dispose of all project identification and temporary signs. All costs for the removal and disposal of signs shall be borne by the Contractor.

END OF SECTION
SECTION 01590
SEPTA FIELD OFFICE

PART 1 - GENERAL

1.01 DESCRIPTION
   A. At a location acceptable to the Project Manager and within thirty (30) days after receipt of Notice to Proceed, the Contractor (GC) shall provide and maintain until completion of the Work a temporary field office for the occupancy and use of SEPTA and its employees, with a minimum of 600 square feet of usable area divided into two (2) independent areas, capable to be isolated from each other with doors that can lock and equipped as specified in this section. At the completion of the work the Contractor shall provide for the removal of the temporary field office.

1.02 RELATED WORK
   Section 01010: Summary of Work
   Section 01500: Construction Facilities and Temporary Controls

1.03 SUBMITTALS
   A. In accordance with Section 01300, submit within thirty (30) days after receipt of the Notice to precede a bill of materials of all required office equipment and supplies for the review of the Project Manager.

PART 2 - PRODUCTS

2.01 STANDARD EQUIPMENT
   A. Furnish the SEPTA field office with the following good quality new equipment and furniture as indicated below. Maintain this equipment in good operating condition until punch list corrective work is completed and accepted by SEPTA.

   B. Item Quantity Description
      a. (1) New laptop computer with the following minimum specifications: CPU: Intel Core i5 2.7GHz or faster, RAM: 4GB 1600MHz DDR3, Hard Drive: 320GB, 7200 RPM, Optical Drive: 8X DVD +/- RW, WiFi: 802.11AGN Dual Band, Bluetooth: 4.0, Display: 15" 1366x768 minimum LED, Windows 7 Professional, Microsoft Office Professional Plus 2010, Docking Station – Dual digital display, USB 3.0, Gigabit Ethernet, complete with 19" LCD flat screen color monitor (WXGA), 8X HD DVD-R/DVD + RW/DVD-RAM/DVD+R DL, 800 MHz front side bus speed, nVidia GeForce 8600M GT Video hardware, 512 MB dedicated, 767MB total available Video Memory, lithium-ion battery, 1 FireWire ports, 19 in one media/smart card reader (or separate USB card reader, Microsoft Office 2007 Small Business, Firewall, antivirus and internet security suite. Confirm specific configuration with SEPTA prior to purchase. Extended keyboard with extended keypad & mouse, speakers, 1GB Ethernet LAN Adapter, Monitor Stand for docking station. Add Docking Station and the ability to connect the laptop to multiple devices simultaneously using a single interface. It must have the flowing ports: VGA, parallel, Serial, PS/2(2), USB 2.0 (4 min.) RJ-11 & RJ-45.
      b. (1) Laser printer with 600 x 1 200 dpi resolution and 27 pages per minute printing capabilities, with network capabilities, scanning and additional 11"x17" paper tray, 160 MB, 533MHz Processor.
c. (2) Double kneehole desk (2 -60" x 30" and 1 -48" x 40") with file drawer and three drawers, all lockable, and with swivel 5-star base armchair for each desk.

d. (2) Staplers and tape dispensers; staples and tape.

e. (1) Heavy-duty stapler with staples. Swingline Strongarm 113 or approved equal.

f. *(1) Rubber stamps: "File Copy", "Date Received", "No Exceptions Taken", "Proceed As Noted", "Revise and Resubmit" and Rejected". Submit stamps for SEPTA approval.

g. (2) Stamp pads (red and black).

h. (2) Ink bottles (red and black).

i. *(1) New hanging plan storage racks on casters with 24" wide binders (total of 30), similar to Bruning Superfile Rolling Stands with channel assemblies, catalog # 58-212-24001, or approved equal.

j. (1) Electrically-operated pencil sharpener.

k. (1) 3-hole punch.

l. (1) 2-hole punch.

m. (1) Drafting table (60" x 36") with drawer and stool.

n. (2) Rolls of brown packing paper with heavy duty packing tape.

o. (1) 12" hand level.

p. (1) String level.

q. (1) Plumb bob with string and pouch.

r. (1) Box of keel (lumber crayons).

s. (1) Folding table 36" x 36"

t. (4) Folding chairs

u. (1) Measuring wheel, as made by Rolatape or approved equal.

v. (1) New copier with automatic top loading document feed, capable of copying 8Y2" X 11", 8Y2" X 14" and 11" X 17" sheets, with automatic top loading document feed, 2 paper trays, automatic 2-sided copying, automatic variable reduction and/or enlargement, and including paper and copying supplies.

w. (1) File cabinet with four drawers (legal size), lock and two keys.

x. (1) Bookcase (36" x 42") with four shelves.

y. (2) Folding conference tables (30" x 54")

z. (1) White board with dry-erase markers.

aa. (10) Folding chairs.

bb. (1) Paper cup dispenser and paper cups.

cc. (1) Paper towel dispenser and continuous supply of paper towels.

dd. (1) Continuous supply of soap and toilet paper.

ee. (1) Water cooler unit with hot and cold spigots, refrigerator and water.

ff. (2) Fire extinguisher, 5 pound ABC type.

gg. (3) Wastepaper basket.

hh. (1) Automatic drip coffee machine with all necessary supplies.

ii. (1) Mid-size digital control microwave oven.

jj. (2) Complete first aid kits.

kk. (2) New digital camera 13.0 megapixel resolution, 12x optical zoom, 5.7x digital zoom, 4" LCD, memory card xD Card/micro xD card, minimum 1G. Second battery, charging adapter and case and USB connectivity.

ll. (1) Dry mil paint thickness gauge

mm. (2) Concrete thermometers w/portable data loggers, capable of taking and storing temperature readings a period of 2 weeks, Led on indicator, downloadable into computer via a Serial USB base station (LogTag, HoboproV2 or approved equals)

nn. (2) Magnetic surface thermometers

oo. (1) 100 feet fiberglass tape measure

pp. (1) 25 feet tape measure

qq. (2) 5 feet folding stick ruler

rr. (2) New digital communicators w/built in 2-way radio and digital cellular phone capabilities. Communicators to be provided w/unlimited 2 way radio communications between the (2) units. Communicators shall be Motorola i700 plus with Nextel Direct
Connect ® or approved equal system. Contractor to provide, maintain and pay all associated costs with this item for the duration of the project.

ss. (1) 12-In-1 Flash Memory Card Reader/Writer

tt. (1) Macklanburg-Duncan #92379 24” SmartTool with Module

All the above items shall be removed promptly at the completion of the project, except for those items marked " * ", which shall remain the property of SEPTA.

PART 3 - EXECUTION

3.01 OFFICE

A. Weathertight, with barred windows and doors, each equipped with screens and adequate locking devices. Exterior doors shall be equipped with cylinder locks and dead bolts, both keyed alike with two keys and also provided with burglar-proof bars and locks across the doors. Interior doors shall be equipped with cylinder locks as well, each keyed separately with two keys for each.

B. Insulated exterior wall, ceilings and floors.

C. Floor covered with resilient flooring material such as VCT or linoleum.

D. Restroom with lavatory, toilet, soap holder, toilet paper, holders, paper towel dispenser, wastepaper basket, mirror, and hot and cold water supply, or restroom facilities commensurate with Contractor’s own on-site facilities.

E. Sufficient lighting to provide a minimum of 100-foot candles at desk light uniformly in all areas.

F. Grounded duplex electrical receptacles around interior walls at approximately 10-foot spacing.

G. Automatically controlled heating and air-conditioning systems with thermostats, capable of maintaining the office at an ambient temperature ranging between 64 and 78 degrees F. The Contractor shall provide fuel and bear all costs in connection therewith.

H. The Contractor shall provide water, sewer, and electrical utility service as required.

3.02 MAINTENANCE AND SERVICE

A. The Contractor shall provide all electrical tie-ins for the field office and provide continuous maintenance of utility tie-ins during the construction period.

B. The Contractor shall provide continuous maintenance during the construction period including daily janitorial service for offices and toilet facilities and provide toiletry supplies as necessary. The Contractor shall clean the windows bi-weekly.

C. The Contractor shall repair or refinish damaged areas as required.

D. The Contractor shall provide supplies for the copying machine for an average usage of approximately 500 copies per month.
E. The Contractor shall repair or replace copying machine, laser printer and other related related equipment within 48 hours of becoming inoperable or defective.

F. The Contractor shall pay cost of all utilities.

G. The Contractor shall provide continuous telephone service within the field office and bear all costs in connection therewith, including long distance telephone charges until final completion and acceptance of the work. The Contractor shall provide as follows:

1. Two separate phone lines on one unit and answering machine.
2. WIFI connection for computers.

3.03 SEPTA PARKING

A. The Contractor shall provide a minimum of two (2) parking spaces at the trailer location for SEPTA's use.

3.04 SECURITY

A. The Contractor shall guard against unauthorized or illegal entry. The Contractor shall be responsible for the replacement and/or compensation for any item owned by the SEPTA or its employees, which are related to the subject work, removed or damaged as the result of vandalism, theft, mischief or illegal entry to the field office.

3.05 REMOVAL

A. Upon project completion, the Contractor shall remove temporary field office and appurtenances from the worksite.

END OF SECTION
SECTION 01600

MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 DESCRIPTION

Work of this section includes:

A. Products
B. Transportation and handling
C. Storage and protection
D. Product options
E. Substitutions

1.02 RELATED WORK

A. SEPTA Agreement:

Section 01010: Summary of Work
Section 01011: Summary of Project
Section 01060: Regulatory Requirements and Safety
Section 01300: Submittals
Section 01400: Inspection and Test Plan

1.03 SUBMITTALS

A. Not used

1.04 QUALITY ASSURANCE

A. The Contractor shall include in its Quality Assurance Program all procedures that are required to assure full protection of work and materials.

1.05 MANUFACTURERS’ RECOMMENDATIONS

A. The Contractor shall comply with manufacturers’ recommendations on product handling, storage, and protection except as noted in the Contract Documents or otherwise approved by SEPTA.

1.06 EXISTING MATERIALS AND PRODUCTS

A. The Contractor shall not reuse materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
B. The Contractor shall provide interchangeable components of the same manufacture, for components being replaced.
1.07 TRANSPORTATION AND HANDLING

A. The Contractor shall transport and handle products in accordance with manufacturer's instructions.

B. The Contractor shall promptly inspect shipments to ensure that products comply with requirements, quantities are correct, and products are undamaged.

C. The Contractor shall provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

D. The Contractor shall deliver and have delivered products to the job site in their manufacturer's original container, with labels intact and legible.

E. The Contractor shall maintain packaged materials with seals unbroken and labels intact until time of installation.

F. The Contractor shall promptly remove damaged material and unsuitable items from the job site, and promptly replace with material meeting the specified requirements, at no additional cost to SEPTA.

G. SEPTA may reject, as non-complying, such material and products that do not bear satisfactory identification as to manufacturer, grade, quality, and other pertinent information.

H. SEPTA reserves the right to require the contractor to turn over copies of all bills or lading, packing slips, labels and other material which establishes that material delivered to the job site match the material requirements of the construction documents.

1.08 STORAGE AND PROTECTION

A. The Contractor shall store and protect products in accordance with manufacturers’ instructions, with seals and labels intact and legible.

B. The Contractor shall store sensitive products in weather tight, climate controlled enclosures.

C. For exterior storage of fabricated products, the Contractor shall place on sloped supports, above ground.

D. The Contractor shall make off-site arrangements for storage and staging, and deliver material to the site as required so as not to affect work progress of other contractors and create unsafe conditions.

E. The Contractor shall protect all finished surfaces and equipment.

F. The Contractor shall provide protection for finished floor surfaces prior to allowing equipment or materials to be moved over such surfaces.

G. The Contractor shall maintain finished surfaces and equipment clean, unmarred, and suitably protected until final acceptance by SEPTA.

1.09 REPAIRS AND REPLACEMENTS

A. In event of damage, the Contractor shall promptly make replacements and repairs at no additional cost to SEPTA.
B. Additional time required to secure replacements and to make repairs will not be considered by SEPTA as justification for extension to contract time.

1.10 PRODUCT OPTIONS

A. Products specified by reference standards or by description only: Any Product meeting those standards or description may be used regardless of manufacturer.

B. Products specified by naming one or more manufacturers: Products of manufacturers named no options or substitutions allowed, except as otherwise provided in the Contract Documents. Must submit any variation as an “or equal” substitution for approval.

C. All newly installed products shall be asbestos-free.

END OF SECTION
SECTION 01700

CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 DESCRIPTION

A. This Section specifies the requirements for closing out the Contract and supplements requirements specified in Paragraph XII of the Agreement.

B. Contract closeout is the term used to describe the collective Project requirements that are to be fulfilled near the end of the Contract term in preparation for final acceptance and occupancy of the Work by SEPTA, as well as final payment to the Contractor and the completion of the Contract.

C. If in the event that the Work of the Contract is completed in phases and/or portions of the Work is completed to the full satisfaction of SEPTA and SEPTA is to utilize that completed phase and/or portion, SEPTA shall issue a Certificate of Substantial Completion in accordance with 1.03 below.

1.02 RELATED DOCUMENTS

A. Agreement

Section 01710: Final Cleaning
Section 01720: Project As-Built Documents
Section 01830: Operation and Maintenance Data

1.03 PREREQUISITES TO SUBSTANTIAL COMPLETION

A. General: The Contractor shall complete the following before requesting the Project Manager's inspection for certification of substantial completion for the Work of the Contract. The Contractor shall list known exceptions in the request.

1. What constitutes substantial completion will be determined by the Project Manager. The SEPTA Project Manager reserves the right to halt the inspection of work at any time which is not substantially complete in his opinion.

2. In the progress payment request that coincides with, or is the first request following the date substantial completion is claimed, activities should be either 100 percent complete for the portion of the Work claimed as "substantially complete," or provide a list incomplete items, the value of incomplete Work, and reasons for the Work being incomplete. Include supporting documentation for completion as indicated in the Contract Documents.

3. Submit written certification to the Project Manager that the project, or designated portion thereof, is substantially complete.

4. Submit the list of items to be completed or corrected and material delivery dates of major items, as applicable.

5. Advise SEPTA of pending insurance change-over requirements.
6. All contract record documents, maintenance manuals, warranties, and bonds shall be submitted as defined in the Agreement and Sections 01720, and 01830.

7. Obtain and submit releases enabling SEPTA full, unrestricted use of the Work and access to services and utilities. Where required, include occupancy permits, operating certificates and similar releases.

8. Deliver any access tools and material stock as required and further defined in Section 01830.

9. Discontinue or change over and remove temporary facilities and services from the project site as directed by the Project Manager along with construction tools and facilities, mock-ups, and similar elements.

10. Touch up and otherwise repair and restore marred exposed finishes.

11. All maintenance instructions for the SEPTA's personnel shall be completed as defined in Section 01830.

12. All building operations, maintenance and owner education instructions for the SEPTA's personnel shall be completed as defined elsewhere in the Specifications.

13. Change out locks, transmit keys and transfer security provisions if required by the Specifications.

14. Startup testing and demonstration of equipment and systems shall be completed as defined elsewhere in the Specifications.

15. Provide written acknowledgement by the Warranty Holders that their products have been installed to their satisfaction and their full warranty shall be honored.

B. Inspection Procedures: Upon receipt of the Contractor's request and submittal for inspection, the Project Manager will either proceed with inspection or advise the Contractor of unresolved prerequisites.

1. Following the initial inspection, the Project Manager or the Architect/Engineer will either prepare the Certificate of Substantial Completion or advise the Contractor of Work which must be performed before the certificate will be issued. The Project Manager will repeat the inspection when requested and when assured that the Work has been completed.

2. Results of the completed inspection will form the initial "punch list" for final acceptance.

3. The "punch list" shall include a reasonable time period to effectuate the work, which is mutually agreed upon by all parties.

1.04 PREREQUISITES TO FINAL ACCEPTANCE

A. General: The Contractor shall complete the following before requesting the Project Manager's final inspection for certification of final acceptance and final payment as required by the Agreement, specifically sections regarding the Contractor and Payment and Completion. The Contractor shall list known exceptions, if any, in the request.

1. Submit the final payment request with final releases and supporting documentation not previously submitted and accepted. Include certificates of insurance for products and completed operations where required.
2. Submit an updated final statement to account for final additional changes to the Contract sum.

3. Submit a Certified copy of the Project Manager's final "punch list" which documents all work which has been completed.

4. Submit final meter readings for utilities, a measured record of stored fuel and similar data as of the date of Substantial Completion or as of the date SEPTA took possession of and responsibility for corresponding elements of the Work, if required.

5. Submit Consent of Surety. Affidavit of Payments of Debts and Claims, Affidavit of Release of Liens. General Release by Trade Contractor of Owner, Guarantee against Defects, any Warranties and Maintenance Bonds. Any special documentation such as copy of Engineer or DER Permits or Certification of Occupancy.

6. Submit evidence of final, continuing insurance coverage, which complies with insurance requirements.

7. Submit any remaining record documents and drawings, maintenance manuals, final project photographs, damage or settlement survey, property survey, and similar final record information.

8. The Contractor shall also issue final project records in an electronic format. Electronic files shall be in a format approved by the SEPTA PM for each specific item. Electronic files shall be organized and named per applicable section or naming protocol as provided by the SEPTA PM.

9. The SEPTA PM may elect progressive submissions of specific listed items during the course of the work. Electronic files shall be created for the following items:
   a. Submittals
   b. Construction Permits
   c. Certificate of Use and Occupancy
   d. As-Built Drawings
   e. Manufacturer's OEM manuals.
   f. Manufacturers’ Warrantees
   g. Construction Photographs
   h. Approved Shop Drawings
   i. Testing Service Results
   j. Steel Certifications
   k. UL Inspections
   l. Survey Log Records
   m. All Engineering, design and calculations
   n. Documentation required by regulatory requirements
   o. Accident Reports

B. Reinspection Procedure: The Project Manager will re-inspect the Work upon receipt of the Contractor's notice that the Work, including "punch list" items resulting from earlier inspections, has been completed except for those items whose completion has been delayed because of circumstances that are acceptable to the Project Manager.

1. Upon completion of reinspection, the Project Manager will either prepare a Certificate of Final Acceptance or will advise the Contractor of Work that is incomplete or of obligations that have not been fulfilled but which are required for final acceptance.
a. SEPTA reserves the right to halt inspections at any time if it becomes apparent that the incomplete items of work are either too numerous or too complex to qualify the project as substantially complete.

2. If necessary, the reinspection procedure will be repeated.

END OF SECTION
SECTION 01710

FINAL CLEANING

PART 1 - GENERAL

1.01 DESCRIPTION

The section details work for preparing the site and/or facility for substantial completion.

1.02 RELATED WORK

Section 01500: Construction Facilities and Temporary Controls

1.03 SUBMITTALS

In accordance with Section 01300 provide the proposed cleaning materials and chemicals for the review of the Project Manager.

1.04 QUALITY ASSURANCE

A. In addition to the standards described in this Section the Contractor shall comply with pertinent requirements of governmental agencies having jurisdiction.

B. "Clean," for the purpose of the Article, and except as may be specifically provided otherwise, shall be interpreted as meaning the level of cleanliness generally provided by skilled cleaners using commercial quality building maintenance equipment and materials.

PART 2 - PRODUCTS

2.01 CLEANING MATERIAL AND EQUIPMENT

A. The Contractor shall provide required personnel, equipment, and materials needed to achieve the specified standard of cleanliness.

2.02 COMPATIBILITY:

A. The Contractor shall use only the cleaning materials and equipment which are compatible with the surface being cleaned, as recommended by the manufacturer of the material and acceptable to SEPTA.

B. The Contractor shall replace surfaces damaged from improper use of material and/or cleaning methods.

PART 3 - EXECUTION

3.01 FINAL CLEANING

A. The Contractor shall, prior to turning over the substantially completed area to SEPTA maintenance, remove from the area all tools, surplus materials, equipment, scrap, debris, and waste. If any of the Contractor's work continues in the substantially completed area, the Contractor shall continue the cleaning specified in Section 01500. Schedule final cleaning date as approved by SEPTA.
B. Site:
   1. Unless otherwise specifically directed by SEPTA, the Contractor shall sweep grade areas within the contract limit and paved areas adjacent to the site.
   2. The Contractor shall completely remove resultant debris.
   3. The Contractor shall remove graffiti from all surfaces and restore surface to original condition.

C. Structures:
   1. The Contractor shall visually inspect all existing and finished surfaces and remove all traces of soil, waste materials, smudges, graffiti and other foreign matter.
   2. The Contractor shall remove all traces of splashed materials from structure within contract limit and from adjacent surfaces.
   3. If necessary to achieve a uniform degree of cleanliness, the Contractor shall wash the exterior of the structure with high pressure detergent.
   4. In the event of stubborn stains not removable with detergent, the Contractor shall utilize light sandblasting or other cleaning methods at no additional cost to SEPTA.
   5. The Contractor shall remove paint droppings, spots, stains and dirt from existing and finished surfaces.
   6. The Contractor shall clean existing and new glass surfaces and frames inside and outside.
   7. The Contractor shall remove all roofing tar and other construction residue as a result of the work from all wall surfaces, pavements, equipment, metal copings and trim, etc.

D. Finished Surface:
   1. The Contractor shall remove all labels and tags, which are strictly used for the convenience of manufacturing, assembly, installation and identifications.
   2. The Contractor shall clean glass and glazing to a polished condition. Remove substances, which are noticeable on surfaces. Replace any broken glass and damaged transparent materials.
   3. The Contractor shall clean stainless steel surfaces (including screens) of all foreign material. Finish surfaces with application of buffed polish material as recommended by the manufacturer.
   4. The Contractor shall clean existing and new tile surfaces including the grout joints to dirt and graffiti free condition.

E. Equipment:
   1. The Contractor shall wipe surfaces of all mechanical and electrical equipment including system components to a dirt free condition. Touch up the surfaces to match with the overall finish of the equipment/system component.
2. Insure that the equipment and system components are properly identified as required by the Contract Documents.

END OF SECTION
SECTION 01720

PROJECT AS-BUILT DOCUMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor, throughout progress of the Work, shall maintain an accurate record of changes to the Contract Drawings and Specifications.

B. The Contractor shall at the time of substantial completion, but prior to requesting release of retainage, transfer the changes to a set of Final As-Built Documents, which shall include an As-Built set of Construction Drawings and an annotated set of Specifications.

C. The Contractor shall in addition to the defined requirements provide approved Final As-Built Documents in an electronic format for SEPTA’s future use. The format of these electronic files shall be approved by the SEPTA PM prior to submission.

1.02 RELATED WORK

A. Documents affecting work of this Section include, but are not necessarily limited to, the Agreement and Division 1 of these Specifications.

B. Other requirements affecting Project As-Built Documents may appear in pertinent other Sections of these Specifications.

1.03 SUBMITTALS

A. The Contractor shall comply with pertinent provisions of Section 01300.

1.04 QUALITY ASSURANCE

A. Accuracy of Records:

1. The Contractor shall thoroughly coordinate changes within the As-Built Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other documents where such entry is required to show the change properly.

2. Accuracy of records shall be such that future search for items as installed may rely reasonably on information obtained from the approved Final Record Documents.

B. The Contractor shall make entries on the As-Built Documents on a weekly basis to include all changes to the Work performed during the last week to confirm they are an accurate representation of the As-Built conditions.

C. The Contractor shall use professional draftsperson to prepare to transfer "job set" information to Final As-Built Documents.

1.05 PRODUCT HANDLING

A. The Contractor shall maintain the "job set" of Record Documents completely protected from deterioration and from loss and damage until completion of the Work and transfer of all recorded data to the Final As-Built Documents.
PART 2 - PRODUCTS

2.01 RECORD DOCUMENTS

A. Job Set:

Following receipt of SEPTA’s Notice to Proceed, the Contractor, shall secure from SEPTA one complete set of all drawings and specifications comprising the Contract Documents. This “job set” will be maintained at the site to record all As-Built changes.

B. Final As-Built Documents:

The Final As-Built Documents are to include:

1. Updated As-Builts of the original Contract Drawings.

2. Additional As-Built Drawings as necessary, to describe changes during the Contract period that could not be included on the original contract drawings.

3. Annotated Specifications to include Contract Specifications with all changes made during the Contract period.

4. “As installed” versions of same size drawings of all fabrication, detail and installation drawings.

PART 3 - EXECUTION

3.01 MAINTENANCE OF JOB SET

A. The Contractor shall, immediately upon receipt of the job set described in Paragraph 2.01, A. above, identify each of the Documents with the title “AS-BUILT DOCUMENTS - JOB SET.”

B. Preservation:

1. The Contractor shall devise a suitable method for protecting the As-Built Job Set (job set) in consideration of the Contract duration, the probable number of occasions upon which the job set must be taken out for new entries and for examination; the transfer of information on Final As-Build Documents; and the conditions under which these activities will be performed.

2. The Contractor shall not use the job set for any purpose except entry of new data, for review by SEPTA and for the transfer of data to Final As-Built Documents.

3. Maintain the job set at the site of Work.

C. Making entries on Drawings:

1. The Contractor shall utilize an erasable colored pencil (not ink or indelible pencil) to clearly describe the change by graphic line and note as required.

2. The Contractor shall date all entries.

3. The Contractor shall call attention to the entry by a “cloud” drawn around the area or areas affected.
4. The Contractor shall in the event of overlapping changes, use different colors for the overlapping changes.

D. Revisions:

1. The Contractor shall transfer all changes to respective Specifications and/or Drawings set (if appropriate) immediately, as the change is approved.

2. The Contractor shall make appropriate entries in the drawings as soon as the change is incorporated in the field.

E. Conversion of schematic layouts:

1. The Contract drawings may indicate arrangements of conduits, circuits, piping, ducts, and similar items shown schematically, and is not intended to portray precise physical layout. Final physical arrangement is determined by the Contractor, subject to SEPTA’s written approval. However, design of future modifications of the facility requires accurate information as to the final physical layout of items, which must be schematically shown on the Final As-Built Drawings.

2. Show on the job set of As-Built Drawings, by dimension accurate to within one (1), the centerline of each run of items such as are described in subparagraph 3.01E.1 above.
   a. The Contractor shall clearly identify the item by accurate note such as "cast iron drain", "galv. conduit," and the like.
   b. The Contractor shall show, by symbol or note, the vertical location of the item ("under slab," "in ceiling plenum," "exposed," and the like).
   c. The Contractor shall make all identification sufficiently descriptive that it may be related reliably to the Specifications.

3.02 FINAL PROJECT RECORD INFORMATION

A. The purpose of the Final Project As-Built Documents is to provide factual information regarding all aspects of the Work, both concealed and visible, to enable future modifications of the Work to proceed without lengthy and extensive site measurement, investigation, and examination.

B. Accuracy of Record Data Prior to Transfer:

1. The Contractor is solely responsible for accurate transfer of all field changes and preparing additional reproducible drawings and specification pages.

C. Transfer of Data to Drawings:

1. The Contractor shall carefully transfer change data shown on the job set to the Final As-Built Documents coordinating the changes as required.

2. The Contractor shall clearly indicate at each affected detail and master drawing a full description of changes made during construction, and the actual location of items.

3. The Contractor shall call attention to each entry by drawing a "cloud" around the areas affected.
4. The Contractor shall make changes neatly, consistently, and with the proper media to assure longevity and clear reproduction.

5. The Contractor shall prepare additional reproducible drawings in the same size as the original contract drawings for changes to details (including installation and fabrication drawings) incorporated in the construction that could not be corrected on the As-Built drawings. These drawings shall be adequately identified and cross-referenced with pertinent Drawing(s) to make it part of the Final As-Built Documents.

D. Transfer of Data to Specifications:
1. The Contractor shall accurately and legibly transfer all information from job set to Final Annotated Project Record Specifications Set.

E. Review and Submittal:
1. The Contractor shall submit the completed set of Final As-Built Documents to SEPTA.
2. The Contractor shall participate in review meetings as required.
3. The Contractor shall make required changes and promptly deliver the Final Project As-Built Documents to SEPTA.
4. The Contractor shall sign each sheet of the record drawings, certifying that they are an accurate representation of the As-Built condition.
5. The Final approved set of As-Built Documents shall in conveyed as (1)copy of the electronic sets.

3.03 CHANGES SUBSEQUENT TO ACCEPTANCE
A. The Contractor has no responsibility for recording changes in the Work subsequent to Final Completion, except for changes resulting from work performed under Warranty.

END OF SECTION
SECTION 01830

OPERATION AND MAINTENANCE DATA

PART 1 - GENERAL

1.01 DESCRIPTION

A. Format and Content of Manuals
B. Instruction of SEPTA Personnel
C. Schedule of Submittal

1.02 RELATED WORK

Section 01300: Submittals
Section 01400: Inspection and Test Plan
Section 01600: Material and Equipment
Section 01700: Contract Closeout
Section 01720: Project As-Built Documents

1.03 SUBMITTALS

A. Submit operations and maintenance manuals for each machinery and equipment item as follows:

1. Four (4) copies of sample format and outline of contents in draft form with the equipment shop drawings for review and comment by SEPTA.
2. Four (4) copies of complete manual in final form on equipment delivery date for review and comment by SEPTA.
3. Five (5) copies of approved manual after the equipment is installed and ready to test.
4. One (1) Copy of the approved manual in PDF format.

1.04 QUALITY ASSURANCE

A. Prepare instructions and data by personnel experienced in maintenance and operation of described products.

B. General Requirements for Manuals:

1. Prepare manuals written in clear grammatical English.
2. Manuals furnished may be manufacturer’s standard publications in regard to size and binding provided they comply with specified requirements relative to quantity and quality of information data.
3. Bind manuals within hard covers. Make illustrations clear, and printed matter, including dimensions and lettering on drawings, easily legible. If reduced drawings are incorporated into manuals, heavy-up original lines and letters as necessary to retain their legibility after reduction. Larger drawings may be folded into manuals to page size.
C. Prepare manuals using the following materials:

1. Loose leaf, on 60-pound, three hole punched paper.
2. Holes reinforced with plastic cloth.
3. Page size, 11 x 8 ½ (if available) or 280 mm x 215 mm.
4. Foldout diagrams and illustrations.
5. Reproducible by dry-copy xerography method.
6. Oil, moisture and wear-resistant plastic covers.

1.05 FORMAT

A. The Contractor shall prepare data in the form of an instructional manual.

Clearly identify each manual through the front cover with at least the following information:

("description of manual)
(description of equipment or systems)

SOUTHEASTERN PENNSYLVANIA TRANSPORTATION AUTHORITY
FRANKFORD TRANSPORTATION BUILDING
(Name of Contractor)
(Date: )

B. The Contractor shall prepare a Table of Contents for each volume, with each product or system description identified, in three parts as follows:

1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, subcontractors, and SEPTA Personnel including Operations.
   a. Title page: Include the name and function of the equipment and manufacturers
   b. Table of Contents, in numerical order listing all sections and subsection titles of included diagrams and drawings
   c. Index, in alphabetical order
   d. Front piece: Recognition illustration of the equipment described in the O&M Manual.

2. Part 2: Operation and maintenance instructions, arranged by system. For each category, identify names, addresses, and telephone numbers of subcontractors and suppliers. Identify the following:
   a. Significant design criteria
   b. List of equipment,
c. Parts list for each component.
   - Manufacturer’s literature describing each piece of equipment including major assemblies and subassemblies, and giving manufacturer’s model number and drawing number.
   - “Long-Lead-Time” spare parts list for all spare parts not readily available on the open market or for which it is anticipated ordering and delivery time will exceed ten (10) days.
   - Complete list of parts and supplies, with current unit prices and sources of supply.
   - List of parts and supplies that are either normally furnished at no extra cost with purchase of equipment, or specified herein to be furnished as part of Contract.
   - List of nearest local suppliers for all equipment parts.

d. Operating Instructions
   - Operation instructions including step-by-step preparation for starting, operation, shutdown and draining and emergency requirements.
   - Control diagrams, as installed by the manufacturer.
   - Sequence of operation by the control manufacturer.
   - Wiring diagrams, as installed by the manufacturer.
   - Diagrammatic location, functions and tag numbers of each valve.

e. Maintenance instructions for equipment and systems.
   - Maintenance instruction: Include step-by-step procedures for inspection, operation checks, cleaning, lubrication, adjustments, repair, overhaul, disassembly, and reassemble of the equipment for proper operation of the equipment. Include list of special tools, which are required for maintenance with the maintenance information.
   - Possible breakdowns and repairs.
   - Lubrication schedule indicating type and frequency of lubrication.

f. Maintenance instructions for finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.

3. Part 3: Project documents and certificates, including the following:
   a. Shop drawings and product data
   b. Air and water balance reports
   c. Certificates
   d. Photocopies of warranties (and bonds).
e. Appendix: Include safety precautions, a glossary, and, if available at time of submittal, copies of test reports, and other relevant material not specified to be submitted.

1.06 CONTENTS, EACH VOLUME

A. Table of Contents: Provide title of Project; names, addresses, and telephone numbers of Architect/Engineer, Sub-consultants, and Contractor with name of responsible parties; schedule of products and systems, indexed to content of the volume.

B. For Each Product or System: List names, addresses and telephone numbers of Sub-contractors and suppliers, including local source of supplies and replacement parts.

C. Product Data: Mark each sheet to clearly identify specific products and component parts, and data applicable to installation. Delete inapplicable information.

D. Drawings: Supplement product data to illustrate relations of component parts of equipment and systems, to show control and flow diagrams. Project As-Built Documents shall not be used as maintenance drawings.

E. Typed Text: As required to supplement product data. Provide logical sequence of instructions for each procedure, incorporating manufacturer's instructions specified in Sections (01400).

1.07 MANUAL FOR MATERIALS AND FINISHES

A. Building Products, Applied Materials, and Finishes: Include product data, with catalog number, size, composition, and color and texture designatures. Provide information for re-ordering custom manufactured Products.

B. Instructions for Care and Maintenance: Include manufacturer's recommendations for cleaning agents and methods, precautions against detrimental agents and methods, and recommended schedule for cleaning and maintenance.


D. Additional Requirements: As specified in individual Product specification sections.

E. Provide a listing in Table of Contents for design data, with tabbed fly sheet and space for insertion of data.

1.08 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Each item of Equipment and each system: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

B. Panelboard Circuit Directories: Provide electrical service characteristics, controls, and communications; by machine.

C. Include color-coded wiring diagrams as installed.
D. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shutdown, and emergency instructions. Include summer, winter, and any special operating instructions.

E. Maintenance Requirements: Include routine procedures and guide for trouble-shooting, disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

F. Provide servicing and lubrication schedule, and list of lubricants required.

G. Include manufacturer’s printed operation and maintenance instructions.

H. Include sequence of operation by controls manufacturer.

I. Provide original manufacturer’s parts list, illustrations, assembly drawings, and diagrams required for maintenance.

J. Provide control diagrams by controls manufacturer as installed.

K. Provide Contractor’s coordination drawings, with color-coded piping diagrams as installed.

L. Provide charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

M. Provide list of original manufacturer’s spare parts, current prices, and recommended quantities to be maintained in storage.

N. Include test and balancing reports as specified in Section 01400.

O. Additional Requirements: As specified in individual Product specification sections.

P. Provide a listing in Table of Contents for design data, tabbed and indexed with space for insertion of data.

1.09 1.09 INSTRUCTION OF SEPTA PERSONNEL

A. Before final inspection, instruct SEPTA designated personnel in operation, adjustment, and maintenance of products, equipment, and systems, at agreed upon time.

B. For equipment requiring seasonal operation, perform instructions for other seasons within six (6) months.

C. Use operation and maintenance manuals as basis for instruction. Review contents of manual with personnel in detail to explain all aspects of operation and maintenance.

D. Prepare and insert additional data in Operation and Maintenance Manual when need for such data becomes apparent during instruction.

END OF SECTION
SECTION 02120
SITE CLEARING

PART 1 - GENERAL

1.01 SUMMARY

A. Section Includes:

1. Removing existing vegetation.
2. Clearing and grubbing.
3. Stripping and stockpiling topsoil.
4. Removing above- and below-grade site improvements.
5. Disconnecting, capping or sealing, and abandoning site utilities in place.
6. Temporary erosion- and sedimentation-control measures.

1.02 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow.

D. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is 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 more than 2 inches in diameter; and free of subsoil and weeds, roots, toxic materials, or other non-soil materials.

E. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

F. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and indicated on Drawings.

G. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.03 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other 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.
1.04 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 videotape.
   2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.
B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

1.05 QUALITY ASSURANCE
A. Preinstallation Conference: Conduct conference at Project site.

1.06 PROJECT CONDITIONS
A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.
   1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
   2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.
B. Utility Locator Service: Notify PA One Call for area where Project is located before site clearing.
C. Do not commence site clearing operations until temporary erosion- and sedimentation-control measures are in place and the preconstruction meeting with authorities having jurisdiction is complete.
D. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - EXECUTION

2.01 PREPARATION
A. Protect and maintain benchmarks and survey control points from disturbance during construction.
B. Locate and clearly identify trees, shrubs, and other vegetation to remain or to be relocated. Wrap a 1-inch blue vinyl tie tape flag around each tree trunk at 54 inches above the ground.
C. Protect existing site improvements to remain from damage during construction.
   1. Restore damaged improvements to their original condition, as acceptable to Owner.

2.02 TEMPORARY EROSION AND SEDIMENTATION CONTROL
A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent roadways, properties, inlets,
and walkways, according to approved erosion- and sedimentation-control drawings and requirements of authorities having jurisdiction.

B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established. Measures should be inspected weekly and after each storm event.

C. Remove erosion and sedimentation controls after entire site is stabilized and restore and stabilize areas disturbed during removal.

2.03 EXISTING UTILITIES

A. Locate, identify, disconnect, and seal or cap utilities indicated to be removed or abandoned in place.
   1. Arrange with utility companies to shut off indicated utilities.

B. Excavate for and remove underground utilities indicated to be removed. Hand dig as necessary.

C. Removal of underground utilities is included in earthwork sections and with applicable fire suppression, plumbing, HVAC, electrical, communications, electronic safety and security and utilities sections.

2.04 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.

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.

2.05 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to depth of 6 inches in a manner to prevent intermingling with underlying subsoil or other waste materials.
   1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more 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. 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. Dispose of surplus topsoil. Surplus topsoil is that which exceeds quantity indicated to be stockpiled or reused.
3. Stockpile surplus topsoil to allow for respreading deeper topsoil.

2.06 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.
   2. Paint cut ends of steel reinforcement in concrete to remain with two coats of antirust coating, following coating manufacturer's written instructions. Keep paint off surfaces that will remain exposed.

2.07 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 non-recyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION
SECTION 02140
DEWATERING

PART 1 - GENERAL

1.01 SUMMARY

A. Section includes construction dewatering.

B. Related Requirements:
   1. Section 02210 "Earth Moving" for excavating, backfilling, site grading, and controlling surface-water runoff and ponding.

1.02 PREINSTALLATION MEETINGS

A. Pre-installation Conference: Conduct conference at Project site.
   1. Verify availability of Installer’s personnel, equipment, and facilities needed to make progress and avoid delays.
   2. Review condition of site to be dewatered including coordination with temporary erosion-control measures and temporary controls and protections.
   3. Review geotechnical report.
   4. Review proposed site clearing and excavations.
   5. Review existing utilities and subsurface conditions.
   6. Review observation and monitoring of dewatering system.

1.03 ACTION SUBMITTALS

A. Shop Drawings: For dewatering system, prepared by or under the supervision of a qualified professional engineer.
   1. Include plans, elevations, sections, and details.
   2. Show arrangement, locations, and details of wells and well points; locations of risers, headers, filters, pumps, power units, and discharge lines; and means of discharge, control of sediment, and disposal of water.
   3. Include layouts of piezometers and flow-measuring devices for monitoring performance of dewatering system.
   4. Include written plan for dewatering operations including sequence of well and well-point placement coordinated with excavation shoring and bracings and control procedures to be adopted if dewatering problems arise.

B. Permits: Provide a copy of the permit(s) for the dewatering plan. Permit fee and renewal, if required are the responsibility of the contractor.

1.04 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and professional engineer.

B. Field quality-control reports.
C. Existing Conditions: Using photographs or video recordings, show existing conditions of adjacent construction and site improvements that might be misconstrued as damage caused by dewatering operations. Submit before Work begins.

D. Record Drawings: Identify locations and depths of capped wells and well points and other abandoned-in-place dewatering equipment.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer that has specialized in dewatering work.

B. An Industrial Waste Permit, as required by the Philadelphia Water Department should pumping to City-owned infrastructure become necessary during construction.

1.06 FIELD CONDITIONS

A. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for dewatering according to the performance requirements.

B. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Dewatering Performance: Design, furnish, install, test, operate, monitor, and maintain dewatering system of sufficient scope, size, and capacity to control hydrostatic pressures and to lower, control, remove, and dispose of ground water and permit excavation and construction to proceed on dry, stable subgrades.

1. Design dewatering system, including comprehensive engineering analysis by a qualified professional engineer.
2. Continuously monitor and maintain dewatering operations to ensure erosion control, stability of excavations and constructed slopes, prevention of flooding in excavation, and prevention of damage to subgrades and permanent structures.
3. Prevent surface water from entering excavations by grading, dikes, or other means.
4. Accomplish dewatering without damaging existing buildings, structures, and site improvements adjacent to excavation.
5. Remove dewatering system when no longer required for construction.
6. Refer to approved E&S plans, which are part of this bid package.

B. Regulatory Requirements: Comply with governing EPA notification regulations before beginning dewatering. Comply with water- and debris-disposal regulations of authorities having jurisdiction.
PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by dewatering operations.

1. Prevent surface water and subsurface or ground water from entering excavations, from ponding on prepared subgrades, and from flooding site or surrounding area.
2. Protect subgrades and foundation soils from softening and damage by rain or water accumulation.

B. Install dewatering system to ensure minimum interference with roads, streets, walks, and other adjacent occupied and 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. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Provide temporary grading to facilitate dewatering and control of surface water.

D. Protect and maintain temporary erosion and sedimentation controls per approved plans.

3.02 INSTALLATION

A. Install dewatering system utilizing wells, well points, or similar methods complete with pump equipment, standby power and pumps, filter material gradation, valves, appurtenances, water disposal, and surface-water controls.

1. Space well points or wells at intervals required to provide sufficient dewatering.
2. Use filters or other means to prevent pumping of fine sands or silts from the subsurface.

B. Place dewatering system into operation to lower water to specified levels before excavating below ground-water level.

C. Provide sumps, sedimentation tanks, and other flow-control devices as required by authorities having jurisdiction.

D. Provide standby equipment on-site, installed and available for immediate operation, to maintain dewatering on continuous basis if any part of system becomes inadequate or fails.

3.03 OPERATION

A. Operate system continuously until drains, sewers, and structures have been constructed and fill materials have been placed or until dewatering is no longer required.

B. Operate system to lower and control ground water to permit excavation, construction of structures, and placement of fill materials on dry subgrades. Drain water-bearing strata above and below bottom of foundations, drains, sewers, and other excavations.

1. Do not permit open-ump pumping that leads to loss of fines, soil piping, subgrade softening, and slope instability.
2. Reduce hydrostatic head in water-bearing strata below subgrade elevations of foundations, drains, sewers, and other excavations.

C. Dispose of water removed by dewatering in a manner that avoids endangering public health, property, and portions of work under construction or completed. Dispose of water and sediment in a manner that avoids inconvenience to others.

D. Remove dewatering system from Project site on completion of dewatering. Plug or fill well holes with sand or cut off and cap wells a minimum of 36 inches below overlying construction.

3.04 FIELD QUALITY CONTROL

A. Observation Wells: Provide two observation wells or piezometers, take measurements, and maintain.

1. Observe and record daily elevation of ground water and piezometric water levels in observation wells.

2. Repair or replace, within 24 hours, observation wells that become inactive, damaged, or destroyed. In areas where observation wells are not functioning properly, suspend construction activities until reliable observations can be made. Add or remove water from observation-well risers to demonstrate that observation wells are functioning properly.

3. Fill observation wells, remove piezometers, and fill holes when dewatering is completed.

B. Survey-Work Benchmarks: Resurvey benchmarks regularly dewatering and maintain an accurate log of surveyed elevations for comparison with original elevations. Promptly notify Architect if changes in elevations occur or if cracks, sags, or other damage is evident in adjacent construction.

C. Provide continual observation to ensure that subsurface soils are not being removed by the dewatering operation.

D. Prepare reports of observations.

3.05 PROTECTION

A. Protect and maintain dewatering system during dewatering operations.

B. Promptly repair damages to adjacent facilities caused by dewatering.

END OF SECTION
SECTION 02160
EXCAVATION SUPPORT AND PROTECTION

PART 1 - GENERAL

1.01 SUMMARY
A. Section includes temporary excavation support and protection systems.

1.02 PREINSTALLATION MEETINGS
A. Pre-installation Conference: Conduct conference at Project site.
   1. Review geotechnical report.
   2. Review existing utilities and subsurface conditions.
   3. Review coordination for interruption, shutoff, capping, and continuation of utility services.
   4. Review proposed excavations.
   5. Review proposed equipment.
   6. Review monitoring of excavation support and protection system.
   7. Review coordination with waterproofing.
   8. Review abandonment or removal of excavation support and protection system.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, performance properties, and
dimensions of individual components and profiles, and calculations for excavation
support and protection system.

B. Shop Drawings: For excavation support and protection system, signed and sealed by a
qualified professional engineer.
   1. Include plans, elevations, sections, and details.
   2. Show arrangement, locations, and details of soldier piles, piling, lagging, tiebacks,
   bracing, and other components of excavation support and protection system according to
   engineering design.
   3. Indicate type and location of waterproofing.
   4. Include a written plan for excavation support and protection, including sequence of
   construction of support and protection coordinated with progress of excavation.

C. Permit: Submit permit from Authorities having Jurisdiction to Owner and Architect for Excavation
Support and Protection Plan.

1.04 INFORMATIONAL SUBMITTALS
A. Qualification Data: For professional engineer.

B. Contractor Calculations: For excavation support and protection system. Include analysis data
signed and sealed by the qualified professional engineer responsible for their preparation.

C. Existing Conditions: Using photographs or video recordings, show existing conditions of
adjacent construction and site improvements that might be misconstrued as damage caused by
inadequate performance of excavation support and protection systems. Submit before Work begins.

D. Record Drawings: Identify locations and depths of capped utilities, abandoned-in-place support and protection systems, and other subsurface structural, electrical, or mechanical conditions.

1.05 FIELD CONDITIONS

A. Interruption of Existing Utilities: Do not interrupt any utility serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Architect no fewer than two days in advance of proposed interruption of utility.
2. Do not proceed with interruption of utility without Owner's written permission.

B. Project-Site Information: A geotechnical report has been prepared for this Project and is available for information only. The opinions expressed in this report are those of a geotechnical engineer and represent interpretations of subsoil conditions, tests, and results of analyses conducted by a geotechnical engineer. Owner is not responsible for interpretations or conclusions drawn from the data.

1. Make additional test borings and conduct other exploratory operations necessary for excavation support and protection according to the performance requirements.
2. The geotechnical report is referenced elsewhere in Project Manual.

C. Survey Work: Engage a qualified land surveyor or professional engineer to survey adjacent existing buildings, structures, and site improvements; establish exact elevations at fixed points to act as benchmarks. Clearly identify benchmarks and record existing elevations.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Provide, design, monitor, and maintain excavation support and protection system capable of supporting excavation sidewalls and of resisting earth and hydrostatic pressures and superimposed and construction loads.

1. Contractor Design: Design excavation support and protection system, including comprehensive engineering analysis by a qualified professional engineer.
2. Prevent surface water from entering excavations by grading, dikes, or other means.
3. Install excavation support and protection systems without damaging existing buildings, structures, and site improvements adjacent to excavation.
4. Continuously monitor vibrations, settlements, and movements to ensure stability of excavations and constructed slopes and to ensure that damage to permanent structures is prevented.

2.02 MATERIALS

A. General: Provide materials that are either new or in serviceable condition.

B. Structural Steel: ASTM A 36/A 36M, ASTM A 690/A 690M, or ASTM A 992/A 992M.

C. Shotcrete: Comply with Section 033713 "Shotcrete" for shotcrete materials and mixes, reinforcement, and shotcrete application.
D. Cast-in-Place Concrete: ACI 301, of compressive strength required for application.

E. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

F. Tiebacks: Steel bars, ASTM A 722/A 722M.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards that could develop during excavation support and protection system operations.

1. Shore, support, and protect utilities encountered.

B. Install excavation support and protection systems to ensure minimum interference with roads, streets, walks, and other adjacent occupied and 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. Provide alternate routes around closed or obstructed traffic ways if required by authorities having jurisdiction.

C. Locate excavation support and protection systems clear of permanent construction so that construction and finishing of other work is not impeded.

3.02 TIEBACKS

A. Drill, install, grout, and tension tiebacks.

B. Test load-carrying capacity of each tieback and replace and retest deficient tiebacks.

1. Have test loading observed by a qualified professional engineer responsible for design of excavation support and protection system.

C. Maintain tiebacks in place until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.03 BRACING

A. Bracing: Locate bracing to clear columns, floor framing construction, and other permanent work. If necessary to move brace, install new bracing before removing original brace.

1. Do not place bracing where it will be cast into or included in permanent concrete work unless otherwise approved by Architect.

2. Install internal bracing if required to prevent spreading or distortion of braced frames.

3. Maintain bracing until structural elements are supported by other bracing or until permanent construction is able to withstand lateral earth and hydrostatic pressures.

3.04 FIELD QUALITY CONTROL

A. Survey-Work Benchmarks: Resurvey benchmarks weekly during installation of excavation support and protection systems, excavation progress, and for as long as excavation remains open. Maintain an accurate log of surveyed elevations and positions for comparison with
original elevations and positions. Promptly notify Architect if changes in elevations or positions occur or if cracks, sags, or other damage is evident in adjacent construction.

B. Promptly correct detected bulges, breakage, or other evidence of movement to ensure that excavation support and protection system remains stable.

C. Promptly repair damages to adjacent facilities caused by installation or faulty performance of excavation support and protection systems.

3.05 REMOVAL AND REPAIRS

A. Remove excavation support and protection systems when construction has progressed sufficiently to support excavation and earth and hydrostatic pressures. Remove in stages to avoid disturbing underlying soils and rock or damaging structures, pavements, facilities, and utilities.

1. Remove excavation support and protection systems to a minimum depth of 48 inches below overlying construction and abandon remainder.
2. Fill voids immediately with approved backfill compacted to density specified in Section 02210 "Earth Moving."
3. Repair or replace, as approved by Architect, adjacent work damaged or displaced by removing excavation support and protection systems.

B. Leave excavation support and protection systems permanently in place.

END OF SECTION
SECTION 02210
EARTH MOVING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS


B. SEPTA guidance document #3005, MANAGEMENT PROGRAM FOR SOILS, CONSTRUCTION AND DEMOLITION DEBRIS GENERATED FROM SEPTA PROPERTY, dated May 2009, and contact System Safety for guidance. This document shall be followed for removing excess soils from site.

1.02 SUMMARY

A. Section Includes:
   1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
   2. Excavating and backfilling for buildings and structures.
   3. Drainage course for concrete slabs-on-grade.
   4. Subbase course for concrete walks and pavements.
   5. Subbase course and base course for asphalt paving.
   6. Subsurface drainage backfill for walls and trenches.
   7. Excavating and backfilling trenches for utilities and pits for buried utility structures.
   8. Excavating well hole to accommodate elevator-cylinder assembly.

1.03 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

   1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
   2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Architect. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

2. Bulk Excavation: Excavation more than 10 feet in width and more than 30 feet in length.

3. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Architect. Unauthorized excavation, as well as remedial work directed by Architect, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

H. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material that exceed 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, maximum, short-tip-radius rock bucket; rated at not less than 138-hp flywheel power with bucket-curving force of not less than 28,700 lbf and stick-crowd force of not less than 18,400 lbf with extra-long reach boom; measured according to SAE J-1179.

2. Bulk Excavation: Late-model, track-mounted loader; rated at not less than 230-hp flywheel power and developing a minimum of 47,992-lbf breakout force with a general-purpose bare bucket; measured according to SAE J-732.

I. 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.

J. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

K. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

L. Utilities: On-site underground pipes, conduits, ducts, and cables, as well as underground services within buildings.

1.04 ACTION SUBMITTALS

A. Product Data: For each type of the following manufactured products required:

1. Geotextiles.
2. Controlled low-strength material, including design mixture.
3. Geofoam.
4. Warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:

2. Warning Tape: 12 inches long; of each color.
1.05 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Material Test Reports: For each on-site soil material proposed for fill and backfill as follows:
   1. Classification according to ASTM D 2487.
   2. Laboratory compaction curve according to ASTM D 698.

C. Seismic survey report from seismic survey agency.

D. Pre-excavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces, that might be misconstrued as damage caused by earth moving operations. Submit before earth moving begins.

1.06 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

B. Pre-excavation Conference: Conduct conference at Project site.

1.07 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth moving 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 traffic ways if required by Owner or authorities having jurisdiction.
   3. Do not proceed with work on adjoining property until directed by Architect.

B. Utility Locator Service: Notify PA One Call for area where Project is located before beginning earth moving operations.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures are in place per approved E&S drawings.

PART 2 - PRODUCTS

2.01 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GP, GM, SW, SP, and SM according to ASTM D 2487 or a combination of these groups; free of rock or gravel larger than 3 inches in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.
1. Satisfactory soils also includes soils that meet the definition of clean fill as defined in the Pennsylvania Department of Environmental Protection “PADEP” Management of fill document, (Document 258-2182-773, dated April 24, 2004, modified August 7, 2010).

2. Unsatisfactory soils also include soils which do not meet the definition of clean fill as defined in the Pennsylvania Department of Environmental Protection “PADEP” Management of fill document, (Document 258-2182-773, dated April 24, 2004, modified August 7, 2010).

C. Unsatisfactory Soils: Soil Classification Groups GC, SC, CL, ML, OL, CH, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Subbase Material: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 12 percent passing a No. 200 sieve.

E. Base Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 95 percent passing a 1-1/2-inch sieve and not more than 8 percent passing a No. 200 sieve.

F. Engineered Fill: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; with at least 90 percent passing a 1-1/2-inch sieve and not more than 20 percent passing a No. 200 sieve.

G. Bedding Course: 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.

H. Drainage Course: 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.

I. 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.

J. Sand: ASTM C 33; fine aggregate.

K. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

2.02 GEOTEXTILES

A. Subsurface Drainage Geotextile: Nonwoven needle-punched geotextile, manufactured for subsurface drainage applications, made from polyolefins or polyesters; with elongation greater than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 157 lbf; ASTM D 4632.
3. Sewn Seam Strength: 142 lbf; ASTM D 4632.
4. Tear Strength: 56 lbf; ASTM D 4533.
5. Puncture Strength: 56 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 40 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.5 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours’ exposure; ASTM D 4355.

B. Separation Geotextile: Woven geotextile fabric, manufactured for separation applications, made from polyolefins or polyesters; with elongation less than 50 percent; complying with AASHTO M 288 and the following, measured per test methods referenced:

1. Survivability: Class 2; AASHTO M 288.
2. Grab Tensile Strength: 247 lbf; ASTM D 4632.
3. Sewn Seam Strength: 222 lbf; ASTM D 4632.
4. Tear Strength: 90 lbf; ASTM D 4533.
5. Puncture Strength: 90 lbf; ASTM D 4833.
6. Apparent Opening Size: No. 60 sieve, maximum; ASTM D 4751.
7. Permittivity: 0.02 per second, minimum; ASTM D 4491.
8. UV Stability: 50 percent after 500 hours’ exposure; ASTM D 4355.

2.03 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches wide and 4 mils thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 3 - EXECUTION

3.01 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations, per approved E&S plans, which are part of this bid package.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

D. Refer to geotechnical report for soil exchange requirements for foundations.
3.02 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.

3.03 EXPLOSIVES

A. Explosives are not permitted.

3.04 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials, and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.

B. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch. If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

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.

2. Pile Foundations: Stop excavations 6 to 12 inches above bottom of pile cap before piles are placed. After piles have been installed, remove loose and displaced material. Excavate to final grade, leaving solid base to receive concrete pile caps.

3. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch. Do not disturb bottom of excavations intended as bearing surfaces.

3.05 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

3.06 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.
B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: As indicated on details.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. For pipes and conduit less than 6 inches in nominal diameter, hand-excavate trench bottoms and support pipe and conduit on an undisturbed subgrade.
2. For pipes and conduit 6 inches or larger in nominal diameter, shape bottom of trench to support bottom 90 degrees of pipe or conduit circumference. Fill depressions with tamped sand backfill.
3. For flat-bottomed, multiple-duct conduit units, hand-excavate trench bottoms and support conduit on an undisturbed subgrade.
4. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

E. Saw cut sidewalks, curbs and roadways to neat lines and at nearest joints.

3.07 SUBGRADE INSPECTION

A. Notify Architect/Geotechnical Advisor when excavations have reached required subgrade.

B. If Architect/Geotechnical Advisor determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.

C. Proof-roll subgrade below the building slabs and pavements in the presence of Architect/Geotechnical Advisor with a pneumatic-tired and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons 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, repeating proof-rolling in direction perpendicular to first direction. Limit vehicle speed to 3 mph.
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Architect/Geotechnical Advisor, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for unit prices.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by Architect/Geotechnical Advisor, without additional compensation.
F. Proof-roll of rock subgrade is not applicable. Rock subgrades should be visually inspected and hand probed (where feasible) by the Architect/Geotechnical Advisor to identify soft pockets.

3.08 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.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Architect.

3.09 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.

3.10 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting 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.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

3.11 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.

B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Section 03300 "Cast-in-Place Concrete".

D. Trenches under Roadways: Provide 4-inch-thick, concrete-base slab support for piping or conduit less than 30 inches below surface of roadways. After installing and testing, completely encase piping or conduit in a minimum of 4 inches of concrete before backfilling or placing roadway subbase course. Concrete is specified in Section 03300 "Cast-in-Place Concrete".
E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of subbase material, free of particles larger than 1 inch in any dimension, to a height of 12 inches over the pipe or conduit.
   1. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Controlled Low-Strength Material: Place initial backfill of controlled low-strength material to a height of 12 inches over the pipe or conduit. Coordinate backfilling with utilities testing.

H. Place and compact final backfill of satisfactory soil to final subgrade elevation. Not to exceed 12 inch lifts.

I. Compaction Requirements:
   1. Foundations and floor slabs: Compact to at least 98%, of the laboratory determined maximum dry density, ASTM D698.
   2. Pavements: Compacted to at least 95% of the laboratory determined maximum dry density, ASTM D698.
   3. Behind walls: Compacted to at least 95% of the laboratory determined maximum dry density in accordance with ASTM D698.

J. Install warning tape directly above utilities, 12 inches below finished grade, except 6 inches below subgrade under pavements and slabs.

3.12 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use engineered fill.
   4. Under building slabs, use engineered fill.
   5. Under footings and foundations, use engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.13 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 percent of optimum moisture content.

   1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
   2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by 2 percent and is too wet to compact to specified dry unit weight.
3.14 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 12 inches in loose depth for material compacted by heavy compaction equipment, and not more than 10 inches in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations, and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under structures, building slabs and steps, compact each layer of backfill or fill soil material at 98 percent.
2. Under pavements compact each layer of backfill or fill soil material at 95 percent.
3. Under walkways, compact each layer of backfill or fill soil material at 92 percent.
4. Under turf or unpaved areas, scarify and recompact top 6 inches below subgrade and compact each layer of backfill or fill soil material at 90 percent.
5. For utility trenches dependent on location with respect to building footprint should be governed by overlying structure/pavement, compact each layer of initial and final backfill soil material at 85 percent.

3.15 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

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. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch.
2. Walks: Plus or minus 1 inch.
3. Pavements: Plus or minus 1/2 inch.

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch when tested with a 10-foot straightedge.

3.16 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Install separation geotextile on prepared subgrade according to manufacturer's written instructions, overlapping sides and ends.
2. Place base course material over subbase course under hot-mix asphalt pavement.
3. Place subbase course and base course that exceeds 6 inches in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches thick or less than 3 inches thick.

4. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

C. Pavement Shoulders: Place shoulders along edges of subbase course and base course to prevent lateral movement. Construct shoulders, at least 12 inches wide, of satisfactory soil materials and compact simultaneously with each subbase and base layer to not less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.17 FIELD QUALITY CONTROL

A. Special Inspections: Contractor to engage a qualified special inspector to perform the following special inspections:

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material and maximum lift thickness comply with requirements.

B. Testing Agency: Engage a qualified geotechnical engineering testing agency to perform tests and inspections.

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. 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.

E. 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. Paved and 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 every 100 linear 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 every 150 linear feet or less of trench length, but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.18 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 Architect; 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 greatest extent possible.

3.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus satisfactory soil and waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

B. Transport surplus satisfactory soil to designated storage areas on Owner's property. Stockpile or spread soil as directed by Architect.

1. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION
SECTION 02533

CONCRETE SIDEWALK

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. The work required under this section consists of furnishing all labor, materials, equipment, services and related items necessary to complete concrete sidewalk paving, and all related work. Complete, as indicated on the drawings or specified herein.

1.02 QUALITY ASSURANCE

A. Codes and Standards

1. Comply with all applicable portions of the Pennsylvania Department of Transportation (PENNDOT) Standard Specifications.

2. Comply with all applicable portions of the City of Philadelphia and Department of Streets standards and specifications.

3. Comply with applicable standards of the American Concrete Institute.

1.03 SUBMITTALS

Furnish samples, manufacturer's product data, test reports, materials' certifications, and as built drawings for review and approval.

1.04 JOB CONDITIONS

Traffic Control: Maintain access for vehicular and pedestrian traffic as required for other construction activities.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Concrete Materials

1. Comply with ACI 301 requirements for concrete mixtures.

2. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as indicated on the Drawings.
   b. Slump: 3 inches 
      1) Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 inches after adding admixture to plant- or site-verified, 2- to 3-inch slump.
3. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content of 6.0 percent within a tolerance of plus 1.0 or minus 1.5 percent.

B. Form Materials

Shall meet the requirements specified in the latest edition of ACI.

C. Expansion Joints

Shall meet the requirements specified in the latest edition of ACI.

D. Curing

Membrane-forming curing and sealing compound or moist curing methods. Refer to Concrete Work in Section 03300.

PART 3 - EXECUTION

3.01 SURFACE PREPARATION

A. On Crushed Stone Sub-base

1. Remove loose material from compacted Crushed Stone Sub-base surface immediately before placing concrete.

2. Proof-roll prepared Crushed Stone Sub-base surface to check for unstable areas and need for additional compaction. Do not begin paving work until such conditions have been corrected and are ready to receive paving.

3. All subgrades under paving and other work of this section must be brought to maximum density before placement of any paving work or materials. Do not place any paving materials until all subgrades over which they are to be installed have been brought to satisfactory density.

3.02 FORM CONSTRUCTION

A. Set forms to required grades and lines, rapidly braced and secured. Install sufficient quantity of forms to allow continuous progress of work and so that forms can remain in place at least twenty-four (24) hours after concrete placement.

B. Check completed formwork for grade and alignment to the following tolerances:

1. Top of forms not more than 1/8" in ten (10') feet.

2. Vertical face on longitudinal axis, not more than 1/4" in ten (10') feet.

C. Clean forms after each use, and coat with form release agent as often as required to ensure separation from concrete without damage.

3.03 CONCRETE PLACEMENT
A. General

1. Comply with applicable requirements of Division 03 Sections for mixing and placing concrete.

2. Install appurtenances in accordance with manufacturer’s specifications.

B. Do not place concrete until forms have been checked for line and grade. Moisten sub-base course if required 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.

C. Place concrete using methods which prevent segregation of mix.

D. Consolidate concrete along face of forms and adjacent to transverse joints with internal vibrator. Keep vibrator away from joint assemblies, or side forms. Use only square-faced shovels for hand spreading and consolidation.

E. Use bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.

F. Deposit and spread concrete in a continuous operation between transverse joints, as far as possible. If interrupted for more than one-half (1/2) hour, place a construction joint.

3.04 JOINTS

A. General

Construct expansion, weakened-plane (contraction), and construction joints true-to-line with face perpendicular to surface of concrete. Construct transverse joints at right angles to the centerline, unless otherwise indicated. When joining existing structures, place transverse joints to align with previously placed joints, unless otherwise indicated.

B. Weakened-Plane (Contraction) Joints

Provide weakened-plan (contraction) joints, sectioning concrete into areas as shown on drawings. Construct weakened-plane joints for a depth as shown on the drawings.

1. Tooled Joints: Form weakened-plane joints in fresh concrete by grooving top portion with a recommended cutting tool and finish edges with a jointer.

C. Construction Joints

Place construction joints at end of placements and at locations where placement operations are stopped for a period of more than one-half (1/2) hour, except when such placements terminate at expansion joints. Construct joints as shown or, if not shown, use standard metal keyway-section forms.

D. Expansion Joints

1. Provide expansion joints at locations shown on the drawings including joints abutting concrete curbs, inlets, structures, and other fixed objects, unless otherwise indicated.

2. Place expansion joints at thirty (30’) feet o.c. maximum in sidewalk areas.

3.05 CONCRETE FINISHING
A. After striking-off and consolidating concrete, smooth surface by screeding and floating. Use hand methods only where mechanical floating is not possible. Adjust floating to compact surface and produce uniform texture.

B. After floating, test surface for trueness with a ten (10') foot straightedge. Distribute concrete as required to relieve surface irregularities, and refloat repaired areas to provide a continuous smooth finish.

C. After completion of floating and troweling when excess moisture or surface sheen has disappeared, complete surface finishing, with a light broom finish as shown on the drawings.

D. Do not remove forms for twenty-four (24) hours after concrete has been placed. After form removal, clean ends of joints and point-up any minor honeycombed areas. Remove and replace areas or sections with major defects, as directed by the Construction Manager.

### 3.06 CURING

A. Protect and cure finished concrete paving, complying with applicable requirements of Division 03 Sections. Use membrane-forming curing and sealing compound or approved moist curing methods.

### 3.07 REPAIRS AND PROTECTIONS

A. Repair and replace broken or defective concrete, as directed by the Construction Manager, and where shown on the drawings.

B. Protect concrete from damage until acceptance of work. Exclude traffic from sidewalk for at least fourteen (14) days after placement. When construction traffic is permitted, maintain pavement as clean as possible by removing surface stains and spillage of materials as they occur.

C. Sweep concrete pavement and wash free of stains, discoloration, dirt and other foreign material just prior to final inspection.

**TECHNICAL SUBMITTAL REQUIREMENTS**

**PORTLAND CEMENT CONCRETE SIDEWALK PAVING**

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A = For Approval     I = For Information     S = Sample

END OF SECTION
SECTION 02667
WATER DISTRIBUTION

PART 1 – GENERAL

1.01 QUALITY ASSURANCE

A. Quality Certification Standards: Precast Concrete Products, Gray Iron Castings, Ready-Mixed Concrete, and Standard Pressure Gate Valves, and Ductile Iron Pipe and Fittings shall conform to QC-1, QC-2, QC-3, QC-4, QC-5, and QC-8 respectively.

B. DI Pipe and Fittings: In addition to the standard acceptance tests, the manufacturer shall perform a special test for ductility (either the ball impression test or the ring test).

C. Water service installation work is subject to the inspection and approval of the Philadelphia Water Department.

1.02 REFERENCES

A. All water main work under this contract shall be governed by, and done in accordance with the most recent revision or amendment to the Standard Specifications and Standard Details of the Philadelphia Water Department, including, but not limited to, the following:

1. Water Main Details & Corrosion Control Specifications.
2. Quality Certification Standard QC-1 for Precast Concrete Products.
5. Quality Certification Standard QC-4 for Welded Steel Inlet Frames and Grates.
6. Quality Certification Standard QC-5 for Standard Pressure Gate Valves (3" Dia. Through 12" Dia.).
8. Quality Certification Standard SIP 86/01 for Lining & Coating of Steel Water Mains.

B. All materials and workmanship shall conform to the most recent revision or amendment to the following standards, except as modified by the Contract Documents:

1. ANSI/AWWA C153/A21.53, American National Standard for Compact Ductile-Iron Fittings, 3 in. Through 24 in. (76 mm Through 610 mm) and 54 in. Through 64 in. (1,400 mm Through 1,600 mm), for Water Service.
5. ANSI/AWWA C151/A21.51, American National Standard for Ductile-Iron Pipe, Centrifugally Cast in Metal Molds or Sand-Lined Molds, for Water or Other Liquids.
10. ASTM B 62, Standard Specification for Composition Bronze or Ounce Metal Castings.

1.03 SUBMITTALS

A. DI Pipe and Fittings: Submit all pipe and fittings to the Construction Manager, Manufacturer's Affidavit that the ANSI/AWWA standard inspection and tests have been made on each casting, and that the results thereof comply with the applicable ANSI/AWWA standards. Certify the following: type of casting; number of pipe or fitting; date of cast; material of composition; weight of pipe or fitting; test bar report; report of hydrostatic test on pipe.

B. Corporation Stops, Curb Boxes, Curb Stops, Valve Boxes, Meters, Meter Pits and accessories and Reduced Pressure Zone facilities: Submit catalog cuts or other documentation establishing conformity to contract requirements.

1.04 SEQUENCING AND SCHEDULING

A. Sequencing and scheduling for this work will be determined by the Construction Manager.

B. Notify the PWD one week in advance of all connections to be made to existing water mains. The Water Department will cooperate in arranging all necessary water main shutdowns, subject to satisfactory operation of the water distribution system. All shutdowns will be performed by Water Department forces, and without cost to the Contractor. There will be no additional payment for delays in accomplishing shutdowns.

C. Notify the PWD 24 hours in advance of all necessary interruptions to existing water service connections. No service may be interrupted without the PWD’s prior approval.

1.05 SCOPE OF WORK

A. Excavation for water mains shall include:

1. Excavation limits for water service as shown in the Standard Details for Water Mains.
2. Excavation, backfilling, and compacting in connection with DI pipe, DI fittings, gate valves, concrete anchors and fire hydrants.

B. DI pipe of the various sizes with extruded polyethylene coating as indicated shall include:
1. The following and all appurtenant work and materials: furnishing and installing DI pipe; cement lining; corrosion control; a three inch layer of cellular glass insulation for mains laid with less than 3'-6" cover; cutting and plugging; making connections; testing; disinfecting; joint restraints.

C. Compact DI fittings with field applied external coating indicated shall include:

1. The following and all appurtenant work and materials: furnishing and installing fittings; cement lining; corrosion control; making connections; disinfecting; testing; hardware; gaskets; glands and joint materials.

D. Gate valves of the various sizes shall include:

1. The following and all appurtenant work and materials: furnishing and installing gate valves; valve boxes; corrosion control; making connections; disinfecting; testing.

E. Not used

F. Concrete anchors shall include:

1. The following and all appurtenant work and materials: furnishing and installing 4000 psi concrete anchors; miscellaneous iron and steel for harnessing; corrosion control work; form work, stripping; tar paper.

G. Paving work in accordance with standard specifications of the Philadelphia Streets Department and of PennDOT shall include:

1. The following and all appurtenant work and materials; furnishing and placing all paving items (e.g., concrete base, bituminous binder, wearing courses, curb, footway and driveway paving).

H. Maintenance and protection of traffic during water main work shall include:

1. The following and all appurtenant work and materials: providing, placing, maintaining, and removing all required signs, barricades, and warning devices; steel plates for decking; bridging; temporary cartway and footway paving; removal and replacement of paving where necessary for decking; excavating, backfilling, and compacting; and cartway, footway, driveway, and curb restoration. Obtain all applicable permits including time restrictions for work, use of City Police, etc.

PART 2 – PRODUCTS

2.01 BACKFILL

A. If required by the Construction Manager, furnish sand backfill for pipe zone in accordance with ASTM C 33 (fine aggregate) and the following:

1. Gradation:

   a. Sieve Number  200  100  50  16  4
   b. Percent Passing 0-5  0-8  5-30  50-98  98-100
2. pH: between 5.5 and 8.5.
3. Electrical Resistivity: 10,000 ohm-centimeters, minimum.
4. Character: clean, free from lumps of clay or other deleterious substances.

B. Structural backfill material shall be used as shown on the drawings. (Refer to Geotechnical Report)

C. The use of slag as structural backfill material is hereby prohibited.

2.02 DI PIPE

A. Furnish ductile iron pipe in accordance with AWWA C151 and C150/A21.50. Furnish gaskets in accordance with AWWA C111. Furnish all pipe with double-thickness cement lining in accordance with AWWA C104. All pipe classes shall be as shown on the plans.

B. Cast into, stamp or paint on each pipe: the manufacturer's mark; casting number; year of cast; "DI"; class of pipe. Markings shall be clear and legible.

C. Furnish DI pipe with extruded polyethylene coating in accordance with W-23.9.

2.03 DI FITTINGS

A. Furnish compact DI fittings in accordance with AWWA C153 for Crosses 3" through 16"; and bends, tees, reducers and sleeves 3" through 24".

B. Furnish DI fittings (rated at least 350 psi) in accordance with AWWA C110 for offsets, caps and plugs 3" through 12".

C. Furnish DI fittings (rated at least 250 psi) in accordance with AWWA C110 for crosses, bends, tees, sleeves, and reducers 30" through 48"; offsets 14" through 16"; and caps and plugs 14" through 48".

D. Furnish gaskets, glands, nuts and bolts in accordance with AWWA C111. Furnish all fittings with double-thickness cement lining in accordance with AWWA C104. Bolts shall be high-strength, low-alloy steel.

E. Cast into, stamp or paint on each fitting: the manufacturer's mark; casting number; year of cast; "DI"; weight before cement lining; pressure rating. Markings shall be clear and legible.

F. Furnish flange fittings and mechanical joint or push-on fittings as noted on the plans.

G. Furnish approved retainer glands where shown in the Standard Details for Water Mains, and as required in the Contract Documents. Retainer glands up to 16" shall be 350 psi rating.

H. Extruded polyethylene coating is required by the Contract Documents. Furnish a composite tape system in accordance with W-23.9 to be field applied to all fittings.

2.04 STANDARD PRESSURE GATE VALVES

A. Furnish standard pressure gate valves in accordance with W-16. Furnish gate valves with vertical stems wherever the stated depth of cover permits, unless otherwise shown on the Plans. Furnish retainer glands for all joints.

B. Furnish standard cast iron valve boxes as shown in the Standard Details for Water Mains.
2.05  Not Used

2.06  CONCRETE ANCHORS

A. Furnish ready-mixed 4000 psi concrete in accordance with ASTM C 94 and QC-3. Use only Type
1 Portland cement of American manufacture. Use maximum one inch coarse aggregate (size 5, 56, 57, 6, or 7).

2.07  COMPOSITION BRONZE CASTINGS

A. Where copper-based component castings are required for fittings, valves, and corporation stop
ferrules, furnish castings in accordance with AWWA C 800 and ASTM B 584. Use only Copper
Alloy UNS No. C 83600 (Composition Bronze, commercial 85-5-5-5 alloy) in accordance with
ASTM B 62 for this work. This alloy consists, nominally, of 85% copper, 5% tin, 5% lead, and 5%
znlt. Do not use alloys containing more than 5% lead for castings which will come into contact
with potable water.

2.08  PIPE GASKET LUBRICANT

A. Furnish lubricant for lubricating rubber gaskets used in push-on joint or mechanical joint pipe
assemblies. Pipe gasket lubricant shall be odorless and suitable for use in potable water
systems. Furnish Blue Lube pipe gasket lubricant as manufactured by Whitlam Chemicals, 200
W. Walnut Street, P.O. Box 71, Wadsworth, Ohio, 44281-0071 (1-800-321-8358) or approved
equal. Alternatives to the Blue Lube lubricant must be approved by the Construction Manager.

2.09  PIPE END PLUGS

A. All DI Pipe shall be capped upon delivery. Furnish commercially manufactured plugs for the
purpose of plugging the ends of 8” pipe, which awaits installation at the job site. The plugs shall
fit tightly so as to be secure in the ends of the pipe. The plug’s design shall prevent over insertion
into the pipe.

B. Other sizes of pipe may be capped by securely taping six-millimeter polyethylene plastic over
their ends.

PART 3 – EXECUTION

3.01  MAINTENANCE AND PROTECTION OF TRAFFIC DURING CONSTRUCTION

A. Maintain and protect traffic during construction as required by the Streets Department.

3.02  EXCAVATING

A. Excavate in accordance with City Standards, Earthwork. Excavation will not be classified,
whether by type of material encountered, or by type of equipment required.

B. Use sheathing and shoring sufficient to avoid damage to or settlement of adjacent paving and
underground structures.

C. Use of a Hydro-Hammer or similar equipment for breaking existing paving is hereby prohibited.
3.03 INSTALLING WATER MAINS

A. Install pipe, fittings, valves, hydrants, anchors, and all appurtenances in accordance with the Contract Documents, and in accordance with AWWA C600 and the manufacturer's recommendations as they apply.

B. Place backfill in trench before placing pipe, fittings, valves, etc. grade and compact to uniform bearing for full length of each pipe section. Use wood template to assure a straight trench bottom, free of humps and hollows, and at the required grade. Correct all irregularities by leveling, filling, and tamping. Use no blocking. Provide bell groove at each joint, with at least 2 inches clearance below bell.

C. Maintain at least 6 inches clearance between water mains and other underground structures.

D. Cut and plug existing water mains as directed by the Construction Manager.

E. Between any two mechanical-joint fittings, use at most one piece of pipe shorter than standard length.

F. Furnish a non-toxic vegetable soap lubricant in sufficient quantities to provide proper fitting for each connection.

G. Restrain all pipe joints within 12 feet of a bend, branch of a tee, valve, or hydrant.

H. Place concrete anchors in accordance with Standard Details for Water Mains.

I. Where the Corrosion Control plans require electrolysis corrosion control work, perform such work as shown on the plan(s) and in accordance with W-23. Extruded polyethylene coating system is required by the Contract Documents, install DI pipe with extruded polyethylene coating and apply composite tape system to all fittings in accordance with W-23.9.

J. Disinfect all new water mains in accordance with W-22 and AWWA C651.

K. Test new water mains in accordance with AWWA C600, Section 4. Take all necessary precautions to prevent test pressure from entering adjoining distribution system. Test distribution mains at 150 psi for at least one hour. Hydrostatic test shall be completed with no measurable drop in pressure. Upon a drop in pressure, determine the amount of leakage by measuring the additional quantity of water that is pumped into the main to maintain pressure within 5 psi of the specified test pressure. Where the measured leakage exceeds the established allowable amounts then the Contractor shall, at his own expense, locate and make approved repairs as necessary until the leakage is within the specified allowance. Repair all visible leaks, regardless of the amount of leakage.

L. Set valve boxes to grade, true and plumb, with valve operating nut centered in box.

M. For mains that are installed with less than 3'-6" cover provide a 3" layer of cellular glass insulation per the City of Philadelphia's standard details.

3.04 BACKFILLING AND COMPACTING

A. Place and compact backfill in accordance with the City's Standards, except as herein modified. (Refer to Geotechnical Report)
B. Do not place backfill around any structure requiring time to gain strength (e.g., masonry or concrete), until so directed by the Construction Manager.

C. Placement of sand backfill and structural backfill material for buried water mains:

1. If required by the Construction Manager, place sand backfill as described in the Standard Details for Water Mains (as amended).
2. Unless indicated otherwise on the drawings, place structural backfill material (with all stones and other objectionable material removed) or up to subgrade elevation over all water mains as directed by the Construction Manager.
3. Compact backfill under pipes and fittings by mechanical tamping. Compact backfill around and over pipes and fittings by hand tamping in 8 inch layers. Compact all other backfill in 8 inch layers by mechanical tamping. Puddling is prohibited.

3.05 Not Used

3.06 PIPE STORAGE

A. Pipes shall be inspected and verified to be clean immediately upon delivery and then plugged so soil, trash, and other contaminates cannot easily enter them while they await installation. Pipes brought to the site with debris shall be cleaned and swabbed before plugging. Inspect pipes for missing caps regularly and replace immediately. During installation inspect pipes upon removing plugs in order to ensure no debris is present.
SECTION 02730
SANITARY SEWERAGE

PART 1 – GENERAL

1.01 SUMMARY
A. This Section includes gravity-flow, non-pressure sanitary sewerage outside the building, with the following components:
   1. Cleanouts.

1.02 PERFORMANCE REQUIREMENTS
A. Gravity-Flow, Non-pressure, Drainage-Piping Pressure Rating: 10-foot head of water.
B. All methods, materials and workmanship shall be in conformance with Philadelphia Water Department Standards.

1.03 SUBMITTALS
A. Product Data: Submit Manufacturers technical product data ain installation instructions for sanitary sewerage system materials and product.
B. Coordination Drawings: Submit shop drawing for sanitary sewer system lateral connections from building to public connection, showing piping materials, size locations, and inverts in relation to existing and proposed features. Show manholes and other structures, pipe sizes, locations, and elevations. Include details of underground structures, connections, traps, fresh air inlet and manholes.
C. Field quality-control test reports.
D. Record Drawings: At project closeout submit record drawings of installed sanitary sewer and products.

1.04 DELIVERY, STORAGE, AND HANDLING
A. Do not store plastic structures, pipe, and fittings in direct sunlight.
B. Protect pipe, pipe fittings, and seals from dirt and damage.

1.05 PROJECT CONDITIONS
A. Site Information: Perform site survey, research public utility records, and verify existing utility locations.
PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. 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.

2.02 PIPING MATERIALS

A. Refer to Part 3 "Piping Applications" Article for applications of pipe, fitting and joining materials.

2.03 DUCTILE-IRON SEWER PIPE: ASTM A 746, FOR PUSH-ON JOINTS

A. Standard-Pattern, Ductile-Iron Fittings: AWWA C110, ductile or gray iron, for push-on joints.

2.04 SPECIAL PIPE COUPLINGS AND FITTINGS

A. Ductile-Iron, Flexible Expansion Joints: Compound 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, rated for 250-psig minimum working pressure and for offset and expansion indicated. Include PE film, pipe encasement.

2.05 CLEANOUTS

A. Gray-Iron Cleanouts: ASME A112.36.2M, round, gray-iron housing with clamping device and round, secured, scoriated, gray-iron cover. Include gray-iron ferrule with inside calk or spigot connection and countersunk, tapered-thread, brass closure plug.

1. Available Manufacturers:
   b. MIFAB Manufacturing Inc.
   d. Wade Div.; Tyler Pipe.
   e. Watts Industries, Inc.
   g. Zurn Specification Drainage Operation; Zurn Plumbing Products Group.

2. Top-Loading Classification: Heavy duty.

3. Sewer Pipe Fitting and Riser to Cleanout: ASTM A 74, Service class, cast-iron soil pipe and fittings.

PART 3 – EXECUTION

3.01 PIPING APPLICATIONS

A. General: Include watertight joints.
B. Pipe couplings and 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. Shielded 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.

C. Gravity-Flow, Non-pressure Sewer Piping: Use any of the following pipe materials for each size range:

1. NPS 6 and NPS 8: Ductile-iron sewer pipe; standard-pattern, ductile-iron fittings; gaskets; and gasketed joints.
2. NPS 8 and NPS 12: Ductile-iron sewer pipe; standard-pattern, ductile-iron fittings; gaskets; and gasketed joints.

3.02 PIPING INSTALLATION

A. General Locations and Arrangements: Drawing plans and details indicate general location and arrangement of underground sanitary sewerage piping. Location and arrangement of piping layout take design considerations into account. Install piping as indicated, to extent practical.

B. Where specific installation is not indicated, follow piping manufacturer's written instructions.

C. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.

D. Install manholes for changes in direction, unless fittings are indicated. Use fittings for branch connections, unless direct tap into existing sewer is indicated.

E. 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.

F. Install gravity-flow, non-pressure, drainage piping according to the following:

1. Install piping pitched down in direction of flow, at minimum slope of 2 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 36-inch minimum cover.

G. Install ductile-iron piping according to AWWA C600.

H. 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.
3.03 PIPE JOINT CONSTRUCTION

A. Basic piping joint construction is specified in Division 2. Where specific joint construction is not indicated, follow piping manufacturer's written instructions.

B. Join gravity-flow, nonpressure, drainage piping according to the following:

   a. Install PE film, pipe encasement over ductile-iron sewer pipe and ductile-iron fittings according to ASTM A 674 or AWWA C105.

C. Ductile-Iron Sewer Pipe with Ductile-Iron Fittings: According to AWWA C600.

1. Join dissimilar pipe materials with non-pressure-type, flexible couplings.

2. Install PE film, pipe encasement over ductile-iron sewer pipe and ductile-iron fittings according to ASTM A 674 or AWWA C105.

3.04 CLEANOUT INSTALLATION

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 heavy-duty, top-loading classification cleanouts.

B. Set cleanout frames and covers in earth in cast-in-place-concrete block, 18 by 18 by 12 inches deep. Set with tops 1 inch above surrounding grade of landscape areas and flush with hardscapes.

3.05 CONNECTIONS

A. Connect non-pressure, gravity-flow drainage piping to building's sanitary building drains.

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 4000 psi.

3.06 FIELD QUALITY CONTROL

A. Clear interior of piping and structures of dirt and superfluous material as work progresses. Maintain swab or drag in piping, and pull past each joint as it is completed.

1. Place plug in end of incomplete piping at end of day and when work stops.

2. Flush piping between manholes and other structures to remove collected debris, if required by authorities having jurisdiction.

B. 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. 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. Re-inspect and repeat procedure until results are satisfactory.

C. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to requirements of authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.
   5. Hydrostatic Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction and the following:
      a. Allowable leakage is maximum of 50 gal./inch of nominal pipe size per mile of pipe, during 24-hour period.
      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.
      f. Option: Test ductile-iron piping according to AWWA C600, "Hydrostatic Testing" Section. Use test pressure of at least 10 psig.
   6. Air Tests: Test sanitary sewerage according to requirements of authorities having jurisdiction, UNI-B-6, and the following:
      a. Option: Ductile-Iron Piping: Test according to AWWA C600, Section "Hydraulic Testing."

D. Leaks and loss in test pressure constitute defects that must be repaired.

E. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

END OF SECTION
SECTION 02820
CHAIN LINK FENCING AND GATES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 DESCRIPTION OF WORK
A. Work under this heading shall include furnishing all labor, materials, tools, equipment, supervision and accessories to construct the chain link fencing and gate work described herein, indicated on the drawings or normally and reasonably required. Work under this section includes, but is not limited to the following:
1. Chain Link Fencing, Gates and Fittings
2. Concrete Footings

1.03 COORDINATION
A. Coordinate chain link fencing work with that of other work indicated on the drawings and in these specifications to facilitate and insure proper and timely completion of all parts of the work.

1.04 SUBMITTALS
A. The Contractor is required to submit all of the Shop Drawings and Product Data Sheets listed below:
1. Shop Drawings: Gates
2. Product Data Sheets:
   Chain Link Fence System (all components)

1.05 APPLICABLE STANDARDS
A. ASTM F567 Standard Practice for Installation of Chain Link Fence.

1.06 WORKMANSHP
A. All chain link fencing work shall be performed by skilled workers under the supervision of a foreman experienced in chain link fencing work.

1.07 COMPLETE UNIT
A. Chain link fencing and gates shall be a complete system provided by a single supplier including necessary erection accessories, fittings and fastenings.
PART 2 - PRODUCTS

2.01 GENERAL

A. All chain link fence components shall be hot-dipped galvanized.

2.02 FENCE FABRIC

A. All chain link fencing and gates shall be 9 gauge galvanized steel chain link fence fabric conforming to ASTM F-668-Type 2B, woven into a 2” mesh.

2.03 FRAME WORK

A. Standard weight Schedule 40 steel pipe, hot-dipped galvanized inside and outside per ASTM F-1083.

2.04 FITTINGS

A. Galvanized steel.

2.05 TIE WIRES

A. 9 gauge galvanized steel wire.

PART 3 - EXECUTION

3.01 GENERAL

A. Chain link fencing work shall be accurately laid out and installed in strict accordance with the drawings, shop drawings, specifications and with applicable manufacturer’s recommendations. They shall be complete in all details, securely installed with no structural defects or marred or damaged surfaces. Gates shall be at proper elevations to function as intended.

3.02 POSTS

A. All posts shall be set in concrete footings, as detailed, with straight alignment and vertical position. Posts shall be spaced uniformly and not further apart than 10’ o.c. Each post shall have a post top designed to exclude moisture from the post.

3.03 RAILS

A. Install rails in horizontal alignment as detailed and securely attach to posts to the rails.

3.04 FABRIC

A. The chain link fabric shall be drawn taut without kinks or bends and shall be firmly secured to posts with stretcher bars, clamps and tie wires. Knuckle fabric at both selvages.

3.05 GATES

A. Gate frames shall be joined at the corners using specially designed corner fittings. Gate frame members (horizontal and vertical) shall be adequate to ensure proper gate operation and attachment of fabric, hardware and accessories.
B. Double gates shall have flush plates with anchors to receive center drop rods or plunger bars in the open and closed position. Provide locking device and padlock eyes as an integral part of the latch requiring only one padlock for locking both gate leaves.

C. All gates hinges shall permit 180° gate opening.

END OF SECTION
SECTION 02930
SOIL PREPARATION

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section includes planting soils specified by composition of the mixes:
   1. Planting Soil Mix for landscaped areas.
B. Related Requirements:
   1. Section 02120 "Site Clearing" for topsoil stripping and stockpiling.
   2. Section 02936 "Turf Seeding" for installation of lawn seed.
   3. Section 02940 "Plants" for installation of trees, shrubs, and groundcover.

1.03 REFERENCES
B. USDA: United States Department of Agriculture: Texture Triangle Classification.

1.04 DEFINITIONS
B. Backfill: The earth used to replace or the act of replacing earth in an excavation. This can be amended or unamended soil as indicated.
C. CEC: Cation exchange capacity.
D. Compost: The product resulting from the controlled biological decomposition of organic material that has been sanitized through the generation of heat and stabilized to the point that it is beneficial to plant growth.
E. Duff Layer: A surface layer of soil, typical of forested areas, that is composed of mostly decayed leaves, twigs, and detritus.
F. Imported Soil: Soil that is transported to Project site for use.
G. Manufactured Soil: Soil produced by blending soils, sand, stabilized organic soil amendments, and other materials to produce topsoil or planting soil.

H. NAPT: North American Proficiency Testing Program. An SSSA program to assist soil-, plant-, and water-testing laboratories through interlaboratory sample exchanges and statistical evaluation of analytical data.

I. Organic Matter: The total of organic materials in soil exclusive of undecayed plant and animal tissues, their partial decomposition products, and the soil biomass; also called "humus" or "soil organic matter."

J. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified as specified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.


L. SSSA: Soil Science Society of America.

M. Subgrade: Surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

N. 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.

O. 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.

P. USCC: U.S. Composting Council.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include recommendations for application and use.
   2. Include test data substantiating that products comply with requirements.
   3. Include sieve analyses for aggregate materials.
   4. Material Certificates: For each type of imported soil, soil amendment and fertilizer before delivery to the site, according to the following:
      a. Manufacturer's qualified testing agency's certified analysis of standard products.
      b. Analysis of fertilizers, by a qualified testing agency, made according to AAPFCO methods for testing and labeling and according to AAPFCO's SUIP #25.
      c. Analysis of nonstandard materials, by a qualified testing agency, made according to SSSA methods, where applicable.

B. Test Reports: Written report including results outlined in section 1.9 Testing Requirements.
1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For each testing agency.
B. Field quality-control reports.

1.07 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent, state-operated, or university-operated laboratory; experienced in soil science, soil testing, and plant nutrition; with the experience and capability to conduct the testing indicated; and that specializes in types of tests to be performed.

1.08 SOIL-SAMPLING REQUIREMENTS

A. General: Extract soil samples according to requirements in this article.
B. Sample Collection and Labeling: Have samples taken and labeled by Contractor or Soil Scientist in presence of Engineer or Landscape Architect, under the direction of the testing agency.

1. Number and Location of Samples: Minimum of three representative soil samples where directed by Engineer or Landscape Architect for each soil to be used or amended for landscaping purposes.
2. Procedures and Depth of Samples: According to USDA-NRCS's "Field Book for Describing and Sampling Soils."
3. Division of Samples: Split each sample into two, equal parts. Send half to the testing agency and half to Owner for its records.
4. Labeling: Label each sample with the date, location keyed to a site plan or other location system, visible soil condition, and sampling depth.

1.09 TESTING REQUIREMENTS

A. General: Perform tests on soil samples according to requirements in this article.
B. Physical Testing:

1. Soil Texture: Soil-particle, size-distribution analysis by one of the following methods according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
   a. Sieving Method: Report sand-gradation percentages for very coarse, coarse, medium, fine, and very fine sand; and fragment-gradation (gravel) percentages for fine, medium, and coarse fragments; according to USDA sand and fragment sizes.
2. Total Porosity: Calculate using particle density and bulk density according to SSSA's "Methods of Soil Analysis - Part 1-Physical and Mineralogical Methods."
C. Chemical Testing:

1. CEC: Analysis by sodium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 3- Chemical Methods."
2. Clay Mineralogy: Analysis and estimated percentage of expandable clay minerals using CEC by ammonium saturation at pH 7 according to SSSA's "Methods of Soil Analysis - Part 1- Physical and Mineralogical Methods."
3. Phytotoxicity: Test for plant-available concentrations of phytotoxic minerals including aluminum, arsenic, barium, cadmium, chlorides, chromium, cobalt, copper, lead, lithium, mercury, nickel, selenium, silver, sodium, strontium, tin, titanium, vanadium, and zinc.

D. Fertility Testing: Soil-fertility analysis according to standard laboratory protocol of SSSA NAPT NEC-67, including the following:

1. Percentage of organic matter.
2. CEC, calcium percent of CEC, and magnesium percent of CEC.
3. Soil reaction (acidity/alkalinity pH value).
4. Buffered acidity or alkalinity.
6. Phosphorous ppm.
7. Potassium ppm.
8. Manganese ppm.
10. Zinc ppm.
11. Zinc availability ppm.
12. Copper ppm.
13. Sodium ppm and sodium absorption ratio.
15. Presence and quantities of problem materials including salts and metals cited in the Standard protocol. If such problem materials are present, provide additional recommendations for corrective action.
16. Other deleterious materials, including their characteristics and content of each.


F. Recommendations: Based on the test results, state recommendations for soil treatments and soil amendments to be incorporated to produce satisfactory planting soil suitable for healthy, viable plants indicated. Include, at a minimum, recommendations for nitrogen, phosphorous, and potassium fertilization, and for micronutrients.

1. Fertilizers and Soil Amendment Rates: State recommendations in weight per 1000 sq. ft. for 6-inch depth of soil.
2. Soil Reaction: State the recommended liming rates for raising pH or sulfur for lowering pH according to the buffered acidity or buffered alkalinity in weight per 1000 sq. ft. for 6-inch depth of soil.

1.10 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials:

1. Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and compliance with state and Federal laws if applicable.
2. Store packaged material with protection from weather or other conditions which would damage or impair the effectiveness of the product.

3. Packaged material which has become wet, moldy, or otherwise damaged in transit or storage will be rejected.

B. Bulk Materials:

1. Store bulk materials in areas as indicated on the plans or as directed by the Engineer/Landscape Architect. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas, plants, or within the drip line of existing trees.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials, discharge of soil-bearing water runoff, and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Do not move or handle materials when they are wet or frozen.

4. Accompany each delivery of bulk fertilizers and soil amendments with appropriate certificates.

PART 2 - PRODUCTS

2.01 PLANTING SOILS SPECIFIED BY COMPOSITION

A. General: Soil amendments, fertilizers, and rates of application specified in this article are guidelines that may need revision based on testing laboratory's recommendations after preconstruction soil analyses are performed.

B. Definition: Topsoil shall be acceptable friable loam that is reasonably free of subsoils, clay lumps, litter, roots or other plant materials, stones larger than 1" in any direction, and other foreign materials. Topsoil shall have a minimum 60% passing through the No. 10 (2 mm) sieve as defined by AASHTO T88.

C. Topsoil for Planting Soil Mixes:

1. Existing Topsoil: On-site surface soil modified as necessary to produce acceptable topsoil, meeting the following:
   a. Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
   b. Unacceptable properties:
      1. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
      2. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
      3. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inch in any dimension
2. Imported Topsoil: Topsoil naturally formed soil from off-site sources.
   a. Sources: Take imported, unamended soil from sources that are naturally well-drained sites where topsoil occurs at least 4 inches deep, not from agricultural land, bogs, or marshes; and that do not contain undesirable organisms; disease-causing plant pathogens; or obnoxious weeds and invasive plants including, but not limited to, quackgrass, Johnsongrass, poison ivy, nutsedge, nimblewill, Canada thistle, bindweed, bentgrass, wild garlic, ground ivy, perennial sorrel, and bromegrass.
   b. Additional Properties of Imported Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
   c. Unacceptable Properties: Clean soil of the following:
      1. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
      2. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 8 percent by dry weight of the imported soil.
      3. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inch in any dimension.

3. Manufactured Topsoil: Topsoil consisting of manufacturer's basic topsoil blended in a manufacturing facility with sand, stabilized organic soil amendments, and other materials to produce viable planting soil.
   a. Additional Properties of Manufacturer's Basic Soil before Amending: Soil reaction of pH 6 to 7 and minimum of 4 percent organic-matter content, friable, and with sufficient structure to give good tilth and aeration.
   b. Unacceptable Properties: Manufactured soil shall not contain the following:
      1. Unacceptable Materials: Concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.
      2. Unsuitable Materials: Stones, roots, plants, sod, clay lumps, and pockets of coarse sand that exceed a combined maximum of 5 percent by dry weight of the manufactured soil.
      3. Large Materials: Stones, clods, roots, clay lumps, and pockets of coarse sand exceeding 1 inch in any dimension.

B. PLANTING SOIL MIX for lawn and landscaped areas.

1. Planting Soil Mix shall be an amended topsoil meeting the following:
   a. Texture of soil shall conform to the classification within the USDA triangle for Sandy Loam or Loamy Sand. Planting Soil Mix shall have the following particle size distribution, as determined by pipette method in compliance with ASTM F-1632:
      
      Sand:  40% to 60% (0.05mm to 2 mm)  
      Silt: 5% to 25%  (0.002mm to 0.05mm)  
      Clay: 5% to 15%  (less than 0.002 mm)
b. Organic content of Planting Soil Mix shall have a range of 2% to 10% by weight as
determined by the appropriate testing method listed herein. Adjust organic content of
Planting Mix prior to placing the soil and finished grading.

c. The pH of the Planting Soil Mix shall have a range of 6.0 to 7.0. Extremes shall be
avoided.

d. The Planting Soil Mix shall also be amended with fertilizer and lime as recommended
by the Soil Test Report and to meet requirements.

2.02 INORGANIC SOIL AMENDMENTS

A. Lime: ASTM C 602, agricultural liming material containing a minimum of 85 percent calcium
and magnesium carbonates.

   1. Form: Provide lime in form of pelletized limestone.
   2. Rate: Apply at a rate as recommended in the Soil Test Reports. Apply mechanically at
      least two weeks prior to planting and fertilizer applications. Incorporate into full depth of
      planting soil prior to finished grading.

B. Sulfur: Granular, biodegradable, and containing a minimum of 90 percent elemental sulfur, with
a minimum of 99 percent passing through a No. 6 sieve and a maximum of 10 percent passing
through a No. 40 sieve.

C. Iron Sulfate: Granulated ferrous sulfate containing a minimum of 20 percent iron and 10
percent sulfur.

D. Perlite: Horticultural perlite, soil amendment grade.

E. Sand: Clean, washed, natural or manufactured, free of toxic materials, and according to
ASTM C 33/C 33M.

2.03 ORGANIC SOIL AMENDMENTS

A. Compost: A commercially manufactured humus product that is dark, crumbly, fine textured,
fully composted decayed organic matter specifically manufactured for use as a soil amendment
to promote vegetative growth. Organic amendments shall be well-aged, and contain no visible
admixture or refuse or other physical contaminants nor any material toxic to plant growth.

   1. Feedstock: Limited to leaves.
   2. Reaction: pH of the finished composted organic matter near 7.0, within the range of 6.0
to 8.0.
   3. Soluble-Salt Concentration: Less than 4 dS/m.
   4. Moisture Content: 35 to 55 percent by weight.
   5. Organic-Matter Content: 40% minimum on a dry weight basis as determined by loss on
      ignition.
   6. Particle Size: 100 percent passing through a ½-inch screen.
   8. Degree of maturity: Composted organic matter shall be considered stable as determined
      by the Solvita compost maturity index. Compost must achieve a maturity index of 6 or
      better, indicating a curing active compost.
   9. Ammonium content: Ammonium shall be less than 400 ppm on a dry-weight basis.
2.04 FERTILIZERS

A. Commercial Fertilizer: Complete slow-release commercial-grade complete fertilizer of neutral character, 50 percent of the fertilizer components shall be derived from natural organic sources of urea formaldehyde, phosphorous, and potassium in the following composition:

1. Composition: Nitrogen, phosphorous, and potassium in amounts recommended in soil reports from a qualified testing agency.

2.05 SAND

A. Coarse Washed Sand with neutral pH.

2.06 GEOTEXTILE FABRIC

A. Geotextile shall consist of needled, non-woven polypropylene fibers and meet the following properties:

1. Grab tensile strength (ASTM D4632) ≥ 120 lbs.
2. Mullen burst strength (ASTM D3786) ≥225 psi.
3. Flow rate (ASTM D4491) ≥ 95 gal/min/ft².
4. UV Resistance after 500 hours (ASTM D4355) ≥70%.
5. Heat-set or heat calendared fabrics are not permitted.

PART 3 - EXECUTION

3.01 GENERAL

A. Place planting soil and fertilizers according to requirements in other Specification Sections.

B. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in planting soil.

C. Proceed with placement only after unsatisfactory conditions have been corrected.

3.02 PREPARATION OF UNAMENDED, ON-SITE SOIL BEFORE AMENDING

A. If on-site topsoil is to be stockpiled and reused, excavate soil from designated areas and stockpile until amended. Depth of topsoil may vary, generally between 4” and 6”. Contractor shall make adjustments to excavation depths as necessary to avoid mixing subsoil with topsoil.

B. Unacceptable Materials: Clean soil of concrete slurry, concrete layers or chunks, cement, plaster, building debris, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, acid, and other extraneous materials that are harmful to plant growth.

C. Unsuitable Materials: Clean soil to contain a maximum of 8 percent by dry weight of stones, roots, plants, sod, clay lumps, and pockets of coarse sand.
3.03 PLACING BLENDED PLANTING SOIL OVER EXPOSED SUBGRADE

A. General: Generally, Planting Soil Mix is to be mixed before placement in its final location. For large lawn areas, Planting Soil may be mixed in place, with approval of the Engineer or Landscape Architect. Do not apply materials or till if existing soil or subgrade is frozen, muddy, or excessively wet.

B. Application:

1. FOR LAWN AREAS:
   a. Till subgrade to a minimum depth of 8 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   b. Apply approximately two inches of the Planting Soil Mix over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade.
   c. Spread remaining Planting Soil Mix to meet depths as indicated on plan (4” minimum), and as required to meet finished grades after natural settlement. Do not spread if soil or subgrade is frozen, muddy, or excessively wet. Compact each lift of to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698.
   d. Finish grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
   e. Test for compaction before installing seed or sod.
   f. Install seed mix or sod in accordance with the applicable specification section.

2. FOR LANDSCAPED AREAS, planting beds, and tree and shrub pits:
   a. Till subgrade to a minimum depth of 8 inches. Remove stones larger than 1-1/2 inches in any dimension and sticks, roots, rubbish, and other extraneous matter and legally dispose of them off Owner's property.
   b. Apply approximately two inches of the Planting Soil Mix over prepared, loosened subgrade. Mix thoroughly into top 4 inches of subgrade.
   c. Spread Planting Soil Mix in lifts not exceeding 8 inches in loose depth for material compacted by compaction equipment, and not more than 4 inches in loose depth for material compacted by hand-operated tampers. Compact each lift soil to 75 to 82 percent of maximum Standard Proctor density according to ASTM D 698. Continue until planting bed or tree pit excavation is filled to finished grade.
   d. Finish grade planting soil to a smooth, uniform surface plane with loose, uniformly fine texture. Roll and rake, remove ridges, and fill depressions to meet finish grades.
   e. Test for compaction before installing plant material.
   f. Install plant material in accordance with the applicable specification section.
3.04 FIELD QUALITY CONTROL

A. Testing Agency: Contractor to engage a qualified testing agency to perform tests and inspections.

B. Perform the following tests:
   1. Compaction: Test Planting Soil Mix compaction after placing each lift and at completion using a densitometer or soil-compaction meter calibrated to a reference test value based on laboratory testing according to ASTM D 698. Space tests at no less than one for each 1000 sq. ft. of in-place soil or part thereof.
   2. Filtration: Perform infiltration testing on the Bio-Retention Soil Mix after placement. If the tested infiltration rate is determined to be out of the allowable range of 0.5 to 1.0 inches per hour, additional soil amendments will be required.

C. Soil will be considered defective if it does not pass tests.

D. Submit test reports.

E. Label each sample and test report with the date, location keyed to a site plan or other location system, visible conditions when and where sample was taken, and sampling depth.

3.05 PROTECTION

A. Protection Zone: Identify protection zones according to Section 015639 "Temporary Tree and Plant Protection."

B. Protect areas of in-place soil from additional compaction, disturbance, and contamination. Prohibit the following practices within these areas except as required to perform planting operations:
   1. Storage of construction materials, debris, or excavated material.
   2. Parking vehicles or equipment.
   3. Vehicle traffic.
   4. Foot traffic.
   5. Erection of sheds or structures.
   6. Impoundment of water.
   7. Excavation or other digging unless otherwise indicated.

C. If planting soil or subgrade is overcompacted, disturbed, or contaminated by foreign or deleterious materials or liquids, remove the planting soil and contamination; restore the subgrade as directed by Engineer or Landscape Architect and replace contaminated planting soil with new planting soil.

3.06 CLEANING

A. Protect areas adjacent to planting-soil preparation and placement areas from contamination. Keep adjacent paving and construction clean and work area in an orderly condition.

B. Remove surplus soil and waste material including excess subsoil, unsuitable materials, trash, and debris and legally dispose of them off Owner's property unless otherwise indicated.
1. Dispose of excess subsoil and unsuitable materials on-site where directed by Owner.

END OF SECTION
SECTION 02936
TURF SEEDING

PART 1 - GENERAL

1.01 RELATED SECTIONS

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

B. Division 2 Section “Planting Soil Mix” for preparation of topsoil before seeding.

1.02 DESCRIPTION

A. This work shall consist of supplying all the materials, labor, equipment and incidentals necessary for the installation and maintenance for 12 months of turf areas, as indicated on the plans and described in this section.

1.03 SUBMITTALS

A. Certificate of Seed: Submit seed vendor's certified statement of seed composition stating botanical and common name, percentage by weight, and percentages of purity and germination analysis prior to installation.

B. Planting Schedule: Submit proposed planting schedule indicating anticipated dates of installation.

C. Methods for temporary storage of seed.

D. Maintenance Instructions: Submit written instruction procedures to be implemented by the Using Agency for maintenance of the turf areas after the guarantee period. Areas to be covered are:
   1. Mowing/grooming
   2. Watering
   3. Fertilizing
   4. Weed removal

1.04 STANDARDS

A. Pennsylvania Seed Act of 1965, Act No. 187

B. Pennsylvania Department of Agriculture regulation (PDAR), Bureau of Plant Industry.
1.05 QUALITY ASSURANCE AND GUARANTEE

A. Comply with applicable federal, state, county, and local regulations governing landscape materials and work.

B. Employ only experienced personnel familiar with required work. Provide adequate supervision by qualified foreman.

C. Substitutions: Substitutions of seed materials are not allowed. If required seed is not obtainable, submit proof of unavailability to Using Agency, together with proposal for use of equivalent material.

D. When authorized, adjustment of contract will be made by change order.

E. Coordinate with work of other sections

1. Utilities: Determine location of underground utilities and perform work in a manner to avoid possible damage. Excavate by hand as required.

2. Maintain grade stakes, and protective fencing set by others until removal is mutually agreed upon by entities involved.

3. Coordinate with other contractors on site for access, locations and sequences of work.

F. Maintenance and Warranty

1. Turf areas shall be maintained and guaranteed by the Contractor to remain alive and healthy for 12 months after the date of the installation acceptance of the Site Architect. Turf areas in an impaired, dead or dying condition, shall be reseeded within 1 week of notification by Site Architect.

2. The Contractor will not be held responsible or liable for damages to seeding by animals, malicious or careless damage by human agencies or by fire, or storm damage.

G. Inspection

1. Upon written notification of completion by Contractor, the Site Architect will make an Installation Inspection of this work. Under normal circumstances this date shall be within two working weeks of written notification.

   a. Criteria-Installation Inspection will be for apparent correctness of seeding, proper maintenance since time of seeding, and addition of all materials at time of inspection.

   b. Acceptance - Acceptance of seeding at Installation Inspection will be the basis for invoicing, excluding any amounts tied to guarantee fulfillment.

   c. Rejection and Replacement

      1). Reseed all turf areas rejected at Installation Inspection within 1 week of the notification and reseeded area shall be maintained as specified.
2. Each reseeding resulting from rejection at Installation Inspection will be considered for inspection and guarantee as if it were a newly seeded area, and all guarantee dates will correlate to the date of the acceptable replacement.

3. Repeated reseeding may be required until the criteria of the Installation Inspection are met.

2. Two guarantee inspections will be made within the guarantee period, as follows:

a. First Guarantee Inspection

<table>
<thead>
<tr>
<th>Season when Installed</th>
<th>Time Elapsed since Installation Acceptance</th>
<th>Date of First Guarantee Inspection</th>
</tr>
</thead>
<tbody>
<tr>
<td>SPRING</td>
<td>3 1/2 to 6 months</td>
<td>on or near September 1 Of the year of installation</td>
</tr>
<tr>
<td>FALL</td>
<td>3 1/2 to 6 months</td>
<td>on or near April 1 Of the year following installation</td>
</tr>
</tbody>
</table>

1). Notify the Site Architect in writing of pending inspections approximately two weeks in advance, and arrange a mutually convenient date.

2). Inspections scheduled on or near April 1 may be adjusted to ensure that the seeded areas are not dormant at the time of inspection.

3). Criteria - The First Guarantee Inspection will be for survival, health, acceptable growth and fullness, durability of installation, proper maintenance practices, and trueness to type.

4). Acceptance - Acceptance at the First Guarantee Inspection will not be the basis of any invoice unless a specific progress payment agreement is listed below.

5). Rejection and Replacement - Replace rejected seeded areas during the planting season most closely following the inspection.

b. The final Guarantee Inspection shall be conducted on or near the date one year after an accepted Installation Inspection. Notify the Site Architect at least two weeks in advance and arrange a mutually convenient date.

1). Criteria - Same as the First Guarantee Inspection

2). Acceptance - Acceptance at the Final Guarantee Inspection will be the basis for final payment.

3). Rejection and Replacement - See Section 02920-2.3 Quality Assurance and Guarantee F., 1., C.

3. The Site Architect retains the right of inspection at any time, during the work to inspect seeding for true species, variety, size and condition of root systems, insects, injuries, and latent defect, and to reject unsatisfactory or defective seeding.
1.06 DELIVERY, STORAGE, AND HANDLING

A. Protect seed during delivery and while stored at site.

B. Seeding: Do not seed when wind velocity exceeds 5 mph. Distribute seed evenly over entire area by seeding equal quantities in two directions at right angles to each other. Do not use seed that is moldy, wet or otherwise damaged in transit or storage.

PART 2 - MATERIALS

2.01 TOPSOIL

A. See Section 02930 “Soil Preparation.”

2.02 SOIL AMENDMENTS

A. Limestone: Ground limestone shall have a minimum of 85% total carbonates and a minimum of 50% total calcium oxides. At least 90% of it shall be able to pass a No. 20 sieve and at least 50% to pass a No. 100 sieve.

B. Fertilizers:

1. Fertilizer shall be standard commercial fertilizers conforming to the requirements of the Pennsylvania Soil Conditioner and Plant Growth Substance Act of December 1, 1977, P.L. 258, No. 86 (3 P.S. 68.2), as amended and any other applicable State and Federal laws.

2. At time of seeding, fertilizers shall be 14-28-15 for dry application. For maintenance, fertilizer shall be 10-6-4 and applied at the rate of 2.5 lbs. N/1000 ft²/yr. Chemical analysis shall be guaranteed and clearly shown on each bag. The derivation of fertilizer elements shall be as follows:

3. Nitrogen...ammonium sulfate, ammonium nitrate, or ammonium phosphate

4. Phosphorus...phosphoric acid, calcium phosphate, ammonium phosphate

5. Potassium...muriate of potash

C. Organic Matter: On dry weight basis 90% or better, pH 3.5-5.5.

2.03 MISCELLANEOUS MATERIALS

A. Outline Stakes: 1"x2"x48" length, as approved by Site Architect.

B. Water shall be free from oil, acids, alkalis, salts or any other substance injurious to plant life. Water from stream, lakes, ponds or similar sources shall not be used unless approved by Site Architect.

2.04 GENERAL LAWN SEEDING MIX
A. Lawn seed shall be “no mow” seed mix consisting primarily of fescue varieties, as supplied by Prairie Nursery (www.prairienursery.com), or approved equal.

2.05 TEMPORARY SEEDING MIX

A. Per approved erosion and sedimentation drawings.

PART 3 - CONSTRUCTION METHOD

3.01 SEEDING SCHEDULE

A. Seed when conditions of ground and weather permit establishment without danger of freezing or drying out.

1. The Contractor shall be responsible for choosing proper seeding times and for taking proper precautionary and maintenance measures to assure survival and growth. Do not place seeds when the temperature is less than 32 degrees Fahrenheit.

B. Installation times:

1. Spring: March 15 - May 15
   Fall: September 1 - October 15.

2. The Site Architect may adjust these dates as a result of actual weather conditions. Submit an installation schedule for written approval.

3. The decision of the Site Architect with regard to changed planting seasons shall be taken in consultation with the Contractor. The decision shall be final and shall not be grounds for any claim whatsoever by the Contractor, nor shall the normal planting seasons defined above be construed as a guarantee that the Contractor can in fact plant during any given day within such seasons.

C. Trees, shrubs, and ground covers shall be planted after final grades are established and prior to seeding unless otherwise acceptable to the Site Architect. If planting of trees, shrubs, or ground covers should occur after seed installation, protect seeded areas and promptly repair damage resulting from planting operations.

3.02 SEED BED PREPARATION

A. Advance Preparation and Clean up:

1. After grading of areas has been completed and before applying fertilizer and ground limestone, areas to be seeded shall be treated mechanically and/or chemically to remove existing vegetative cover.

2. Areas to be seeded shall also be raked or otherwise cleared of stones larger than 50 millimeters in any diameter, sticks, stumps and other debris that might interfere with sowing of seed, growth of grasses, or subsequent maintenance of grass covered areas. If any damage by erosion or other causes has occurred after the completion of grading and before beginning the application of fertilizer and ground limestone, the Contractor shall repair such damage.
3. This may include filling gullies, smoothing irregularities, and repairing other incidental damages.

B. Sub-grade Preparation

1. An area to be seeded shall be considered a satisfactory bed without additional treatment if it meets the following conditions:
   
a. If it has recently been thoroughly loosened and worked to a depth of not less than 6 inches as a result of roto-tilling and grading operations.
   
b. If immediately prior to seeding, the top 3 inches of soil is loose, friable, reasonably free from large clods, rocks, large roots, or other undesirable matter.

2. If shaped to the required grade.

C. Topsoil:

1. See Section 02930 “Soil Preparation”

2. Topsoil shall be 6” after rolling.

3. The grade of topsoil shall reflect proposed finished grade.

4. At locations where proposed seedbeds meet existing lawn, topsoil shall be feathered into existing lawn.

D. Soil shall be tested by a soil testing service. Soil amendments shall be added at rates recommended by the results of the soil tests before seeding.

3.03 SEED APPLICATION

A. Wet Application Method

1. General: The Contractor shall apply seed and fertilizer (and lime, if required) and mulch by spraying them on the previously prepared seedbed in the form of an aqueous mixture and by using the methods and equipment described herein. The rates of application shall be as follows: lime 100 lbs per 1,000 sq. ft. and fertilizer 1.5 lbs. per 1,000 sq. ft. unless otherwise recommended by soil test results. The rate of seed application shall be 220 lbs. per acre. Mulch shall be applied at the rate of 35-45 lbs. Per 1,000 sq. ft.

2. Spraying Equipment:
   
a. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50 gallons over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.
   
b. The unit shall also be equipped with a pressure pump capable of delivering 100 gallons per minute at a pressure of 100 lbs. per square inch. The pump shall be mounted in a line which will re-circulate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passengers and pipeline shall be capable of providing clearance for
5/8 inch solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

c. The nozzle pipe shall be mounted on an elevated supporting stand in such a manner that it can be rotated through 360 degrees horizontally and inclined vertically from at least 20 degrees below to at least 60 degrees above the horizontal. There shall be a quick-acting, three-way control valve connecting the re-circulating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over distance varying from 20 feet to 100 ft. One shall be a close range jet nozzle. For ease of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

d. In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet in length shall be provided to which the nozzles may be connected.

3. Mixtures: Lime, if required, shall be applied separately, in the quantity specified, prior to the fertilizing and seeding operations. Not more than 220 lbs. of lime shall be added to and mixed with 100 gallons of water.

a. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 lbs. of these combined solids shall be added to and mixed with each 100 gallons of water. Mulch may be mixed with the seed and fertilizer or applied afterwards.

b. All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. Brackish water shall not be used at any time. The Contractor shall identify to the Site Architect all sources of water at least 2 weeks prior to use. The Site Architect may take samples or require the Contractor to take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content, at the Contractor's expense.

4. The Contractor shall not use any water from any source disapproved by the Site Architect following such tests.

a. All such mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within 2 hours from the time they were mixed or they shall be wasted and disposed of at locations acceptable to the Site Architect.

5. Spraying: Lime shall be sprayed only upon previously prepared seedbeds. Mixtures of seed, fertilizer, and mulch shall only be sprayed upon previously prepared seedbeds on which the lime shall already have been worked in.

a. The mixtures shall be applied by means of a high-pressure spray that shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

b. Particular care shall be exercised to insure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined
quantities of the mixture in accordance with specifications shall be used to cover specified sections of known areas. Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of materials deposited thereon.

6. When the wet application method outlined above is used for work done in or out of season, it will be required that the Contractor establish a good stand of grass of uniform color and density to the satisfaction of the Site Architect.

3.04 MAINTENANCE

A. The Contractor shall protect seeded areas against traffic or other use by warning signs or barricades, as approved by the Site Architect. Surfaces gullied or otherwise damaged following seeding shall be repaired by re-grading and reseeding as directed.

B. The Contractor shall coordinate mowing with other activities by maintenance staff. Water as required and otherwise maintain seeded areas in a satisfactory condition until final installation acceptance.

1. Contractor shall mow turf grass to 2" when grass reaches above 3" in height weekly during the growing season.

C. Contractor shall fertilize grass 3 times during each maintenance year: (1) late summer or early fall, (2) late November, and (3) late spring.

D. Contractor shall be responsible for weed control for turf areas as follows:

1. Selectively cut weeds with a string trimmer during growing period, removing cut weeds to avoid germination.

2. Do not use herbicide unless approved by Site Architect due to the presence of wetlands in the area.

E. In the event that the Site Architect approves an herbicide, use selectively during germination of seed until Specialty Seeding Mix becomes established.

END OF SECTION
SECTION 02940

PLANTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Trees.
   2. Shrubs
   4. Perennials.
   5. Mulches.
   6. Tree stabilization.
   7. Related materials.

B. Related Requirements:
   1. Division 2 Section "Soil Preparation" for planting soil mixes.
   2. Division 2 Section "Turf and Grasses" for turf (lawn) and meadow planting, hydoseeding, and erosion-control materials.

1.03 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Balled and Potted Stock: Plants dug with firm, natural balls of earth in which they are grown and placed, unbroken, in a container. Ball size is not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required.

D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

E. Finish Grade: Elevation of finished surface of planting soil.

F. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
G. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

H. Planting Area: Areas to be planted.

I. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth. See Section 02930 "Soil Preparation" for drawing designations for planting soils.

J. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

K. Root Flare: Also called "trunk flare." The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

L. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

M. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.04 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.05 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Anti-desiccant spray
2. Mycorrhizal inoculant.
3. Pesticides and herbicides
4. Steel edge and stakes.
5. Tree stabilization.
6. Tree grates.

B. Samples for Verification: For each of the following:

1. Organic Mulch: 1-quart volume of each organic mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

2. Edging Materials and Accessories: 6” sample section.

3. Tree Stabilization: 1 piece or unit.

C. Plant Material:
1. Location Data: Quantities and sizes of each plant material type, location of nursery, and location of growth (if different from nursery). Include address, phone number, and contact person for each nursery or other place of growth.

2. Photographs: At least 14 days prior to submittal of Plant Material Location Data, submit three color photographs in digital format of each required species and size of plant material as it will be furnished to the Project.
   a. Take photographs from an angle depicting true size and condition of the typical plant to be furnished. Include a scale rod or other measuring device in each photograph.
   b. For species where more than 20 plants are required, include a minimum of three photographs showing the average plant, the best quality plant, and the worst quality plant to be furnished.
   c. Identify each photograph with the full scientific name of the plant, plant size, and name of the growing nursery.

1.06 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer's capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners' contact persons.

B. For each type of manufactured product, from manufacturer, and complying with the following:
   1. Manufacturer's certified analysis of standard products.
   2. Analysis of other materials by a recognized laboratory made according to methods established by the Association of Official Analytical Chemists, where applicable.

C. Sample Warranty: For special warranty.

D. Tree grates: Submit 3 sets of drawings of tree grates and frames for review prior to purchase.

1.07 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.08 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.
   1. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.
   1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not
measure branches or roots tip to tip. Take caliper measurements 6 inches above the root flare for trees up to 4-inch caliper size, and 12 inches above the root flare for larger sizes.

2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Landscape Architect may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Landscape Architect may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Landscape Architect of sources of planting materials seven days in advance of delivery to site.

1.09 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

D. Handle planting stock by root ball or the container. Do not lift or handle container plants by the tops, stems, or trunks. Do not bend or bind/tie trees or shrubs in such a manner as to destroy their natural shape. Do not drop plants during delivery or handling.

E. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F until planting.

F. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

G. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation. Pad trunk and branches at all points of contact between plant material and equipment.

H. Deliver plants after preparations for planting have been completed, and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate
aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
2. Do not remove container-grown stock from containers before time of planting.
3. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

I. Store tree grates and frames in manufacturer’s packaging until ready to install.

1.10 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

2. Fall Planting: October 15th through November 30th.

C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Death and unsatisfactory growth, except for defects resulting from abuse, lack of adequate maintenance, or neglect by Owner.
   b. Structural failures including plantings falling or blowing over.
   c. Faulty performance of tree stabilization.

2. Plant Warranty Periods: From date of Substantial Completion.

   a. Trees, Shrubs, Vines, and Ornamental Grasses: 12 months.
   b. Ground Covers, Biennials, Perennials, and Other Plants: 12 months.
   c. Delays in completion of planting operations which extend the planting into more than one planting season shall extend the Warranty Period accordingly.

3. Include the following remedial actions as a minimum:

   a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
   b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

4. Incorrect Materials:
   a. During Warranty Period, replace at no cost to the Owner, plants revealed as being untrue to name.
   b. Provide replacements of a size and quality to match the planted materials at the time the mistake is discovered.

5. Tree grates and frames shall be warranted by the Manufacturer against defects in materials and workmanship for a minimum of five (5) years.

PART 2 - PRODUCTS

2.01 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning.

1. Provide well-shaped, fully branched, healthy, vigorous stock, densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

2. Provide plants with healthy, well developed root systems, free of kinked, circling, girdling and center roots, root-bound conditions, and cracked or broken root balls.

3. Trunk and branches must be structurally strong and tree must be able to stand upright without stakes or guys on a windless day. Reject trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk (“included bark”); with crossing trunks; or with cut-off limbs more than 3/4 inch in diameter.

4. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

5. Climatic Growing Conditions: Plant material shall be grown under climatic conditions similar to those of the project for at least two years unless otherwise accepted by the Landscape Architect.

6. Container Growth Limitations: Container stock, excluding annuals, shall have been grown in the containers in which plant material is delivered for at least six months, but not more than two years.

7. Do not prune, thin, or shape plants before delivery without approval of the Landscape Architect.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Landscape Architect, with a proportionate increase in size of roots or balls.
C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label at least one plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant. Plant nomenclature shall meet requirements of ICBN and ICNCP.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

2.02 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

2.03 MULCHES

A. Organic Mulch: Free of soil, rocks, toxic material, weed seeds, and other deleterious materials, and suitable as a top dressing of trees, shrubs, and plants. Mulch shall be of a uniform grade with no additives or any other treatment. The pH shall range from 5.8 to 6.2.

1. Shredded hardwood mulch.
   a. Aged, double shredded.
   b. Color: Natural.

2. Composted Leaf Mulch

2.04 PESTICIDES AND HERBICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.05 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new hardwood, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal by length indicated, pointed at one end.

2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or equivalent.

2.06 TREE GRATES AND FRAMES

A. Manufacturer: Tree grates and frames shall be as supplied by IRONSMITH, INC., 41-701 Corporate Way, Unit 3, Palm Desert, CA 92260 (800) 338-4766, (ironsmith.cc) or approved equal.

B. Tree grate shall be: ADA 48X72 inch RECTANGULAR Model 7210 with 16 inch square opening .

C. Tree grate material shall be cast gray iron from 100% recycled material. All tree grate castings shall be manufactured true to pattern and component parts, and shall fit together in a satisfactory manner. The castings shall be of uniform pattern and quality, free from blowholes, hard spots, shrinkage, distortion or other defects. Castings shall be cleaned by shot blasting.

D. Finish: Grates are to be supplied in unfinished natural state.

E. Matching steel angle frames provided by the tree grate manufacturer for specified model shall be provided with installation details.
   a. Frames to be provided unfinished.
   b. Pilfer proof screws shall be provided and installed per manufacturer’s standard.

F. Total quantity as indicated on Drawings.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.
   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
   3. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   4. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Landscape Architect and replace with new planting soil.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.
C. Lay out individual tree and shrub locations and areas for multiple plantings.

1. Stake locations of trees where indicated on drawings. Drive a 3-foot long wood lath stake at each tree location and mark each tree type with a different color survey tape.

2. Lay out container grown shrubs and perennials as indicated on the drawings. Do not remove container grown shrubs from containers until time of planting.

3. Lay out a sample of ground cover spacing for review.

4. Contact the Landscape Architect to review locations prior to excavation of the plant pits. Adjust the locations in the field as directed by the Landscape Architect.

5. Do not excavate plant pits until the Landscape Architect has accepted the locations.

3.03 PLANTING AREA ESTABLISHMENT

A. General: Prepare planting area for soil placement and mix planting soil according to Section 02930 “Soil Preparation”.

B. Before planting, obtain Landscape Architect's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

3.04 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.

1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.

2. Excavate plant pits to a diameter which is three times as wide as root ball diameter for trees and shrubs.

3. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.

4. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.

5. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.

6. Maintain supervision of excavations during working hours.

7. Keep excavations covered or otherwise protected after working hours and when unattended by Installer's personnel.

B. Backfill Soil: Planting Soil Mix as specified in Section 02930 “Soil Preparation”.

C. Obstructions: Notify Landscape Architect if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.

1. Hardpan Layer: Drill 6-inch-diameter holes, 24 inches apart, into free-draining strata or to a depth of 10 feet, whichever is less, and backfill with free-draining material.

D. Drainage: Notify Landscape Architect if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.
E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.

3.05 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Planting Soil mix as specified.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch from root tips; do not place tablets in bottom of the hole.

   a. Quantity: Fertilization as recommended by soil testing reports.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch above adjacent finish grades.

1. Backfill: Planting Soil mix as specified.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.

   a. Quantity: Fertilization as recommended by soil testing reports.

5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.06 MECHANIZED TREE-SPADE PLANTING

A. Trees may be planted with an approved mechanized tree spade at the designated locations. Do not use tree spade to move trees larger than the maximum size allowed for a similar field-
grown, balled-and-burlapped root-ball diameter according to ANSI Z60.1, or larger than manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller.

B. Use the same tree spade to excavate the planting hole as will be used to extract and transport the tree.

C. When extracting the tree, center the trunk within the tree spade and move tree with a solid ball of earth.

D. Cut exposed roots cleanly during transplanting operations.

E. Plant trees following procedures in "Tree, Shrub, and Vine Planting" Article.

F. Where possible, orient the tree in the same direction as in its original location.

3.07 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.

B. Prune, thin, and shape trees, shrubs, and vines as directed by Landscape Architect.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices, in accordance with the ANSI A300 Part I (Pruning) Standards from the Tree Care Industry Association. Unless otherwise indicated by Landscape Architect, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.08 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees over 2” caliper. Stake trees of less than 2-inch caliper as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches below bottom of backfilled excavation and to extend at least 72 inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3. Do not install root barrier surrounding the root ball of tree.

3.09 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Backfill: Planting Soil mix as specified.

C. Dig holes large enough to allow spreading of roots.
D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.10 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees in Turf Areas: Apply organic mulch ring of 3-inch average thickness, with 36-inch radius around trunks or stems. Do not place mulch within 3 inches trunks or stems.

2. Organic Mulch in Planting Areas: Apply 3-inch average thickness of organic mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 3 inches of trunks or stems.

3.11 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

3.12 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Pre-Emergent Herbicides (Selective and Nonselective): Apply to tree, shrub, and ground-cover areas according to manufacturer's written recommendations. Do not apply to seeded areas.

C. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.13 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged by construction operations at no cost to the Owner, in a manner approved by Landscape Architect.

1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Landscape Architect.

B. Remove and replace trees that are more than 25 percent dead or in an unhealthy condition before the end of the corrections period or are damaged during construction operations that Landscape Architect determines are incapable of restoring to normal growth pattern, at no cost to the Owner.
   1. Provide new trees of same size as those being replaced.
   2. Species of Replacement Trees: Same species being replaced.

C. Plant Warranty will apply to replaced plant materials.

3.14 TREE GRATE INSTALLATION

A. Install materials and system in proper relation with adjacent construction and with uniform appearance. Coordinate with work of other sections.

B. Install grates and frames where indicated on plan. Verify elevations to ensure that tree grate will be flush and level with finished grade of adjacent pavement surface.

C. Install steel angle frame.
   a. Maintain elevations while preparing site for concrete. Use spreaders or stakes to keep frame from being distorted by concrete pressure.
   b. Install frame per manufacturer’s written instructions and specifications.

D. Install street tree and planting soil per drawings, details, and specifications. Verify proper planting depth of tree root collar.

E. Clean concrete and debris from steel frame prior to tree grate installation.

F. If needed, grind pads on underside of tree grate to level and prevent rocking in frame.

G. Position tree grates to meet in the center of tree well and have uniform spacing around outside edges of castings. Drill through counter bored holes in grates and install pilfer proof bolts per manufacturer’s instructions.
   a. Use 1” thick wood or foam block out under the frame to allow pilfer proof screw to extend below angle.

3.15 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner’s property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.
D. Protect tree grates from damage until completion of project. Do not allow water from new concrete to run off or wash into tree grate to protect grate and tree from damage from concrete exudates, lime and efflorescence.

E. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

END OF SECTION
SECTION 02941

VEGETATED GREEN ROOF

PART 1 - GENERAL

1.01 DESCRIPTION

Provide equipment, materials, tools, and labor to install vegetated roofing modules. Modules are to include growth media and plants. This work shall also include edge treatments, custom shaping of modules, and installing paver stones or ballast, slip sheet/root barrier and irrigation system, if specified.

1.02 SUBMITTALS

A. To fully disclose merits of system and specifications, provide three (3) product catalogs and supporting literature showing specifications and project photographs of completed jobs.

B. In order to provide third party perspective, provide reference sheet listing 6 references of owners and caretakers of green roof system.

C. To provide visual reference, conduct site visit and proposed dates to visit for 3 existing projects using same green roof system, within 50 miles of project site.

D. To provide visual reference, provide two (2) sample vegetated modules, showing same or similar product grown to maturity, with homogeneous mix of cutting grown plants, with 95% or greater coverage, as it will be delivered to job site. Sample to be provided to facility manager and owner of property or other as indicated.

E. To demonstrate soil quality, provide two (2) plastic bags, each containing a 1 cup (8 oz.) sample of growing medium.

F. To conform to project requirements, provide additional agreements of warranty and maintenance contract.

G. To ensure proper care, provide written maintenance protocol.

H. To ensure proper installation, provide written documentation of installation procedures. If required for warranty and maintenance purposes, provide documentation showing installer as being certified to install system.

I. To ensure Installer has been trained to efficiently and correctly install green roof system, provide certificate of completion of training issued by green roof system manufacturer.

J. To facilitate planning and create installation efficiency, indicate length of time required to install the green roof.

K. To provide evidence of wind and fire safety, demonstrate video evidence of fire-spread testing and high speed wind resistance testing (minimum of 110 mph).

L. To ensure proper plant selection and efficient delivery, provide address and contact information of professional horticulturist who will oversee planting and cultivation of modules, within 300 miles of project location.

M. To ensure efficient and correct use of materials, submit shop drawings indicating layout of modules,
pavers, and square footage.

N. Philadelphia Construction Certification Package: After installation contractor shall submit the following documentation.
1. Copies of receipts for vegetated roofing modules.
2. Copies of receipts for growing medium.
5. Photos showing green roof following the installation of vegetated roofing modules.
6. Photos showing #8 AASHTO Pea Gravel.
7. Photos showing roof drains.

1.03 QUALITY ASSURANCE

A. No deviation should be made from this specification. Installer assumes liability for any deviations from specification.

B. Only manufacturer-approved Installers may perform the green roof installation.

C. Please contact your local green roof system supplier for a list of approved installers to provide estimates for you.

D. Prior to installing green roof modules, the following procedures are to be conducted:
   1. The building Owner, Architect, or Engineer shall verify that the roof is properly designed and constructed to adequately support the load of the green roof system.
   2. The roof is to be flood tested for water tightness for 24 hours. Water testing shall be witnessed and confirmed in writing by Owner's Representative and/or Design Professional, Waterproofing Contractor, Membrane Manufacturer, and Installation Contractor.
   3. Slipsheet/root barrier to be properly installed, seams overlapped and bonded, in accord with architect's and manufacturer's specifications.
   4. The roof is to be inspected and determined ready to accept the green roof modules by a Technical Representative of the Installer.

E. Once the green roof installation is completed, an inspection is to be conducted by a Technical Representative of the installer to verify that the green roof modules have been installed tight against each other, in straight rows, corners aligned, properly oriented, and tight against the edging.

1.04 PRE-INSTALLATION MEETING

A. Convene one week before starting work of this section. Review green roof installation standardized procedures with supervisory staff.

1.05 DELIVERY, STORAGE, HANDLING, PROTECTION

A. Green roof modules are to be delivered in good condition free from shipping damage.

B. Modules are to be kept out of the sun if plastic wrapped to prevent overheating.

C. Modules are to be installed on the roof top within 4 hours of delivery.

D. On the job site, modules are to be handled to prevent damage to the modules themselves and all roofing components.

E. To ensure optimum plant condition and safety, modules must be conveyed to the roof using a rack designed specifically for this use and constructed according to engineer approved and stamped plans. DO NOT stack modules during conveyance to rooftop or installation.
F. Modules are to be conveyed to roof surface with equipment designed to carry the collective load of the green roof modules and transport vehicle. Account for decreasing load limits when boom (of crane or fork lift) is extended. Use crane stabilizers and take all necessary precautions to protect building and personnel.

G. NEVER exceed the load capacity of the roof deck when placing green roof modules on the roof.

H. When suspending modules and conveyance vehicle above deck, take precautions to stabilize and prevent twisting of conveyance vehicle. Four tires or two four inch thick sheets of Styrofoam is recommended.

I. During installation, protect the roof deck and membranes with appropriate material such as plywood sheeting. NEVER scrape or puncture the slip sheet or membranes. Keep roof surfaces free of soil, grit, or debris at all times with broom. Never set modules on top of soil, dirt or grit.

J. Transport conveyors to be run parallel to the line of installation.

K. Transport carts to have pneumatic tires, to be wheeled about only upon protective plywood sheeting, and to be loaded so as not to exceed weight capacity of roof deck.

PART 2 - PRODUCTS

2.01 VEGETATED GREEN ROOF MODULE MANUFACTURER

A. For ease of handling during installation, future maintenance activities, storage, and reduction in special sizes, the module system to be used comprising of 1’ x 2’ x 3” tray; soil height raised to approximately 4 1/4” elevation with removable soil elevator.

B. Provide LiveRoof standard tray (http://liveroof.com), or equivalent system approved by the owner and FM Global.

C. For uniformity, modules must be obtained from a single source.

D. To meet sustainability objectives, modules to be 100 % post-industrial recycled polypropylene with 100 mil thick walls.

E. To meet plant growth, plant health, and maximum storm water absorption, module system to have a minimum of 337 cu ft of soil per 1000 square feet of coverage.

F. To resist photo-degradation, module color to be black.

G. For optimal root health and drainage, module to have positive drain holes placed at lowest point in the module.

H. For proper roof drainage and root health, module bottom to have water dispersal via its drain channels of approximately 7.0 gallons per minute per lineal foot.

I. To optimize plant health and maximize storm water absorption, soil height approximately 4 1/4”.

J. To shield the module from photo-degradation and to promote plant health via sharing of water and nutrients between the modules, the soil continuum is to be monolithic, approximately 1” inch taller than modules, and shall obscure modules during all 12 months of the year for optimal year-round aesthetic presentation.

K. For plant health by sharing of water and nutrients between modules, soil to be joined via subterranean moisture portals uniting soil from module to module.
L. To ensure minimal maintenance, plant material to cover minimum of 95% of surface area of soil within modules at time of delivery.

M. To ensure proper plant selection, efficient delivery and sustainable objectives, module planting and cultivation to occur under supervision of professional horticulturist located within 300 miles of project location.

N. To ensure adherence to proper installation procedures, green roof system manufacturer to provide the Installer with in-person training of Standardized Installation Procedures.

O. To facilitate design, provide photos and descriptions of plant mixture or individually specified plant species to be used.

P. To optimize logistical efficiency, during the growing season, April to Sept. 30, growing time and method to be coordinated so as to mature on or before installation date. Time to mature depends upon plant selection, climate, and time or year. Ask grower for specific timeframes for individual project.

2.02 GROWING MEDIUM

A. Green roof growing medium should be a lightweight mineral material with a minimum of organic material and should meet the following standards:

1. Moisture content at maximum water holding capacity (ASTM E2399 or FLL): ≥ 35%
2. Porosity at maximum water holding capacity (ASTM E2399 or FLL): ≥ 6%
3. Total organic matter (MSA) 3-8%
4. pH (MSA) 6.5-8.0
5. Soluble salts (DPTA saturated media extraction) ≤ 6 mmhos/cm
6. Water permeability (ASTM E2399 or FLL) ≥ 0.5 in/min
7. Grain-size distribution, as recommended by FLL

B. To ensure sustainability, plant health and longevity, and minimal shrinkage, soil to be enhanced German FLL 93+ (% by dry weight) inorganic content.

C. To ensure proper soil environment and allow for predictable maximum roof load during rain storm, module saturated weight (with soil and fully vegetated) to range between 27 and 29 pounds per square foot.

2.03 PLANTS

A. Green Roof landscaping shall be provided by Creek Hill Nursery or approved equal.

B. Plants shall consist of a minimum of eight (8) sedum varieties selected for hardiness and sequence of bloom, and suited for the project location and micro-climate.

2.04 ACCESSORIES

A. Slip sheet/Root Barrier: 16 ounce per square yard polypropylene non-woven needled fabric

   Density (ASTM-D3776): ≥ 16 oz/yd²
   Puncture Resistance (ASTM D-4833): ≥ 220 lbs

B. Edging: L-shaped extruded aluminum edging with perforations for drainage. Edging is 4” x 3” with a minimum gauge of 210 mil. Edging, regardless of type, must allow for adequate drainage via sufficient drain perforations at the bottom of the edging, with sidewalls tall enough to cover the modules and contain the soil.
1. Edging required between modules and stone ballast.
2. If edging is attached to modules, use 10-24 x 1" wafer head self-tapping screws in gray finish.

PART 3 - EXECUTION

3.01 INSTALLER QUALIFICATIONS

A. Green Roof Installation must be conducted by a manufacturer-approved installer.

3.02 PREPARATION OF ROOF SURFACE

A. Slip sheet/root barrier, specified by architect and approved by waterproofing and green roof system manufacturer, of 40-60 mil. thickness with overlapped and effectively bonded seams to ward against root penetration and to keep waterproofing layer safe and clean from soil during installation. Slip sheet/root barrier typified as follows:

1. Welded Seam Types (40 mil or greater thickness)
   a. TPO, with seams heat welded
   b. PVC, with seams heat welded
   c. Polypropylene, with seams heat welded
   d. HOPE, with seams heat welded

2. Glued Seam Types (40 mil or greater thickness)
   a. EPDM, with seams overlapped a minimum of 3 inches and glued with roll out adhesive or double sided tape adhesive of the type that is impervious to and not affected by moisture, and recommended by the manufacturer.
   b. Low profile drain board (appx. 17 mil. thickness), with edges overlapped 3 inches and glued with manufacturer approved adhesive.


4. Never use duct tape or any other adhesive not recommended by the manufacturer.

5. Never use moisture holding fabric, such as needle punched polyethylene or felt, under the green roof system. Such materials:
   - Are impossible to sweep during installation
   - Stay wet and encourage root growth and root penetration, and could lead to impeded drainage; especially detrimental if a woody plant were to become established; such plants have woody root systems and potentially could cause roof leaks.

B. Experienced Contractor to install slip sheet/root barrier in accordance with manufacturer's recommendations.

C. All surfaces to be smooth, free of debris, soil, and grit prior to placing modules. All materials to be tested water tight and free draining prior to module placement.

D. All surfaces to be maintained clean and free of debris, soil, and grit during installation process via use of broom. Never walk upon such materials as they may damage membranes.

3.03 INSTALLATION SEASON

A. When plants are properly adapted and acclimatized to local weather conditions.

B. When weather is above 35° F and there is no ice on the roof and engineered soil is unfrozen.

C. No later than the cutoff date required by the green roof system provider's warranty terms, if applicable.
3.04 DELIVERY, STORAGE, HANDLING, PROTECTION

A. Green roof modules are to be delivered in good condition free from shipping damage.

B. If plastic wrapped, modules are to be kept out of the sun to prevent overheating.

C. Modules are to be installed on the roof top within 4 hours of delivery.

D. On the job site, modules are to be handled to prevent damage to the modules themselves and all roofing components.

E. To ensure optimum plant condition and safety, modules must be conveyed to the roof using a rack designed specifically for this use and constructed according to engineer approved and stamped plans. DO NOT stack modules during conveyance to rooftop or installation.

F. Modules are to be conveyed to roof surface with equipment designed to carry the collective load of the green roof modules and transport vehicle. Account for decreasing load limits when boom (of crane or fork lift) is extended. Use crane stabilizers and take all necessary precautions to protect building and personnel.

G. Never exceed the load capacity of the roof deck when placing green roof modules on the roof.

H. When suspending modules and conveyance vehicle above deck, take precautions to stabilize and prevent twisting of conveyance vehicle. Four tires or two four inch thick sheets of Styrofoam is recommended.

I. During installation, protect the roof deck and membranes with appropriate material such as plywood sheeting. Never scrape or puncture slip sheet or membranes. Keep roof surfaces free of soil, grit, or debris at all times with broom. Never set modules on top of soil, dirt or grit.

J. Transport conveyors to be run parallel to the line of installation.

K. Transport carts to have pneumatic tires, to be wheeled about only upon protective plywood sheeting, and to be loaded so as not to exceed weight capacity of roof deck.

3.05 SAFEGUARDING SYSTEM INTEGRITY

A. Properly instructed in safety procedures and provided with green roof manufacturer's Guide to Standardized Installation Procedures.

B. Instructed to keep all work surfaces clean and debris free.

C. To report immediately any damage to membranes, protective sheeting, or drain elements to supervisor, and to make appropriate repairs before proceeding.

D. Instructed in proper methods of green roof installation by manufacturer trained and approved representative of installation company.

3.06 LAYING (PLACING) MODULES

A. Module installation to follow behind installation of slip sheet/root barrier, irrigation system, pavers, ballast, and edging.

B. Module installation to be conducted in strict accordance with manufacturer installation guidelines.
Surface to be clean and swept free of soil, dirt, stones or grit before placing each module. Rows to be straight, modules to be tight against each other with edges overlapping and arranged in proper directional orientation. As soon as one row of modules is surrounded completely by the parapet, edging, or other modules, pull all of the plastic soil elevator inserts out of the modules. Pull the soil elevators while standing on the slip sheet and avoid walking on the plants.

C. Module installation to be conducted in accordance with green roof design.

D. Modules to be placed directly on top of appropriate slip sheet/root barrier.

E. It is recommended that any custom cutting/fitting be oriented on the high side (top), or sides of the roof. It is recommended that the cut side of the module be set tight against the edging or toward the side of an intact module so as to prevent soil spillage. If custom cutting must be done on the low, draining, side of the roof, it is imperative that no filter cloth be inserted as it could impede drainage. It is best to orient the cut side against another module, facing upstream.

F. After installing modules, they should be immediately watered so as to thoroughly moisten the media from top to bottom. Water shall be of suitable quality for plant growth and irrigation system or hoses and sprinklers may be used for such purpose. Note: it takes approximately 1 inch of water, or 1% gallons per module to moisten each module thoroughly.

G. First maintenance visit to be conducted two (2) weeks after installation is completed and continued according to Section 3.7 by SEPTA and the installer. Installer is to provide 2 years of Maintenance commencing completion of installation.

3.07 MAINTENANCE

A. Green Roof Provider Shall Provide a seasonal informational email newsletter, free of charge, that shares current best maintenance practices, seasonal topics related to plant care, and chronologically guides the maintenance contractor through the various steps of the maintenance protocol beginning April 1 and ending Nov. 1 of each year.

B. Record all green roof maintenance events. Include name of person, date and activity.

1. If fertilizer, record type and amount applied per 1000sf
2. If soil test, record lab
3. If irrigation, record duration and quantity

C. Foot Traffic: Limit foot traffic to a random path a couple times per week by one person. Avoid walking in a single path, standing in one place, or trampling plants. If parapet or adjoining wall must be serviced, plants may be covered with plywood or foam sheeting for up to 4 hours intermittently, provided foliage is not wet and conditions are not too hot or sunny.

D. Annual Maintenance


   During April 1 to 15 of each year, administer an annual soil test for PH and fertility levels.

   a. Maintain pH in the range of 6.5 to 8.0. In the event that pH is outside of the 6.5 to 8.0 range, consult the manufacturer for the appropriate amendment.

   b. Maintain fertility in the normal range using a typical field soil fertility test as provided by A&L labs. When indicated, apply a single springtime application of Nutricote 14 14 14, Type 180 (180 day release period) or equivalent, at 201bs per 1000sf. Follow the Nutricote labeled directions for application rate, which take priority over any recommendations listed here. Runoff potential does exist and should be evaluated by the applicator in accord with the site specifics; the greater the runoff sensitivity, the lower the application rate. All applications of
fertilizer are the sole responsibility of the applicator.

E. Irrigation

1. Watering

Contractor shall provide supplemental watering (ie, hand irrigation) as needed during warm weather to ensure the health of the green roof vegetation.

Even in the northern temperate zone of North America, successive watering may sometimes be needed to keep green roof plants alive. Protracted hot dry weather can result in plant thinning or death. In warmer climates, depending upon rainfall and exposure, occasional irrigation may be required. Prolonged hot dry weather, in the northern temperate zone, is generally defined as periods of 75 degree weather, with less than 1" of rainfall persisting for 4 weeks or longer. This time period will likely be less if the temperatures are hotter the climate warmer, on sloping rooftops, or roofs exposed to strong winds. Such conditions can dry out the green roof substrate and cause the plants to go dormant or to dry up and die. Dormant plants tend to shrink to a smaller size and expose soil, which can predispose the system to weed encroachment.

NOTE: There are no absolutes when it comes to irrigation. Check the plants for wilting in the morning rather than midday. Irrigate thoroughly to runoff to remoisten entire soil profile if the plants show signs of wilting in the morning.

In areas of reflected light, such as next to south facing walls, more frequent irrigation should be applied to keep the soil from becoming excessively dry.

F. Inspections and Plant Care Protocol

Conduct the following once per month during the entire Spring through Fall Growing Season

1. Conduct hand weeding. Pull all weeds, never allow any weed to flower, set seed and complete its life cycle. Weeding should be conducted spring through fall.

   The interval may be adjusted in accord with seasonal variations in weed growth, but the interval should never exceed 4 weeks or be long enough to allow for weeds to flower and set seed. Never allow woody plants to establish in a green roof system as their root systems are extensive and can damage roof membranes.

   Herbicides, whether pre-emergent or post-emergent, are not recommended as they are not healthy for the environment and can contaminate runoff. A need for pre-emergent herbicides is a sign of weeding too infrequently.

2. Displaced Soil:
   Any displaced soil, typically due to nesting birds, should be immediately replaced.

3. Drainage Inspection:
   Roof drains should be cleared of any debris, pebbles, leaves, etc. during the twice monthly inspection to keep drains flowing freely.

4. Debris/Trash Removal:
   Remove immediately debris or trash during monthly inspection. Especially during fall and spring, rake green roof planting clean of any matted tree leaves to prevent smothering.

5. Pesticides:
   Pesticide use is discouraged and should always be considered secondary to cultural and biological control measures, as pesticides can get into runoff water and cause environmental damage. Pesticide use should only be conducted by qualified and licensed applicators, and on an...
"as needed" basis. All applications of pesticides are the sole responsibility of the applicator.

6. Winter:
   Avoid applying salt and other deicing agents to green roof plantings. Avoid walking on frozen plants and roof surfaces.

G. Apply slow release fertilizer as needed in accord with manufacturer's directions. DO NOT fertilize within two months of the first frost. In northern temperate climates, this is approximately August 15. Avoid runoff into sensitive areas.

3.08 ACCEPTANCE
   A. Conduct post installation inspection to determine acceptance of modules. Inspection to be made by General Contractor's Representative or by Owner's Representative upon General Contractor's request; five working days notice required.

   B. Installer is responsible to ensure proper module/plant maintenance until work has been accepted by representative of Owner or General Contractor.

   C. Upon acceptance, Owner assumes responsibility for module/plant maintenance.

3.09 CLEAN UP
   A. Throughout installation, keep all work surfaces clean and free of grit, dirt, or debris. Use broom not blower, do not sweep soil under modules or slip sheet. Do not place modules upon soil, dirt, stones or grit. Following installation, remove all excess materials and tools from job site. Ensure that any damage that occurs as a result of installation is appropriately and immediately repaired.

END OF SECTION
SECTION 03300

CAST-IN-PLACE CONCRETE (LIMITED APPLICATIONS)

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section specifies cast-in-place concrete, including reinforcement, concrete materials, mix design, placement procedures, and finishes.

1.03 SUBMITTALS

A. General: In addition to the following, comply with submittal requirements in ACI 301.

B. Product Data: For each type of manufactured material and product indicated.

C. Design Mixes: For each concrete mix.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed concrete work 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.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products complying with ASTM C 94 requirements for production facilities and equipment.

C. Source Limitations: Obtain each type of cement of the same brand from the same manufacturer's plant, each aggregate from one source, and each admixture from the same manufacturer.

D. Comply with ACI 301, "Specification for Structural Concrete," including the following, unless modified by the requirements of the Contract Documents.

1. General requirements, including submittals, quality assurance, acceptance of structure, and protection of in-place concrete.
2. Formwork and form accessories.
3. Steel reinforcement and supports.
4. Concrete mixtures.
5. Handling, placing, and constructing concrete.
PART 2 - PRODUCTS

2.01 FORMWORK
A. Furnish formwork and form accessories according to ACI 301.

2.02 STEEL REINFORCEMENT
A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.
B. Plain-Steel Welded Wire Fabric: ASTM A 185, fabricated from as-drawn steel wire into flat sheets.

2.03 CONCRETE MATERIALS
A. Portland Cement: ASTM C 150, Type II.
B. Normal-Weight Aggregate: ASTM C 33, uniformly graded, not exceeding 1-1/2-inch (38-mm) nominal size.
D. Water: Potable and complying with ASTM C 94.

2.04 ADMIXTURES
A. General: Admixtures certified by manufacturer to contain not more than 0.1 percent water-soluble chloride ions by mass of cement and to be compatible with other admixtures. Do not use admixtures containing calcium chloride.
C. Water-Reducing Admixture: ASTM C 494, Type A.
D. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
E. Water-Reducing and Accelerating Admixture: ASTM C 494, Type E.
F. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.

2.05 RELATED MATERIALS
A. Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber, or ASTM D 1752, cork or self-expanding cork.
B. Vapor Retarder: Multi-ply reinforced polyethylene sheet, ASTM E 1745, Class C, not less than 7.8 mils (0.18 mm) thick; or polyethylene sheet, ASTM D 4397, not less than 10 mils (0.25 mm) thick.
2.06 CURING MATERIALS

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) 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.

2.07 CONCRETE MIXES

A. Comply with ACI 301 requirements for concrete mixtures.
B. Prepare design mixes, proportioned according to ACI 301, for normal-weight concrete determined by either laboratory trial mix or field test data bases, as indicated on the Drawings.
   1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
   2. Slump: 4 inches (100 mm).
      a. Slump Limit for Concrete Containing High-Range Water-Reducing Admixture: Not more than 8 inches (200 mm) after adding admixture to plant- or site-verified, 2- to 3-inch (50- to 75-mm) slump.
C. Add air-entraining admixture at manufacturer’s prescribed rate to result in concrete at point of placement having an air content of 6.0 percent within a tolerance of plus 1.0 or minus 1.5 percent.
   1. Air content of trowel-finished interior concrete floors shall not exceed 3.0 percent.

2.08 CONCRETE MIXING

A. Ready-Mixed Concrete: Comply with ASTM C 94.
   1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
B. Project-Site Mixing: Measure, batch, and mix concrete materials and concrete according to ASTM C 94. Mix concrete materials in appropriate drum-type batch machine mixer.
   1. For mixer capacity of 1 cu. yd. (0.76 cu. m) or smaller, continue mixing at least one and one-half minutes, but not more than five minutes after ingredients are in mixer, before any part of batch is released.
   2. For mixer capacity larger than 1 cu. yd. (0.76 cu. m), increase mixing time by 15 seconds for each additional 1 cu. yd. (0.76 cu. m).
   3. Provide batch ticket for each batch discharged and used in the Work, indicating Project identification name and number, date, mix type, mix time, quantity, and amount of water added. Record approximate location of final deposit in structure.
PART 3 - EXECUTION

3.01 FORMWORK

A. Design, construct, erect, shore, brace, and maintain formwork according to ACI 301.

3.02 VAPOR RETARDER

A. Install, protect, and repair vapor-retarder sheets according to ASTM E 1643; place sheets in position with longest dimension parallel with direction of pour.

B. Lap joints 6 inches (150 mm) and seal with manufacturer's recommended tape.
   1. Cover vapor retarder with fine-graded granular material, moisten, and compact with mechanical equipment to elevation tolerances of plus 0 inch (0 mm) or minus 3/4 inch (19 mm).

3.03 STEEL REINFORCEMENT

A. Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.
   1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.04 JOINTS

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Locate and install so as not to impair strength or appearance of concrete, at locations indicated or as approved by Architect.

C. Isolation Joints: Install joint-filler strips at junctions with slabs-on-grade and vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
   1. Extend joint fillers full width and depth of joint, terminating flush with finished concrete surface, unless otherwise indicated.

D. Contraction (Control) Joints in Slabs-on-Grade: 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:
   1. Grooved Joints: Form contraction joints after initial floating by grooving and finishing each edge of joint with groover tool to a radius of 1/8 inch (3 mm). Repeat grooving of contraction joints after applying surface finishes. Eliminate groover marks on concrete surfaces.
   2. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-Inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
3.05 CONCRETE PLACEMENT

A. Comply with recommendations in ACI 304R for measuring, mixing, transporting, and placing concrete.

B. Consolidate concrete with mechanical vibrating equipment.

3.06 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defective areas repaired and patched, and fins and other projections exceeding 1/4 inch (6 mm) in height rubbed down or chipped off.

1. Apply to concrete surfaces not exposed to public view.

3.07 FINISHING UNFORMED SURFACES

A. General: Comply with ACI 302.1R for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Screed surfaces with a straightedge and strike off. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane before excess moisture or bleedwater appears on the surface.

1. Do not further disturb surfaces before starting finishing operations.

C. Float Finish: Apply float finish to surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

D. Trowel Finish: Apply a hard trowel finish to surfaces indicated and to floor and slab 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.

3.08 TOLERANCES

A. Comply with ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

3.09 CONCRETE PROTECTION 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 follow recommendations in ACI 305R for hot-weather protection during curing.

B. 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 (1 kg/sq. m 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. Begin curing after finishing concrete, but not before free water has disappeared from concrete surface.
D. Curing Methods: Cure formed and unformed concrete for at least seven days 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 (300-mm) lap over adjacent absorptive covers.

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 (300 mm), and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during 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.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: See the Drawings for Testing Agency requirements.

1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mix 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.

3.11 REPAIRS

A. Remove and replace concrete that does not comply with requirements in this Section.

END OF SECTION
PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Unit masonry assemblies consisting of the following:

1. Concrete masonry units (CMUs).
2. Sound-absorbing concrete masonry units.
3. Face brick.
4. Glazed Masonry Units.
5. Glazed Sound Absorbing Masonry Units.
6. Mortar and grout.
7. Reinforcing steel.
8. Masonry joint reinforcement.
9. Ties and anchors.
10. Embedded flashing.
11. Miscellaneous masonry accessories.

B. Related Sections:

1. Section 07115 “Bituminous Dampproofing”
2. Section 07210 “Building Insulation”
3. Section 07600 “Metal Flashing and Trim”
4. Section 07900 “Joint Sealants”

C. Products installed, but not furnished, under this Section include the following:

1. Steel lintels and shelf angles for unit masonry, furnished under Section 05500 “Metal Fabrications.”
2. Cavity-wall insulation specified in Section 07210 “Building Insulation.”
3. Manufactured reglets in masonry joints for metal flashing, furnished under Section 07600 “Metal Flashing and Trim.”
4. Pipe sleeves furnished by mechanical and electrical.

1.03 DEFINITIONS

A. Reinforced Masonry: Masonry containing reinforcing steel in grouted cells.

1.04 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops the following net-area compressive strengths ($f'_{m}$) at 28 days.

1. For Concrete Unit Masonry: As indicated.
2. For Brick Unit Masonry: $f'_{m} = 2000$ psi.
B. Determine net-area compressive strength \( (f'_{\text{m}}) \) of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For the following:

1. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement." Show elevations of reinforced walls.
2. Fabricated Flashing: Detail corner units, end-dam units, and other special applications.

C. Samples for Initial Selection: For colored mortar.

D. Samples for Verification: For each type and color of the following:

1. Face brick, in the form of straps of five or more bricks.
2. Special brick shapes.
3. Exposed mortar. Make Samples using same sand and mortar ingredients to be used on Project. Label Samples to indicate types and amounts of pigments used.
4. Weep holes/vents.
5. Accessories embedded in masonry.

E. List of Materials Used in Constructing Sample Panels: List generic product names together with manufacturers, manufacturers’ product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of sample panel constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

F. Qualification Data: For testing agency.

G. Material Certificates: Include statements of material properties indicating compliance with requirements including compliance with standards and type designations within standards. Provide for each type and size of the following:

1. Masonry units.
   a. Include material test reports substantiating compliance with requirements.
   b. For bricks, include size-variation data verifying that actual range of sizes falls within specified tolerances.
   c. For exposed brick, include material test report for efflorescence according to ASTM C 67.
   d. For masonry units used in structural masonry, include data and calculations establishing average net-area compressive strength of units.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Reinforcing bars.
7. Anchors, ties, and metal accessories.
H. Mix Designs: For each type of mortar and grout. Include description of type and proportions of ingredients.
   1. Include test reports, per ASTM C 780, for mortar mixes required to comply with property specification.
   2. Include test reports, per ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

I. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

J. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with cold-weather and hot-Weather requirements.

K. Mock-up showing relationship between brick, metal panel and windows.

1.06 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM C 1093 for testing indicated, as documented according to ASTM E 548.

B. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, through one source from a single manufacturer for each product required.

C. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from a single manufacturer for each cementitious component and from one source or producer for each aggregate.

D. Preconstruction Testing Service: Engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to meet specified requirements shall be done at Contractor's expense.
   1. Clay Masonry Unit Test: For each type of unit required, per ASTM C 67.
   2. Concrete Masonry Unit Test: For each type of unit required, per ASTM C 140.
   3. Mortar Test (Property Specification): For each mix required, per ASTM C 780.
   4. Grout Test (Compressive Strength): For each mix required, per ASTM C 1019.
   5. Prism Test: For each type of construction required, per ASTM C 1314.

E. Fire-Resistance Ratings: Where indicated, provide materials and construction identical to those of assemblies with fire-resistance ratings determined per ASTM E 119 by a testing and inspecting agency, by equivalent concrete masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

F. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects.
   1. Build sample panels for typical exterior and interior walls in sizes approximately 72 inches long by 48 inches high by full thickness. Include all brick colors specified.
   2. Clean one-half of exposed faces of panels with masonry cleaner indicated.
   3. Protect approved sample panels from the elements with weather-resistant membrane.
   4. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.
a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

G. Preinstallation Conference: Conduct conference at Project site to comply with requirements in Division 01.

1.07 PRODUCT HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for lifting and emptying into dispensing silo. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in a metal dispensing silo with weatherproof cover.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.08 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides and hold cover securely in place.
2. Where 1 wythe of multiwythe masonry walls is completed in advance of other wythes, secure cover a minimum of 24 inches down face next to unconstructed wythe and hold cover in place.

B. Do not apply uniform floor or roof loads for at least 12 hours and concentrated loads for at least 3 days after building masonry walls or columns.

C. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

D. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.
1. **Cold-Weather Cleaning:** Use liquid cleaning methods only when air temperature is 40 deg F and above and will remain so until masonry has dried, but not less than 7 days after completing cleaning.

E. **Hot-Weather Requirements:** Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

**PART 2 PRODUCTS**

2.01 **MASSONRY UNITS, GENERAL**

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to exceed tolerances and to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not uses units where such defects, including dimensions that vary from specified dimensions by more than stated tolerances, will be exposed in the completed Work or will impair the quality of completed masonry.

2.02 **CONCRETE MASONRY UNITS (CMUs)**

A. Shapes: Provide shapes indicated and as follows:

1. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
2. Provide bullnose units for outside corners, unless otherwise indicated.

B. Concrete Masonry Units: ASTM C 90.

1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2150 psi, unless greater strength is required to comply with net-area compressive strengths \( f'_{m} \) indicated for masonry assemblies.
2. Weight Classification: Normal weight, unless otherwise indicated.
3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

C. Sound-Absorbing Masonry Units: Specially designed masonry units with factory-installed noise attenuating fillers that provide stacking, slot-type volume resonator and sound diffusion.

2. Sound Absorption Efficiency: 100 percent average across 100-125-160-200 Hz frequency bandwidth.
3. Flutter Echo Effect: Units have 77 percent of their surface area skewed to a 3:12 ratio to arrest flutter echo annoyance.

D. Special Units for Reinforced CMU: Provide in locations indicated, to control location of horizontal and vertical reinforcing. Comply with requirements indicated for concrete masonry units and the following:

1. Basis-of-Design Product: Ivany Block; as patented by George R. Ivany Assoc., Inc., and produced by authorized Ivany Block licensee.
2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 3500 psi.
3. Weight Classification: Normal weight.

E. Glazed Masonry Units: Glazed surface shall have a smooth satin-gloss finish, externally heat-polymerized cast-on facing conforming to ASTM C744-08 and all applicable Federal Specifications.

2. Construct a sample panel, no less than 4' x 4', of units of each color and size to be used in the project.
3. Actual facing dimensions shall be 7-3/4" x 15-3/4" forming a 1/16" lip around the edges of a modular 7-5/8" x 15-5/8" block. Nominal 2", 4", 6", 8", 10" and 12" standard block thickness shall be used as required, as well as standard and special block shapes. Basic units may include stretchers, jambs, caps and cove bases. Other possible face dimensions are nominal 16" x 16", 12" x 12", 8" x 18", 4" x 16", 8" x 8". Semi-solid and solid units shall be used where specified and/or shown on the drawings.
4. Carefully following the manufacturer’s cleaning instructions. Do not powerwash.
5. Color as selected by architect from manufacturer's standard colors.
6. Review contract documents for details prior to ordering and installation of masonry units.

F. Sound Absorbing Glazed Masonry Units: Glazed surface shall have a smooth satin-gloss finish, externally heat-polymerized cast-on facing conforming to ASTM C744-08 and all applicable Federal Specifications.

2. Construct a sample panel, no less than 4' x 4', of units of each color and size to be used in the project.
3. Actual facing dimensions shall be 7-3/4" x 15-3/4" forming a 1/16" lip around the edges of a modular 7-5/8" x 15-5/8" block. Nominal 2", 4", 6", 8", 10" and 12" standard block thickness shall be used as required, as well as standard and special block shapes. Basic units may include stretchers, jambs, caps and cove bases. Other possible face dimensions are nominal 16" x 16", 12" x 12", 8" x 18", 4" x 16", 8" x 8". Semi-solid and solid units shall be used where specified and/or shown on the drawings.
4. Carefully following the manufacturer’s cleaning instructions. Do not powerwash.
5. Color as selected by architect from manufacturer's standard colors.
6. Review contract documents for details prior to ordering and installation of masonry units.

2.03 CONCRETE AND MASONRY LINTELS

A. General: For exposed conditions, provide masonry lintels complying with requirements below. For concealed conditions, provide either concrete or masonry lintels, at Contractor's option, complying with requirements below.

B. Concrete Lintels: Precast units made from concrete matching concrete masonry units in color, texture, and compressive strength and with reinforcing bars indicated or required to support loads indicated. Cure precast lintels by same method used for concrete masonry units.

C. Masonry Lintels: Built-in-place masonry lintels made from bond beam concrete masonry units with reinforcing bars placed as indicated and filled with coarse grout. Temporarily support built-in-place lintels until cured.

2.04 BRICK

A. General: Provide shapes indicated and as follows:

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.
2. Provide special shapes for applications where stretcher units cannot accommodate special conditions, including those at corners, movement joints, bond beams, sashes, and lintels.
3. Provide special shapes for applications requiring brick of size, form, color, and texture on exposed surfaces that cannot be produced by sawing.
4. Provide special shapes for applications where shapes produced by sawing would result in sawed surfaces being exposed to view.

B. Face Brick: ASTM C 216, Grade SW, Type FBS.
1. Basis-of-Design Manufacturer: Glen-Gery Brick, Tuscan Series
2. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
3. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated “not effloresced.”
5. Texture: Wire-cut.
6. Colors: As follows, with types corresponding to designations on Drawings:
   a. Type 1: Sunset.

2.05 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement complying with ASTM C 150, Type I or Type III, and hydrated lime complying with ASTM C 207, Type S.
   1. Formulate blend as required to produce color indicated or, if not indicated, as selected from manufacturer's standard colors by architect.
   2. Pigments shall not exceed 10 percent of portland cement by weight.
   3. Products: Subject to compliance with requirements, provide one of the following:
      b. Holcim (US) Inc.; Rainbow Mortamix Custom Color Cement/Lime.
      c. Lafarge North America Inc.; Eaglebond.
      d. Lehigh Cement Company; Lehigh Custom Color Portland/Lime Cement.

D. Aggregate for Mortar: ASTM C 144.

E. Aggregate for Grout: ASTM C 404.

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Glen Gery Brick Corporation
      b. Euclid Chemical Company (The); Accelguard 80.
      d. Sonneborn, Div. of ChemRex; Trimix-NCA.

G. Water: Potable.

H. Mortar Color: G-207; by Glen Gery colored mortar blend; Portland cement-lime.

2.06 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951.
   2. Wire Size for Side Rods: W2.8 or 0.188-inch diameter.
   3. Wire Size for Cross Rods: W1.7 or 0.148-inch diameter.
   4. Wire Size for Veneer Ties: W2.8 or 0.188-inch diameter.
5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry Joint Reinforcement for Single-Wythe Masonry: Either ladder or truss type with single pair of side rods.

D. Masonry Joint Reinforcement for Multiwythe Masonry:
   1. Ladder type with one side rod at each face shell of hollow masonry units more than 4 inches in width, plus one side rod at each wythe of masonry 4 inches or less in width.
   2. Tab type, either ladder or truss design, with one side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face.
   3. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate ties that extend into facing wythe. Ties have two hooks that engage eyes or slots in reinforcement and resist movement perpendicular to wall. Ties extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

2.07 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in subsequent paragraphs that are made from materials that comply with subparagraphs below, unless otherwise indicated.
   2. Galvanized Steel Sheet: ASTM A 653/A 653M, Commercial Steel, G60 zinc coating.
   3. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, hot-dip galvanized after fabrication to comply with ASTM A 153/A 153M.
   4. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches parallel to face of veneer.

C. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches wide.
   1. Z-shaped ties with ends bent 90 degrees to provide hooks not less than 2 inches long may be used for masonry constructed from solid units or hollow units laid with cells horizontal.
   2. Where wythes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches.

D. Adjustable Anchors for Connecting to Structure: Provide anchors that allow vertical or horizontal adjustment but resist tension and compression forces perpendicular to plane of wall.
   1. Continuous Channel for Attachment to Masonry Backup: Continuous Slotted Channel, 0.097-inch thick (12 gage); made from hot-dip galvanized steel.
   2. Anchor Section for Welding to Steel Frame: Crimped 1/4-inch-diameter, hot-dip galvanized steel wire.
   3. Tie Section for Steel Frame: Triangular-shaped wire tie, sized to extend within 1 inch of masonry face, made from 0.188-inch diameter, hot-dip galvanized steel wire.
   4. Connector Section for Concrete: Dovetail tabs for inserting into dovetail slots in concrete and attached to tie section; formed from 0.053-inch thick, steel sheet, galvanized after fabrication.
5. Tie Section for Concrete: Corrugated metal ties with dovetail tabs for inserting into dovetail slots in concrete and sized to extend to within 1 inch of masonry face.

E. Lateral Bracing: Provide lateral restraint at top of masonry walls where indicated and as follows:

1. Anchors: Provide 12-inch long steel angles as detailed on Drawings. Fabricate from ASTM A 366-93 steel sheet, not less than 0.0966-inch thick (12 gage), with ASTM A F153-95 galvanized finish unless otherwise indicated.
2. Anchor Spacing: 48 inches o.c. maximum.
3. Attachment: Weld or screw anchors to structural steel and metal deck.

F. Rigid Anchors: Fabricate from steel bars 1-1/2 inches wide by 1/4 inch thick by 24 inches long, with ends turned up 2 inches or with cross pins, unless otherwise indicated.

1. Corrosion Protection: Hot-dip galvanized to comply with ASTM A 153/A 153M or epoxy coating 0.020 inch thick.

2.08 MISCELLANEOUS ANCHORS

A. Anchor Bolts: L-shaped steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers; hot-dip galvanized to comply with ASTM A 153/A 153M, Class C; of dimensions indicated.

B. Postinstalled Anchors: Torque-controlled expansion anchors or chemical anchors.

1. Load Capacity: Capable of sustaining, without failure, a load equal to six times the load imposed when installed in grouted unit masonry and four times the load imposed when installed in concrete, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.
2. Material for Interior Locations: Carbon-steel components zinc plated to comply with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for Class SC 1 service condition (mild).

2.09 EMBEDDED FLASHING MATERIALS

A. Metal Flashing: Provide metal flashing, where flashing is exposed or partly exposed and where indicated, complying with Section 07600 "Metal Flashing and Trim" and as follows:

1. Stainless Steel: ASTM A 240/A 240M, Type 304, 0.016 inch thick.
2. Fabricate continuous flashings in sections 96 inches long minimum, but not exceeding 12 feet. Provide splice plates at joints of formed, smooth metal flashing.
3. Fabricate through-wall metal flashing embedded in masonry from stainless steel, with ribs at 3-inch intervals along length of flashing to provide an integral mortar bond.

a. Products: Subject to compliance with requirements, provide one of the following:

1) Cheney Flashing Company; Cheney Flashing (Dovetail) or Cheney 3-Way Flashing (Sawtooth).

4. Fabricate through-wall flashing with snaplock receiver on exterior face where indicated to receive counterflash.
5. Fabricate through-wall flashing with drip edge, unless otherwise indicated. Fabricate by extending flashing 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.
6. Fabricate metal drip edges for ribbed metal flashing from plain metal flashing of same metal as ribbed flashing and extending at least 3 inches into wall with hemmed inner edge to
receive ribbed flashing and form a hooked seam. Form hem on upper surface of metal so that completed seam will shed water.

B. Solder and Sealants for Sheet Metal Flashings: As specified in Section 07600 "Metal Flashing and Trim."

1. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

C. Adhesives, Primers, and Seam Tapes for Flashings: Flashing manufacturer's standard products or products recommended by flashing manufacturer for bonding flashing sheets to each other and to substrates.

2.10 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene.

B. Preformed Control-Joint Gaskets: Made from styrene-butadiene-rubber compound, complying with ASTM D 2000, Designation M2AA-805 or PVC, complying with ASTM D 2287, Type PVC-65406 and designed to fit standard sash block and to maintain lateral stability in masonry wall; size and configuration as indicated.

C. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

D. Weep/Vent Product: Cellular plastic weep/vent; one-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Advanced Building Products Inc.; Mortar Maze weep vent.
   b. Dayton Superior Corporation, Dur-O-Wal Division; Cell Vents.
   c. Heckmann Building Products Inc.; No. 85 Cell Vent.
   d. Hohmann & Barnard, Inc.; Quadro-Vent.
   e. Wire-Bond; Cell Vent.

E. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Provide one of the following configurations:
   a. Strips, full thickness of cavity and 10 inches wide, with dovetail shaped notches 7 inches deep that prevent mesh from being clogged with mortar droppings.
   b. Strips, full thickness of cavity and 10 inches wide, with dimpled surface designed to catch mortar droppings and prevent weep holes from being clogged with mortar.

2. Products: Subject to compliance with requirements, provide one of the following:
   a. Advanced Building Products Inc.; Mortar Break II.
   b. Dayton Superior Corporation, Dur-O-Wal Division; Polytite MortarStop.
   c. Mortar Net USA, Ltd.; Mortar Net.

F. Reinforcing Bar Positioners: Wire units designed to fit into mortar bed joints spanning masonry unit cells with loops for holding reinforcing bars in center of cells. Units are formed from 0.142-inch steel wire, hot-dip galvanized after fabrication. Provide units with either two loops or four loops as needed for number of bars indicated.
1. Products: Subject to compliance with requirements, provide one of the following:
   a. Dayton Superior Corporation, Dur-O-Wal Division; D/A 810, D/A 812 or D/A 817.
   c. Hohmann & Barnard, Inc.; #RB or #RB-Twin Rebar Positioner.
   d. Wire-Bond; O-Ring or Double O-Ring Rebar Positioner.

2.11 MASONRY CLEANERS

A. Proprietary Acidic Cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Verify acceptability of cleaner for masonry type and pigmented mortar joints.
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Diedrich Technologies, Inc.
   b. EaCo Chem, Inc.
   c. ProSoCo, Inc.

2.12 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures, unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Limit cementitious materials in mortar to portland cement and lime.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. Type M: For masonry below grade or in contact with earth.
2. Type S: For reinforced masonry; for exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated.
3. Type S or N: For mortar parge coats.

D. Pigmented Mortar: Use colored cement product.

1. Do not add pigments to colored cement products.

E. Grout for Unit Masonry: Comply with ASTM C 476.

1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.
2. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.
2.13 SOURCE QUALITY CONTROL

A. Engage a qualified independent testing agency to perform source quality-control testing indicated below.

1. Retesting of materials failing to comply with specified requirements shall be done at Contractor's expense.

B. Clay Masonry Unit Test: For each type of unit furnished, per ASTM C 67.

C. Concrete Masonry Unit Test: For each type of unit furnished, per ASTM C 140.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.
2. Verify that foundations are within tolerances specified.
3. Verify that reinforcing dowels are properly placed.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. Thickness: Build cavity and composite walls and other masonry construction to full thickness shown. Build single-wythe walls to actual widths of masonry units, using units of widths indicated.

B. Build chases and recesses to accommodate items specified in this and other Sections.

C. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

D. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

E. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

F. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

G. Comply with construction tolerances in ACI 530.1/ASCE 6/TMS 602 and with the following:
1. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

2. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

3. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.

4. For exposed bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch. Do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

5. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch. Do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

6. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.

7. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.03 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond unless otherwise indicated, and special bond pattern indicated on Drawings; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Lay concealed masonry with all units in a wythe in running bond or bonded by lapping not less than 4-inches. Bond and interlock each course of each wythe at corners. Do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

D. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

E. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

F. Fill space between steel frames and masonry solidly with mortar, unless otherwise indicated.

G. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

H. Fill cores in hollow concrete masonry units with grout 24 inches under bearing plates, beams, lintels, posts, and similar items, unless otherwise indicated.

I. Build non-load-bearing interior partitions full height of story to underside of solid floor or roof structure above, unless otherwise indicated.

1. Install compressible filler in joint between top of partition and underside of structure above.

2. Fasten partition top anchors to structure above to brace each side of partition. Space anchors 48 inches o.c., unless otherwise indicated.
J. Installation of Sound-Absorbing Masonry: Lay units in running bond with open ends of cavities facing downward. Seat units in full bed of mortar to ensure optimum sound absorption and sound transmission loss performance.

1. Expose slots toward area where sound absorption is desired, as indicated on Drawings.
2. Keep slots free of mortar and debris above mortar joints.
3. Install with lines straight and true, with consistent pattern of slots.
4. Treat joints in front and back of units as recommended by manufacturer.

3.04 MORTAR BEDDING AND JOINTING

A. Lay hollow masonry units as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

C. Set cast stone trim units in full bed of mortar with full vertical joints. Fill dowel, anchor, and similar holes.

1. Clean soiled surfaces with fiber brush and soap powder and rinse thoroughly with clear water.
2. Wet joint surfaces thoroughly before applying mortar.

D. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness, unless otherwise indicated.

3.05 CAVITY WALLS

A. Bond wythes of cavity walls together using one of the following methods:

1. Individual Metal Ties: Provide ties as shown installed in horizontal joints, but not less than one metal tie for 2.67 sq. ft. of wall area spaced not to exceed 24 inches o.c. horizontally and 16 inches o.c. vertically. Stagger ties in alternate courses. Provide additional ties within 12 inches of openings and space not more than 36 inches apart around perimeter of openings. At intersecting and abutting walls, provide ties at no more than 24 inches o.c. vertically.

   a. Use adjustable (two-piece) type ties with continuous horizontal wire in facing wythe.


   a. Where bed joints of wythes do not align, use adjustable (two-piece) type reinforcement with continuous horizontal wire in facing wythe attached to ties.

B. Keep cavities clean of mortar droppings and other materials during construction. Bevel beds away from cavity, to minimize mortar protrusions into cavity. Do not attempt to trowel or remove mortar fins protruding into cavity.

C. Coat cavity face of backup wythe to comply with Section 07115 "Bituminous Dampproofing."

D. Installing Cavity-Wall Insulation: Place small dabs of adhesive, spaced approximately 12 inches o.c. both ways, on inside face of insulation boards, or attach with plastic fasteners designed for this purpose. Fit courses of insulation between wall ties and other confining obstructions in cavity, with
edges butted tightly both ways. Press units firmly against inside wythe of masonry or other construction as shown.

1. Fill cracks and open gaps in insulation with crack sealer compatible with insulation and masonry.

3.06 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.
3. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings.
   a. Reinforcement above is in addition to continuous reinforcement.

B. Interrupt joint reinforcement at control and expansion joints, unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

E. Cut and bend reinforcing units as directed by manufacturer for continuity at corners, returns, offsets, column fireproofing, pipe enclosures, and other special conditions.

3.07 ANCHORING MASONRY TO STRUCTURAL MEMBERS

A. Anchor masonry to structural members where masonry abuts or faces structural members to comply with the following:

1. Provide an open space not less than 1 inch in width between masonry and structural member, unless otherwise indicated. Keep open space free of mortar and other rigid materials.
2. Anchor masonry to structural members with anchors embedded in masonry joints and attached to structure.
3. Space anchors as indicated, but not more than 24 inches o.c. vertically and 36 inches o.c. horizontally.

3.08 CONTROL AND EXPANSION JOINTS

A. General: Install control and expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span control and expansion joints without provision to allow for in-plane wall or partition movement.

B. Form control joints in concrete masonry as follows:

1. Install preformed control-joint gaskets designed to fit standard sash block.

C. Form expansion joints in brick as follows:

1. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07900 "Joint Sealants."

D. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07900 "Joint Sealants," but not less than 3/8 inch.
1. Locate horizontal, pressure-relieving joints beneath shelf angles supporting masonry.

3.09 LINTELS

A. Install steel lintels where indicated.

B. Provide concrete or masonry lintels where shown and where openings of more than 12 inches for brick-size units and 24 inches for block-size units are shown without structural steel or other supporting lintels.

C. Provide minimum bearing of 8 inches at each jamb, unless otherwise indicated.

3.10 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated. Install vents at shelf angles, ledges, and other obstructions to upward flow of air in cavities, and where indicated.

B. Install flashing as follows, unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.

2. At multiwythe masonry walls, including cavity walls, extend flashing through outer wythe, turned up a minimum of 8 inches, and 1-1/2 inches into the inner wythe. Form 1/4-inch hook in edge of metal flashing embedded in inner wythe.

3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.

4. Interlock end joints of ribbed sheet metal flashing by overlapping ribs not less than 1-1/2 inches or as recommended by flashing manufacturer, and seal lap with elastomeric sealant complying with requirements in Section 07900 "Joint Sealants" for application indicated.

5. Install metal drip edges with ribbed sheet metal flashing by interlocking hemmed edges to form hooked seam. Seal seam with elastomeric sealant complying with requirements in Section 07900 "Joint Sealants" for application indicated.

C. Install reglets and nailers for flashing and other related construction where they are shown to be built into masonry.

D. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.

2. Space weep holes 24 inches o.c., unless otherwise indicated.

E. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in Part 2 "Miscellaneous Masonry Accessories" Article.

3.11 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

1. Construct formwork to provide shape, line, and dimensions of completed masonry as indicated. Make forms sufficiently tight to prevent leakage of mortar and grout. Brace, tie, and support forms to maintain position and shape during construction and curing of reinforced masonry.
2. Do not remove forms and shores until reinforced masonry members have hardened sufficiently to carry their own weight and other temporary loads that may be placed on them during construction.

B. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

C. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.
   1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
   2. Limit height of vertical grout pours to not more than 60 inches.

3.12 FIELD QUALITY CONTROL

A. Inspectors: Owner will engage qualified independent inspectors to perform inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed to perform inspections.
   1. Place grout only after inspectors have verified compliance of grout spaces and grades, sizes, and locations of reinforcement.

B. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections indicated below and prepare test reports:
   1. Retesting of materials failing to comply with specified requirements shall be done at Contractor’s expense.

C. Testing Frequency: One set of tests for each 5000 sq. ft. of wall area or portion thereof.

D. Grout Test (Compressive Strength): For each mix provided, per ASTM C 1019.

3.13 PARGING

A. Parge basement walls of existing building where exposed by excavation, in 2 uniform coats to a total thickness of 3/4 inch. Dampen wall before applying first coat and scarify first coat to ensure full bond to subsequent coat.

B. Use a steel-trowel finish to produce a smooth, flat, dense surface with a maximum surface variation of 1/8 inch per foot. Form a wash at top of parging and a cove at bottom.

C. Damp-cure parging for at least 24 hours and protect parging until cured.

3.14 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.

2. Test cleaning methods on sample wall panel; leave one-half of panel uncleaned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.

3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.

4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.

   a. If necessary to further clean brick following detergent cleaning, and only if approved by brick and mortar manufacturers, clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.

6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

7. Clean cast stone by bucket and brush hand-cleaning method described in BIA Technical Notes No. 20 Revised II, using job-mixed detergent solution. If recommended by cast stone manufacturer, clean cast stone with proprietary acidic cleaner applied according to manufacturer's written instructions.

END OF SECTION
SECTION 05120
STRUCTURAL STEEL

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes structural steel.

B. Related Sections: The following Sections contain requirements that relate to this Section:

1. Division 1 Section "Quality Control" for independent testing agency procedures and administrative requirements.

1.03 PERFORMANCE REQUIREMENTS

A. Structural Performance: Engineer structural steel connections required by the Contract Documents to be selected or completed by the fabricator to withstand design loadings indicated.

B. Engineering Responsibility: Engage a fabricator who utilizes a qualified professional engineer to prepare calculations, Shop Drawings, and other structural data for structural steel connections.

1.04 SUBMITTALS

A. General: Submit each item in this Article according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product Data for each type of product specified.

C. Shop Drawings detailing fabrication of structural steel components.

1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.

2. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld.

3. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify high-strength bolted slip-critical, direct-tension, or tensioned shear/bearing connections.

4. Include Shop Drawings signed and sealed by a qualified professional engineer responsible for their preparation.
D. Qualification data for firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.

E. Mill test reports signed by manufacturers certifying that their products, including the following, comply with requirements.
   1. Structural steel, including chemical and physical properties.
   2. Bolts, nuts, and washers, including mechanical properties and chemical analysis.
   3. Shop primers.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who has completed structural steel work similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Fabricator Qualifications: Engage a firm experienced in fabricating structural steel similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to fabricate structural steel without delaying the Work.

C. Comply with applicable provisions of the following specifications and documents:
   2. AISC's "Load and Resistance Factor Design (LFRD) Specification for Structural Steel Buildings."
   5. AISC's "Seismic Provisions for Structural Steel Buildings."
   6. ASTM A 6 (ASTM A 6M) "Specification for General Requirements for Rolled Steel Plates, Shapes, Sheet Piling, and Bars for Structural Use."

D. Professional Engineer Qualifications: A professional engineer who is legally authorized to practice in the jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for projects with structural steel framing that are similar to that indicated for this Project in material, design, and extent.

E. Welding Standards: Comply with applicable provisions of AWS D1.1 "Structural Welding Code-Steel."
   1. Present evidence that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

F. Preinstallation Conference: Conduct conference at Project site to comply with requirements of Division 1 Section "Project Meetings."
1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver structural steel to Project site in such quantities and at such times to ensure continuity of installation.

B. Store materials to permit easy access for inspection and identification. Keep steel members off ground by using pallets, platforms, or other supports. Protect steel members and packaged materials from erosion and deterioration.

1. Store fasteners in a protected place. Clean and relubricate bolts and nuts that become dry or rusty before use.
2. Do not store materials on structure in a manner that might cause distortion or damage to members or supporting structures. Repair or replace damaged materials or structures as directed.

1.07 SEQUENCING

A. Supply anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, templates, instructions, and directions, as required, for installation.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Structural Steel Shapes, Plates, and Bars: As indicated on Drawings:

B. Anchor Rods, Bolts, Nuts, and Washers: As follows:

2. Headed Bolts: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts and heavy hex carbon-steel nuts.

C. High-Strength Bolts, Nuts, and Washers: ASTM A 325 (ASTM A 325M), Type 1, heavy hex steel structural bolts, heavy hex carbon-steel nuts, and hardened carbon-steel washers.

1. Finish: Plain, uncoated.

D. Welding Electrodes: Comply with AWS requirements.

2.02 PRIMER

A. Primer: SSPC-Paint 25, Type II, zinc oxide, alkyd, linseed oil primer.
2.03 GROUT

A. Metallic, Shrinkage-Resistant Grout: Premixed, factory-packaged, ferrous aggregate grout, complying with ASTM C 1107, of consistency suitable for application, and a 30-minute working time.

2.04 FABRICATION

A. Fabricate and assemble structural steel in shop to greatest extent possible. Fabricate structural steel according to AISC specifications referenced in this Section and in Shop Drawings.
   1. Identify high-strength structural steel according to ASTM A 6 (ASTM A 6M) and maintain markings until steel has been erected.
   2. Mark and match-mark materials for field assembly.
   3. Fabricate for delivery a sequence that will expedite erection and minimize field handling of structural steel.
   4. Complete structural steel assemblies, including welding of units, before starting shop-priming operations.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
   1. Plane thermally cut edges to be welded.

C. Finishing: Accurately mill ends of columns and other members transmitting loads in bearing.

D. Holes: Provide holes required for securing other work to structural steel framing and for passage of other work through steel framing members, as shown on Shop Drawings.
   1. Cut, drill, or punch holes perpendicular to metal surfaces. Do not flame-cut holes or enlarge holes by burning. Drill holes in bearing plates.
   2. Weld threaded nuts to framing and other specialty items as indicated to receive other work.

2.05 SHOP CONNECTIONS

A. Shop install and tighten nonhigh-strength bolts, except where high-strength bolts are indicated.

B. Shop install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Shop install and tighten high-strength bolts according to RCSC's "Load and Resistance Factor Design Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
   1. Bolts: ASTM A 325 (ASTM A 325M) high-strength bolts, unless otherwise indicated.
   2. Connection Type: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.

D. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.
2.06 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 (50 mm).
   2. Surfaces to be field welded.
   3. Surfaces to be high-strength bolted with slip-critical connections.

B. Surface Preparation: Clean surfaces to be painted. Remove loose rust, loose mill scale, and spatter, slag, or flux deposits. Prepare surfaces according to SSPC specifications as follows:
   1. SSPC-SP 3 "Power Tool Cleaning."

C. Priming: Immediately after surface preparation, apply primer according to manufacturer's instructions and at rate recommended by SSPC to provide a dry film thickness of not less than 1.5 mils (0.038 mm). 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 2 coats of shop paint to inaccessible surfaces after assembly or erection. Change color of second coat to distinguish it from first.

2.07 SOURCE QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform shop inspections and tests and to prepare test reports.
   1. Testing agency will conduct and interpret tests and state in each report whether test specimens comply with or deviate from requirements.
   2. Provide testing agency with access to places where structural steel Work is being fabricated or produced so required inspection and testing can be accomplished.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Shop-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, shop-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.
   1. Liquid Penetrant Inspection: ASTM E 165.
   2. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
   3. Radiographic Inspection: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
PART 3 - EXECUTION

3.01 EXAMINATION

A. Before erection proceeds, and with the steel erector present, verify elevations of concrete and masonry bearing surfaces and locations of anchorages for compliance with requirements.

B. Do not proceed with erection until unsatisfactory conditions have been corrected.

3.02 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.

3.03 ERECTION

A. Set structural steel accurately in locations and to elevations indicated and according to AISC specifications referenced in this Section.

B. Base and Bearing Plates: Clean concrete and masonry bearing surfaces of bond-reducing materials and roughen surfaces prior to setting base and bearing plates. Clean bottom surface of base and bearing plates.

1. Set base and bearing plates for structural members on wedges, shims, or setting nuts as required.
2. Tighten anchor bolts after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of base or bearing plate prior to packing with grout.
3. Pack grout solidly between bearing surfaces and plates so no voids remain. Finish exposed surfaces, protect installed materials, and allow to cure.
   a. Comply with manufacturer's instructions for proprietary grout materials.

C. Maintain erection tolerances of structural steel within AISC's "Code of Standard Practice for Steel Buildings and Bridges."

D. Align and adjust various members forming part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that will be in permanent contact. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.

1. Level and plumb individual members of structure.
2. Establish required leveling and plumbing measurements on mean operating temperature of structure. Make allowances for difference between temperature at time of erection and mean temperature at which structure will be when 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 by using drift pins. Ream holes that must be enlarged to admit bolts.

### 3.04 FIELD CONNECTIONS

A. Install and tighten high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

1. **Bolts**: ASTM A 325 (ASTM A 325M) high-strength bolts, unless otherwise indicated.
2. **Connection Type**: Snug tightened, unless indicated as slip-critical, direct-tension, or tensioned shear/bearing connections.

B. Weld Connections: Comply with AWS D1.1 for procedures, appearance and quality of welds, and methods used in correcting welding work.

1. Comply with AISC specifications referenced in this Section for bearing, adequacy of temporary connections, alignment, and removal of paint on surfaces adjacent to field welds.

### 3.05 FIELD QUALITY CONTROL

A. Owner will engage an independent testing and inspecting agency to perform field inspections and tests and to prepare test reports.

1. Testing agency will conduct and interpret tests and state in each report whether tested Work complies with or deviates from requirements.

B. Correct deficiencies in or remove and replace structural steel that inspections and test reports indicate do not comply with specified requirements.

C. Additional testing, at Contractor's expense, will be performed to determine compliance of corrected Work with specified requirements.

D. Field-bolted connections will be tested and inspected according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

E. In addition to visual inspection, field-welded connections will be inspected and tested according to AWS D1.1 and the inspection procedures listed below, at testing agency's option.

1. **Liquid Penetrant Inspection**: ASTM E 165.
2. **Magnetic Particle Inspection**: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration will not be accepted.
3. **Radiographic Inspection**: ASTM E 94 and ASTM E 142; minimum quality level "2-2T."
4. **Ultrasonic Inspection**: ASTM E 164.

### 3.06 CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint. Apply paint to exposed areas using same material as used for shop painting.
1. Apply by brush or spray to provide a minimum dry film thickness of 1.5 mils (0.038 mm).

END OF SECTION
SECTION 05210

STEEL JOISTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY
A. This Section includes the following:

1.03 DEFINITIONS
A. SJI "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 non-uniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.04 PERFORMANCE REQUIREMENTS
A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.
B. Design special joists to withstand design loads with live load deflections no greater than the following:

1.05 SUBMITTALS
A. Product Data: For each type of joist, accessory, and product indicated.
B. Shop Drawings: Show layout, designation, number, type, location, and spacing of joists. Include joining and anchorage details, bracing, bridging, joist accessories; splice and connection locations and details; and attachments to other construction.
   1. Indicate locations and details of bearing plates to be embedded in other construction.
2. Comprehensive engineering analysis of special joists signed and sealed by the qualified professional engineer responsible for its preparation.

C. Welding certificates.

D. Manufacturer Certificates: Signed by manufacturers certifying that joists comply with requirements.

E. Mill Certificates: Signed by bolt manufacturers certifying that bolts comply with requirements.

F. Qualification Data: For manufacturer.

G. Field quality-control test and inspection reports.

H. Research/Evaluation Reports: For joists.

1.06 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer certified by SJI to manufacture joists complying with applicable standard specifications and load tables of SJI "Specifications."

   1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. SJI Specifications: Comply with standard specifications in SJI's "Specifications" that are applicable to types of joists indicated.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.07 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.

1.08 SEQUENCING

A. Deliver steel bearing plates to be built into cast-in-place concrete and masonry construction.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Steel: Comply with SJI's "Specifications" for web and steel-angle chord members.

B. Steel Bearing Plates: ASTM A 36.
C. High-Strength Bolts, Nuts, and Washers: ASTM A 325 Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.

1. Finish: Plain.

D. Welding Electrodes: Comply with AWS standards.

2.02 PRIMERS

A. Primer: SSPC-Paint 15, or manufacturer's standard shop primer complying with performance requirements in SSPC-Paint 15.

2.03 K-SERIES STEEL JOISTS


B. 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.

C. Comply with AWS requirements and procedures for shop welding, appearance, quality of welds, and methods used in correcting welding work.

D. Provide holes in chord members for connecting and securing other construction to joists.

E. Top-Chord Extensions: Extend top chords of joists with SJI's Type S top-chord extensions where indicated, complying with SJI's "Specifications."

F. Bottom Chord Extensions: Extend bottom chords to comply with OSHA as shown on the drawings, complying with SJI’s “Specifications.”

G. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

H. Do not camber joists.

I. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.04 JOIST ACCESSORIES

A. Bridging: 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.

B. Bridging: Schematically indicated. Detail and fabricate according to SJI's "Specifications." Furnish additional erection bridging if required for stability.
C. Fabricate steel bearing plates with integral anchorages of sizes and thicknesses indicated. On the Drawings.

D. Supply ceiling extensions, either extended bottom-chord elements or a separate extension unit of enough strength to support ceiling construction. Extend ends to within 1/2 inch of finished wall surface, unless otherwise indicated.

E. Supply miscellaneous accessories, including splice plates and bolts required by joist manufacturer to complete joist installation.

2.05 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.

B. Apply 1 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

3.01 EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing for compliance with requirements for installation tolerances and other conditions affecting performance.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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 recommendations, 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 have been 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. Bolt joists to supporting steel framework using high-strength structural bolts. Comply with RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts" for high-strength structural bolt installation and tightening requirements.

F. 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.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Field welds will be visually inspected according to AWS D1.1/D1.1M.

C. In addition to visual inspection, field welds will be tested according to AWS D1.1/D1.1M and the following procedures, as applicable:
   4. Liquid Penetrant Inspection: ASTM E 165.

D. Bolted connections will be visually inspected.

E. High-strength, field-bolted connections will be tested and verified according to procedures in RCSC's "Specification for Structural Joints Using ASTM A 325 or ASTM A 490 Bolts."

F. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

G. Additional testing will be performed to determine compliance of corrected Work with specified requirements.

3.04 REPAIRS AND PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists, bearing plates, abutting structural steel, and accessories.
   1. Clean and prepare surfaces by hand-tool cleaning, SSPC-SP 2, or power-tool cleaning, SSPC-SP 3.
   2. Apply a compatible primer of same type as shop primer used on adjacent surfaces.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer that ensure that joists and accessories are without damage or deterioration at time of Substantial Completion.

END OF SECTION
SECTION 05310
STEEL DECK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:
   1. Roof deck.

B. Related Sections include the following:
   1. Division 5 Section "Structural Steel" for shop- and field-welded shear connectors.

1.03 SUBMITTALS

A. Product Data: For each type of deck, accessory, and product indicated.

B. Shop Drawings: Show layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

C. Product Certificates: For each type of steel deck, signed by product manufacturer.

D. Welding certificates.

E. Field quality-control test and inspection reports.

F. Research/Evaluation Reports: For steel deck.

1.04 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency qualified according to ASTM E 329 for testing indicated.

B. Welding: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."
1.05 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.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to materials that comply with the requirements, of the specifications.

2.02 ROOF DECK

A. Steel Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 30, and with the following:

1. Galvanized Steel Sheet: ASTM A 653/A 653M, Structural Steel (SS), Grade 33 G960 zinc coating.
2. Deck Profile: As indicated on the Drawings.
3. Profile Depth: As indicated on the Drawings.
4. Design Uncoated-Steel Thickness: As indicated on the Drawings.
5. Side Laps: As indicated on the Drawings.

2.03 ACCESSORIES

A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.

B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.

C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.

D. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi not less than 0.0359-inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.

E. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi of same material and finish as deck, and of thickness and profile as indicated on the Drawings.

F. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck, unless otherwise indicated.

G. Piercing Hanger Tabs: Piercing steel sheet hanger attachment devices for use with floor deck.
H. **Weld Washers:** Uncoated steel sheet, shaped to fit deck rib, 0.0598 inch thick, with factory-punched hole of 3/8-inch minimum diameter.

I. **Recessed Sump Pans:** Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck, with 3-inch-wide flanges and sloped recessed pans of 1-1/2-inch minimum depth. For drains, cut holes in the field.

J. **Galvanizing Repair Paint:** ASTM A 780.

**PART 3 - EXECUTION**

3.01 **EXAMINATION**

A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.

3.02 **INSTALLATION, GENERAL**

A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 30, manufacturer's written instructions, and requirements in this Section.

B. Install temporary shoring before placing deck panels, if required to meet deflection limitations.

C. Locate deck bundles to prevent overloading of supporting members.

D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.

E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.

F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.

G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.

H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.

I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.03 **ROOF-DECK INSTALLATION**

A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam 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 indicated on the Drawings:
1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1-1/2 inches with end joints as follows:

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.

1. Install reinforcing channels or zees in ribs to span between supports and weld.

E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld to substrate to provide a complete deck installation.

1. Weld cover plates at changes in direction of roof-deck panels, unless otherwise indicated.

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field welds will be subject to inspection.

C. Testing agency will report inspection results promptly and in writing to Contractor and Architect.

D. Remove and replace work that does not comply with specified requirements.

E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.05 REPAIRS AND PROTECTION

A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.

B. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION
SECTION 05500

METAL FABRICATIONS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
2. Shelf angles.
3. Angles supporting window sills in exterior wall assemblies.
4. Metal ladders.
5. Loose bearing and leveling plates for applications where they are not specified in other Sections.
6. Custom fabricated, insulated hollow metal cover assemblies for duct penetrations through exterior walls.

B. Products furnished, but not installed, under this Section:

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.

C. Related Sections:

1. Section 03300 "Cast-in-Place Concrete"
2. Section 04220 "Masonry Unit"
3. Section 05120 "Structural Steel"
4. Section 05520 "Metal Railings"

1.03 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design ladders, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Aluminum Ladders: Aluminum ladders shall withstand the effects of loads and stresses within limits and under conditions specified in ANSI A14.3.

C. 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.

1.04 SUBMITTALS
A. Product Data: For paint products and grout.

B. Shop Drawings: Show fabrication and installation details for metal fabrications.
   1. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items.

C. Delegated-Design Submittal: For installed products 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 professional engineer.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.05 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."

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.07 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 anchorages and steel weld plates and angles for casting into concrete. 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.

C. Coordinate configuration, fabrication and installation of duct penetration covers with penetrating ductwork and with masonry wall construction to produce weathertight closures.

PART 2 PRODUCTS

2.01 METALS, GENERAL

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.

2.02 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

B. Stainless-Steel Sheet, Strip, and Plate: ASTM A 240/A 240M or ASTM A 666, Type 304.
C. Stainless-Steel Bars and Shapes: ASTM A 276, Type 304.

D. Steel Tubing: ASTM A 500, cold-formed steel tubing.

E. Steel Pipe: ASTM A 53/A 53M, standard weight (Schedule 40) unless otherwise indicated.

F. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.

G. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.
   2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, structural steel, Grade 33; with 0.0677-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel or hot-dip galvanized after fabrication.

H. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.

2.03 NONFERROUS METALS


C. Aluminum Castings: ASTM B 26/B 26M, Alloy 443.0-F.

2.04 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.
   1. Provide stainless-steel fasteners for fastening aluminum.

2.05 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.

B. Shop Primers: Provide primers that comply with Section 09900 “Paints and Coatings.”

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

D. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.


2.06 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 will be 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.
   1. 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.

2.07 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.

2.08 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 shelf angles located in exterior walls and with painted exposed surfaces.

D. Furnish wedge-type concrete inserts, complete with fasteners, to attach shelf angles to cast-in-place concrete.

2.09 METAL LADDERS

A. General: Comply with ANSI A14.3 unless otherwise indicated.

B. Aluminum Ladders:

1. Basis-of-Design Products: Subject to compliance with requirements, provide the following products of ALACO Ladder Company, Chino CA (1-888-310-7040):

2. Space siderails 24 inches apart unless otherwise indicated.

3. Siderails: Continuous extruded-aluminum channels or tubes, not less than 2-1/2 inches deep, 3/4 inch wide, and 1/8 inch thick.

4. Rungs: Extruded-aluminum tubes, not less than 3/4 inch deep and not less than 1/8 inch thick, with ribbed tread surfaces.

5. Fit rungs in centerline of siderails; fasten by welding or with stainless-steel fasteners or brackets and aluminum rivets.

6. Support each ladder at top and bottom and not more than 60 inches o.c. with welded or bolted aluminum brackets.

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 plates.

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 HOLLOW METAL DUCT PENETRATION COVERS
   A. General: Provide closure panel assemblies not less than 1-3/4 inches thick, of seamless hollow
      construction unless otherwise indicated. Construct closure panels with smooth surfaces without
      visible joints or seams on exposed faces.
      1. Design: Flush panel, of configuration indicated.
      2. Core Construction: Polystyrene, polyurethane or polyisocyanurate core.
   B. Fabrication: Provide face sheets and continuous, welded edges fabricated from metallic-coated
      steel sheet not less than 0.053-inch thick (16 gage).
      1. Fabricate concealed stiffeners and anchorage reinforcement from metallic-coated steel
         sheet.
      2. Fabricate exposed perimeter trim from metallic-coated steel sheet not less than 0.027-inch
         thick (22 gage). Miter corners and weld joints continuously; grind, fill, dress, and make
         smooth, flush, and invisible.

2.14 FINISHES, GENERAL
   A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for
      recommendations for applying and designating finishes.
   B. Finish metal fabrications after assembly.
   C. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into
      surrounding surface.

2.15 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. Shop prime iron and steel items unless they are to be embedded in concrete, sprayed-on
      fireproofing, or masonry, or unless otherwise indicated.
   C. Preparation for Shop Priming: Prepare surfaces to comply with SSPC-SP 3, "Power Tool Cleaning."
   D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1:
      Shop, Field, and Maintenance Painting of Steel," for shop painting.
      1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

2.16 ALUMINUM FINISHES
   A. Finish designations prefixed by AA comply with the system established by the Aluminum Association
      for designating aluminum finishes.
   B. As-Fabricated Finish (Mill Finish): AA-M10 (Mechanical Finish: as fabricated, unspecified).
PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal fabrications. Set metal fabrications accurately in location, alignment, and elevation; with edges and surfaces level, plumb, true, and free of rack; and measured from established lines and levels.

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

F. Corrosion Protection: Coat concealed surfaces of aluminum that will come into contact with grout, concrete, masonry, wood, or dissimilar metals with the following:
   1. Cast Aluminum: Heavy coat of bituminous paint.
   2. Extruded Aluminum: Two coats of clear lacquer.

3.02 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.

3.03 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with grout.
   1. Use nonshrink grout, either metallic or nonmetallic, in concealed locations where not exposed to moisture; use nonshrink, nonmetallic grout in exposed locations unless otherwise indicated.
   2. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
3.04 INSTALLING HOLLOW METAL DUCT PENETRATION COVERS

A. Install hollow metal closure panels plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and approved shop drawings.

3.05 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780.

END OF SECTION
SECTION 05520
METAL RAILINGS

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Aluminum railing assemblies for exterior locations.

1.03 PERFORMANCE REQUIREMENTS
A. Delegated Design: Design railings, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
B. General: In engineering railings to withstand structural loads indicated, determine allowable design working stresses of railing materials based on the following:
   1. Aluminum: The lesser of minimum yield strength divided by 1.65 or minimum ultimate tensile strength divided by 1.95.
C. Structural Performance: Railings shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
   1. Handrails and Top Rails of Guards:
      a. Uniform load of 50 lbf/ft applied in any direction.
      b. Concentrated load of 200 lbf applied in any direction.
      c. Uniform and concentrated loads need not be assumed to act concurrently.
   2. Infill of Guards:
      a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
      b. Infill load and other loads need not be assumed to act concurrently.
D. 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.
E. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1.04 SUBMITTALS
A. Product Data: For railings, railing brackets, grout, anchoring cement, and paint products.
B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
C. Delegated-Design Submittal: For installed products 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 professional engineer.

E. Welding certificates.

F. Paint Compatibility Certificates: From manufacturers of topcoats applied over shop primers certifying that shop primers are compatible with topcoats.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

1. AWS D1.2/D1.2M, "Structural Welding Code - Aluminum."

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of walls and other construction contiguous with metal fabrications by field measurements before fabrication.

1.07 COORDINATION AND SCHEDULING

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 anchorages for railings. 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.

C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. R & B Wagner, Inc.

2.02 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
2.03 ALUMINUM

A. Aluminum, General: Provide alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with not less than the strength and durability properties of alloy and temper designated below for each aluminum form required.

   1. Provide Standard Weight (Schedule 40) pipe, unless otherwise indicated.

C. Formed Elbow Fittings: Alloy 6063-T4.

D. Refer to drawings for additional information.

2.04 FASTENERS

A. General: Provide the following:
   1. Aluminum Railings: Type 316 stainless-steel fasteners.

B. Fasteners for Anchoring Railings to Other Construction: Select fasteners of type, grade, and class required to produce connections suitable for anchoring railings to other types of construction indicated and capable of withstanding design loads.

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.
   2. Provide tamper-resistant flat-head machine screws for exposed fasteners unless otherwise indicated.

D. Post-Installed Anchors: Torque-controlled expansion anchors or chemical 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, conducted by a qualified independent testing agency.

2.05 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
   1. For aluminum railings, provide type and alloy as recommended by producer of metal to be welded and as required for color match, strength, and compatibility in fabricated items.

B. Shop Primers: Provide primers that comply with Section 09900 “Paints and Coatings.”

C. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

F. 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.

2.06 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Assemble railings in the shop to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. 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.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
   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 flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.
   1. Fabricate splice joints for field connection using an epoxy structural adhesive if this is manufacturer's standard splicing method.

J. Form changes in direction by inserting prefabricated elbow fittings of radius indicated.

K. Bend members in jigs to produce uniform curvature for each configuration required; maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

L. Close exposed ends of railing members with prefabricated end fittings.

M. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

N. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.
O. Brackets for Wall-Mounted Handrails: Cast metal units with round flange with tapped hole for exposed mounting.

P. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.

Q. For railing posts set in concrete, provide stainless-steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

### 2.07 ALUMINUM FINISHES

A. Baked-Enamel Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

1. Finish: Clear anodized mill finish
2. Solid Colors: To be selected from full range of custom colors.

### PART 3 EXECUTION

#### 3.01 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that have been coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Corrosion Protection: Coat concealed surfaces of aluminum that will be in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.

#### 3.02 RAILING CONNECTIONS

A. Nonwelded Connections: Use mechanical or adhesive joints for permanently connecting railing components. Seal recessed holes of exposed locking screws using plastic cement filler colored to match finish of railings.

#### 3.03 ANCHORING POSTS

A. Use metal 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 or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

1. Leave anchorage joint exposed with anchoring material flush with adjacent surface.
B. Side-Mounting: Where indicated, anchor posts to supporting surfaces with side-mounted fascia flanges, connected to posts and to supporting construction as follows:

1. Attach posts using fittings designed and engineered for this purpose.

3.04 ATTACHING RAILINGS

A. Where indicated, anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.

B. Where indicated, attach railings to wall with wall brackets, unless otherwise indicated. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

1. Use type of bracket with predrilled hole for exposed bolt anchorage.
2. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

C. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

3.05 ADJUSTING

A. Clean aluminum by washing thoroughly with clean water and soap and rinsing with clean water.

B. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

3.06 PROTECTION

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

END OF SECTION
SECTION 06100

ROUGH CARPENTRY

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Wood blocking and nailers.
   2. Plywood backing panels.

1.03 PRODUCT HANDLING
A. Stack lumber and plywood; place spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.

PART 2 PRODUCTS

2.01 WOOD PRODUCTS, GENERAL
A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.
   1. Factory mark each piece of lumber with grade stamp of grading agency.
   2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
   3. Provide dressed lumber, S4S, unless otherwise indicated.
   4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal thickness or less, unless otherwise indicated.

B. Plywood Panels:
   1. Plywood: DOC PS 1.
   2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
   3. Factory mark panels according to indicated standard.

2.02 WOOD-PRESERVATIVE-TREATED MATERIALS
A. Preservative Treatment by Pressure Process: AWPA UC2 (lumber) and AWPA UC3 (plywood).
   1. Preservative Chemical: Ammoniacal, or amine, copper quat (ACQ).
      a. Do not use chemicals containing chromium or arsenic.

B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.
C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, stripping, and similar concealed members in contact with masonry or concrete.

2.03 DIMENSION LUMBER

A. General: Provide dimension lumber of grades indicated according to the American Lumber Standards Committee National Grading Rule provisions of the grading agency indicated.

B. Miscellaneous Lumber: Provide lumber for support or attachment of other construction, including blocking and nailers.

C. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and any of the following species:

1. Mixed southern pine; SPIB.
2. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or Spruce-pine-fir; NELMA, NLGA, WCLIB, or WWPA.
4. Eastern softwoods; NELMA.
5. Northern species; NLGA.
6. Western woods; WCLIB or WWPA.

2.04 PLYWOOD PANELS

A. Telephone and Electrical Equipment Backing Panels: DOC PS 1, Exposure 1, C-D Plugged, fire-retardant treated, in thickness indicated or, if not indicated, not less than 1/2 inch thick.

2.05 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this Article for material and manufacture.

1. Where miscellaneous carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.
2. Where miscellaneous carpentry is preservative-treated, provide fasteners of Type 304 or Type 316 stainless steel.

B. Nails: FS FF-N-105.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Bolts: Steel bolts complying with ASTM A 307, Grade A; with ASTM A 563 hex nuts and, where indicated, flat washers.

F. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

PART 3 EXECUTION

3.01 INSTALLATION, GENERAL

A. Discard units of material with defects that impair quality of carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

C. Securely attach carpentry work as indicated and according to applicable codes and recognized standards.

D. Use fasteners of appropriate type and length. Predrill members when necessary to avoid splitting wood.

3.02 WOOD BLOCKING AND NAILER INSTALLATION

A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.

B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces, unless otherwise indicated.

3.03 PLYWOOD PANEL INSTALLATION


END OF SECTION
SECTION 06400
ARCHITECTURAL WOODWORK

PART 1  GENERAL

1.01  RELATED DOCUMENTS

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

1.02  SUMMARY

A. Section Includes:

1. Interior standing and running wood trim, including window heads and jambs, and medium-density fiberboard (MDF).
2. Shop priming woodwork for paint finish.
3. Interior wood chair rail.

B. Related Sections:

1. Section 06100 "Rough Carpentry"
2. Section 09900 "Paints and Coating"
3. Section 08413 "Glazed Aluminum Curtain Wall"
4. Section 12320 "Manufactured Plastic-Laminate-Faced Casework"

1.03  DEFINITIONS

A. Architectural woodwork includes wood blocking and shims for installing woodwork items, unless concealed within other construction before woodwork installation.

1.04  SUBMITTALS

A. Product Data: For each type of product indicated.

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 blocking, including concealed blocking and reinforcement specified in other Sections.

C. Samples for Initial Selection: Manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available for each type of material indicated.

1. Plastic laminates.
2. Solid Maple.

D. Qualification Data: For firms and persons specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names and addresses of architects and owners, and other information specified.
1.05 QUALITY ASSURANCE

A. Fabricator Qualifications: A firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Installer Qualifications: An experienced installer who has completed architectural woodwork 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.

1. Solid Surface Material Installer: Certified in writing by solid surface material manufacturer for installation of solid surfacing materials.

C. Quality Standard: Unless otherwise indicated, comply with AWI's "Architectural Woodwork Quality Standards" for grades of architectural woodwork, construction, finishes, and other requirements.

1. The Contract Documents may contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with such selections and requirements in addition to the quality standard.

1.06 PRODUCT 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.

1.07 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.

2. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish dimensions and proceed with fabricating woodwork without field measurements. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.08 COORDINATION

A. Coordinate sizes and locations of framing, blocking, reinforcements, and other related units of Work specified in other Sections to ensure that architectural woodwork can be supported and installed as indicated.

PART 2 PRODUCTS

2.01 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade specified, unless otherwise indicated.

B. Wood Species for Opaque Finish: Yellow poplar or white hardwoods.

D. Medium-Density Fiberboard (MDF): ANSI A208.2, Grade MD.

E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated, or if not indicated, as required by woodwork quality standard.
   1. Manufacturer: Subject to compliance with requirements, provide high-pressure decorative laminates by one of the following:
      a. Formica Corporation.
      b. Nevamar Company, LLC; Decorative Products Div.
      c. Wilsonart International; Div. of Premark International, Inc.

2. Colors, Patterns, and Finishes: Provide Architect's selections from laminate manufacturer's full range of colors and finishes.

F. Adhesive for Bonding Plastic Laminate: Resorcinol unless otherwise indicated.
   1. Adhesive for Bonding Edges: Hot-melt adhesive or adhesive specified above for faces.

G. Solid-Surfacing Material: Homogeneous solid sheets of filled plastic resin complying with material and performance requirements in ANSI Z124.3, for Type 5 or Type 6, without a precoated finish.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Corian; DuPont Polymers.
      b. Surell; Formica Corporation.
      c. Fountainhead; International Paper, Decorative Products Div.
      d. Swanstone; Swan Corporation (The).
      e. Gibraltar; Wilsonart International, Div. of Premark International, Inc.
   2. Colors, Patterns, and Finishes: Provide Architect's selections from material manufacturer's full range of colors and finishes.

2.02 MISCELLANEOUS MATERIALS

A. Blocking, Shims, and Nailers: 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.

2.03 FABRICATION, GENERAL

A. 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.

B. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to 1/16 inch radius.

C. 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.
2.04 INTERIOR STANDING AND RUNNING TRIM AND MDF FOR OPAQUE FINISH
   A. Quality Standard: Comply with AWI Section 300.
   B. Grade: Custom.
   C. Backout or groove backs of flat wood trim members and kerf backs of other wide, flat wood members, except for members with ends exposed in finished work.

2.05 CLOSET SHELVING
   A. Quality Standard: Comply with AWI Section 400 requirements for plastic-laminate fabrications.
   B. Grade: Custom.
   C. Shelf Thickness: 3/4 inch.
   D. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:
      1. Horizontal Surfaces: HGS; 0.048 inch minimum thickness.
      2. Edges: PVC T-mold, 3.0 mm thick, matching laminate in color, pattern, and finish.
   E. Shelf Core Material: Veneer plywood.
   F. Clothes Rods: 1-inch diameter, stainless-steel or aluminum tubes.

2.06 SOLID-SURFACING-MATERIAL WINDOW STOOLS
   A. Quality Standard: Comply with AWI Section 400 requirements.
   B. Grade: Custom.
   C. Solid-Surfacing-Material Thickness: 1/2 inch.

2.07 SHOP PRIMING
   A. Woodwork for Opaque Finish: Shop prime woodwork for paint finish with one coat of wood primer specified in Section 09900 "Paints and Coating."
   B. Preparations 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 surfaces installed in contact with concrete or masonry and to end-grain surfaces.

PART 3 EXECUTION

3.01 PREPARATION
   A. Condition woodwork to average prevailing humidity conditions in installation areas before installation.
   B. Before installing architectural woodwork, examine shop-fabricated work for completion and complete work as required, including removal of packing and backpriming.
C. Examine substrates for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Quality Standard: Install woodwork to comply with AWI Section 1700 for the same grade specified in Part 2 of this Section for type of woodwork involved.

B. 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.

C. Scribe and cut woodwork to fit adjoining work, and refinish cut surfaces and repair damaged finish at cuts.

D. 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.

E. Standing and Running Trim: Install with minimum number of joints possible, using full-length pieces (from maximum length of lumber available) to greatest extent possible. Do not use pieces less than 96 inches long, except where shorter single-length pieces are necessary. Scarf running joints and stagger in adjacent and related members.
   1. Fill gaps, if any, between top of base and wall with plastic wood filler, sand smooth, and finish same as wood base, if finished.
   2. Install standing and running trim with no more variation from a straight line than 1/8 inch in 96 inches.

F. Window Stools: Install without joints, using full-size pieces for each window stool.
   1. Install window stools with no more variation from a straight line than 1/8 inch in 96 inches.

G. Shelves: Anchor securely to supports.
   1. Install shelves with no more than 1/8 inch in 48-inch sag, bow, or other variation from a straight line.

3.03 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 woodwork on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION
SECTION 07115

BITUMINOUS DAMPPROOFING

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes: Bituminous dampproofing applied to the following surfaces:
      1. Exterior face of inner wythe of exterior masonry cavity walls.
   B. Related Sections:
      1. Section 04200 "Masonry Unit"
      2. Section 07210 "Building Insulation"

1.03 SUBMITTALS
   A. Product Data: For each type of product indicated. Include recommendations for method of application, primer, number of coats, coverage or thickness, and protection course.
   B. Material Certificates: For each product, signed by manufacturers.

1.04 QUALITY ASSURANCE
   A. Source Limitations: Obtain primary dampproofing materials and primers through one source from a single manufacturer. Provide secondary materials recommended by manufacturer of primary materials.

1.05 PROJECT CONDITIONS
   A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit dampproofing to be performed according to manufacturers' written instructions.

PART 2 PRODUCTS

2.01 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. ChemMasters Corp.
      2. Degussa Building Systems; Sonneborn Brand Products.
      3. Gardner Gibson, Inc.
      6. Koppers Inc.
      7. Malarkey Roofing Products.
   B. Trowel Coats: ASTM D 1227, Type II, Class 1.
C. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.
D. Brush and Spray Coats: ASTM D 1227, Type III, Class 1.

2.02 MISCELLANEOUS MATERIALS
A. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended by manufacturer.
B. Asphalt-Coated Glass Fabric: ASTM D 1668, Type I.
C. Patching Compound: Epoxy or latex-modified repair mortar or manufacturer's fibered mastic of type recommended by dampproofing manufacturer.

PART 3 EXECUTION

3.01 EXAMINATION
A. Examine substrates, with Installer present, for compliance with requirements for surface smoothness and other conditions affecting performance of work.
   1. Proceed with dampproofing application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.02 PREPARATION
A. Protection of Other Work: 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.
B. Clean substrates of projections and substances detrimental to work; fill voids, seal joints, and apply bond breakers if any, as recommended by prime material manufacturer.
C. Apply patching compound for filling and patching tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.03 APPLICATION, GENERAL
A. Comply with manufacturer's written recommendations unless more stringent requirements are indicated or required by Project conditions to ensure satisfactory performance of dampproofing.
   1. Apply additional coats if recommended by manufacturer or if required to achieve coverages indicated.
   2. Allow each coat of dampproofing to cure 24 hours before applying subsequent coats, unless another period is recommended by manufacturer.
   3. Allow 48 hours drying time prior to backfilling, unless another period is recommended by manufacturer.
B. Apply dampproofing to provide continuous plane of protection on exterior face of inner wythe of exterior masonry cavity walls.
   1. Lap dampproofing at least 1/4 inch onto flashing, masonry reinforcement, veneer ties, and other items that penetrate inner wythe.
   2. Extend dampproofing over outer face of structural members and concrete slabs that interrupt inner wythe, and lap dampproofing at least 1/4 inch onto shelf angles supporting veneer.
   3. Extend dampproofing over CMU cavity closer.

3.04 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING
A. On Exterior Face of Inner Wythe of Cavity Walls: Apply primer and 1 brush or spray coat at not less than 1 gal./100 sq. ft.

3.05 CLEANING

A. Remove dampproofing materials from surfaces not intended to receive dampproofing.

END OF SECTION
SECTION 07140
COLD FLUID-APPLIED WATERPROOFING

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes: Cold fluid-applied waterproofing systems including the following:
   1. Latex-rubber waterproofing.
   2. Insulation drainage panels.
B. Applications for cold fluid-applied waterproofing include the following:
   1. Below-grade surfaces of foundation walls and footings in new construction.
C. Related Sections:
   1. Section 03300 “Cast in Place Concrete”
   2. Section 04200 “Masonry Unit”

1.03 SUBMITTALS
A. Product Data: For each type of product indicated. Include manufacturer's written instructions for evaluating, preparing, and treating substrate, technical data, and tested physical and performance properties of waterproofing.
B. Samples: For the following products:
   1. Flashing Sheet: 10 by 8 inches.
   2. Insulation Drainage Panel: 10 by 8 inches.
C. Qualification Data: For Installer.
D. Product Test Reports: For waterproofing, based on evaluation of comprehensive tests performed by a qualified testing agency.
E. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE
A. Installer Qualifications: A firm that is approved or licensed by waterproofing manufacturer for installation of waterproofing required for this Project.
B. Source Limitations: Obtain waterproofing materials from single source from single manufacturer.

1.05 PRODUCT HANDLING
A. Deliver liquid materials to Project site in original containers with seals unbroken, labeled with manufacturer’s name, product brand name and type, date of manufacture, shelf life, and directions for storing and mixing with other components.
B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by waterproofing manufacturer.

C. Remove and replace liquid materials that cannot be applied within their stated shelf life.

D. Protect stored materials from direct sunlight.

1.06 PROJECT CONDITIONS
A. Environmental Limitations: Apply waterproofing within the range of ambient and substrate temperatures recommended by waterproofing manufacturer. Do not apply waterproofing to a damp or wet substrate, when relative humidity exceeds 85 percent, or when temperatures are less than 5 deg F above dew point.

1. Do not apply waterproofing in snow, rain, fog or mist, or when such weather conditions are imminent during application and curing period.

B. Maintain adequate ventilation during application and curing of waterproofing materials.

1.07 WARRANTY
A. Special Manufacturer's Warranty: Manufacturer's standard form in which waterproofing manufacturer agrees to repair or replace waterproofing that does not comply with requirements or that fails to remain watertight within specified warranty period.

1. Warranty does not include failure of waterproofing due to failure of substrate prepared and treated according to requirements or formation of new joints and cracks in substrate that exceed 1/16 inch in width.

2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 LATEX-RUBBER WATERPROOFING
A. Two-Component, Unreinforced, Latex-Rubber Waterproofing: Comply with ASTM C 836 and with manufacturer's written physical requirements.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Grace, W. R. & Co.; Procor.

2.02 AUXILIARY MATERIALS
A. General: Provide auxiliary materials recommended by manufacturer to be compatible with one another and with waterproofing, as demonstrated by waterproofing manufacturer, based on testing and field experience.

B. Primer: Manufacturer's standard, factory-formulated polyurethane or epoxy primer.

C. Joint Reinforcing Strip: Manufacturer's recommended fiberglass mesh or polyester fabric.

D. Joint Sealant: Multicomponent polyurethane sealant, compatible with waterproofing, complying with ASTM C 920 Type M, Class 25; Grade NS for sloping and vertical applications or Grade P for deck applications; Use NT exposure; and as recommended by manufacturer for substrate and joint conditions.

1. Backer Rod: Closed-cell polyethylene foam.
2.03 INSULATION DRAINAGE PANELS

A. Geotextile-Faced, Wall Insulation Drainage Panels: Extruded-polystyrene board insulation complying with ASTM C 578, Type IV, 25-psi minimum compressive strength; fabricated with tongue-and-groove edges and with one side having grooved drainage channels faced with a nonwoven-geotextile filter fabric.

1. Products: Subject to compliance with requirements, provide one of the following:

   a. Owens Corning; Insul-Drain.
   b. T. Clear Corporation; Thermadry 750.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance.

1. Verify that concrete has cured and aged for minimum time period recommended by waterproofing manufacturer.
2. Verify that substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 SURFACE PREPARATION

A. Clean and prepare substrate according to manufacturer's written recommendations. Provide clean, dust-free, and dry substrate for waterproofing application.

B. Mask off adjoining surfaces not receiving waterproofing to prevent spillage or overspray affecting other construction.

C. Close off deck drains and other deck penetrations to prevent spillage and migration of waterproofing fluids.

D. Remove grease, oil, bitumen, form-release agents, paints, curing compounds, acid residues, and other penetrating contaminants or film-forming coatings from concrete.

   1. Abrasive blast clean concrete surfaces uniformly to expose top surface of fine aggregate according to ASTM D 4259 with a self-contained, recirculating, blast-cleaning apparatus. Remove material to provide a sound surface free of laitance, glaze, efflorescence, curing compounds, concrete hardeners, or form-release agents. Remove remaining loose material and clean surfaces according to ASTM D 4258.

   E. Remove fins, ridges, and other projections and fill honeycomb, aggregate pockets, and other voids.

3.03 PREPARATION AT TERMINATIONS AND PENETRATIONS

A. Prepare vertical and horizontal surfaces at terminations and penetrations through waterproofing and at expansion joints, drains, and sleeves according to ASTM C 1471 and manufacturer's written instructions.

B. Prime substrate unless otherwise instructed by waterproofing manufacturer.

C. Apply waterproofing in two separate applications, and embed a joint reinforcing strip in the first preparation coat when recommended by waterproofing manufacturer.
1. Provide sealant cants around penetrations and at inside corners of deck-to-wall butt joints when recommended by waterproofing manufacturer.

3.04 JOINT AND CRACK TREATMENT

A. Prepare, treat, rout, and fill joints and cracks in substrate according to ASTM C 1471 and waterproofing manufacturer's written instructions. Remove dust and dirt from joints and cracks, complying with ASTM D 4258, before coating surfaces.

2. Apply bond breaker between sealant and preparation strip.
3. Prime substrate and apply a single thickness of preparation strip extending a minimum of 3 inches along each side of joint. Apply waterproofing in two separate applications and embed a joint reinforcing strip in the first preparation coat.

B. Install sheet flashing and bond to deck and wall substrates where indicated or required according to waterproofing manufacturer's written instructions.

1. Extend sheet flashings onto perpendicular surfaces and other work penetrating substrate according to ASTM C 898.

3.05 WATERPROOFING APPLICATION

A. Apply waterproofing according to ASTM C 1471 and manufacturer's written instructions.

B. Start installing waterproofing in presence of manufacturer's technical representative.

C. Apply primer over prepared substrate.

D. Unreinforced Waterproofing Applications: Mix materials and apply waterproofing by spray, roller, notched squeegee, trowel, or other application method suitable to slope of substrate.

1. Apply one or more coats of waterproofing to obtain a seamless membrane free of entrapped gases, with an average dry film thickness of 60 mils and a minimum dry film thickness of 50 mils at any point.
2. Apply waterproofing to prepared wall terminations and vertical surfaces.
3. Verify wet film thickness of waterproofing every 100 sq. ft.

3.06 INSULATION INSTALLATION

A. Install insulation drainage panels over waterproofed surfaces. Cut and fit to within 3/4 inch of projections and penetrations.

B. On vertical surfaces, set insulation units in adhesive applied according to manufacturer's written instructions. Use type of adhesive recommended in writing by insulation manufacturer.

3.07 CURING, PROTECTION, AND CLEANING

A. Cure waterproofing according to manufacturer's written recommendations, taking care to prevent contamination and damage during application stages and curing.

B. Protect waterproofing from damage and wear during remainder of construction period.

C. Protect installed insulation drainage panels from damage due to ultraviolet light, harmful weather exposures, physical abuse, and other causes. Immediately after installation, provide temporary coverings where insulation will be subject to abuse and cannot be concealed and protected by permanent construction.
D. Clean spillage and soiling from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

END OF SECTION
SECTION 07210
BUILDING INSULATION

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Perimeter insulation under slabs-on-grade.
   2. Cavity-wall insulation.
   3. Concealed building insulation.

B. Related Sections:
   1. Section 04200 "Unit Masonry"
   2. Section 07115 “Bituminous Dampproofing”
   3. Section 07140 "Cold Fluid-Applied Waterproofing"
   4. Section 07900 "Joint Sealants"

1.03 DEFINITIONS

A. Mineral-Fiber Insulation: Insulation composed of rock-wool fibers, slag-wool fibers, or glass fibers; produced in boards and blanket with latter formed into batts (flat-cut lengths) or rolls.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency for insulation products.

C. Research/Evaluation Reports: For foam-plastic insulation.

1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of building insulation through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide insulation and related materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction. Identify materials with appropriate markings of applicable testing and inspecting agency.

1.06 PRODUCT HANDLING

A. Protect insulation materials from physical damage and from deterioration by moisture, soiling, and other sources. Store inside and in a dry location. Comply with manufacturer's written instructions for handling, storing, and protecting during installation.

B. Protect plastic insulation as follows:
   1. Do not expose to sunlight, except to extent necessary for period of installation and concealment.
   2. Protect against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
   3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 PRODUCTS

2.01 FOAM-PLASTIC BOARD INSULATION

A. Extruded-Polystyrene Board Insulation: ASTM C 578, of type and density indicated below, with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. DiversiFoam Products.
      b. Dow Chemical Company.
      c. Owens Corning.
      d. Pactiv Building Products Division.
   2. Type VII, 2.20 lb/cu. ft.

2.02 SOUND ATTENUATION BLANKET INSULATION

A. 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.

2.03 AUXILIARY INSULATING MATERIALS

A. Adhesive for Bonding Insulation: Product with demonstrated capability to bond insulation securely to substrates indicated without damaging insulation and substrates.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements of Sections in which substrates and related work are specified and for other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.
3.02  PREPARATION

A. Clean substrates of substances harmful to insulation or vapor retarders, including removing projections capable of puncturing vapor retarders or of interfering with insulation attachment.

3.03  INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and application indicated.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed at any time to ice, rain, and snow.

C. Extend insulation in thickness indicated to envelop entire area to be insulated. Cut and fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Water-Piping Coordination: If water piping is located within insulated exterior walls, coordinate location of piping to ensure that it is placed on warm side of insulation and insulation encapsulates piping.

E. For preformed insulating units, provide sizes to fit applications indicated and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units to produce thickness indicated unless multiple layers are otherwise shown or required to make up total thickness.

3.04  INSTALLATION OF UNDER-SLAB INSULATION

A. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

B. Where coarse backfill materials is used that might damage insulation, protect below-grade insulation on vertical surfaces from damage during backfilling by applying protection course with joints butted. Set in adhesive according to insulation manufacturer's written instructions.

C. Where slab installation is likely to damage insulation, protect top surface of horizontal insulation from damage during concrete work by applying protection course with joints butted.

3.05  PROTECTION

A. Protect installed insulation and vapor retarders from damage due to harmful weather exposures, physical abuse, and other causes. Provide temporary coverings or enclosures where insulation is subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

END OF SECTION
SECTION 07410

METAL WALL RAINDSCREEN PANEL WITH METAL WALL INSULATED COMPOSITE BACKUP PANEL AND INTEGRATED GLAZING FRAMES

PART 1 - GENERAL

1.01 SECTION INCLUDES

A. Exposed-fastener metal wall rainscreen panels installed over metal wall insulated composite backup panels providing thermal, air, water, and water vapor control with integrated glazing frames and wall louvers.

1.02 RELATED SECTIONS

1. Section 07600 "Metal Flashing and Trim"
2. Section 07900 "Joint Sealants"
3. Section 08810 "Glazing"
4. Section 09100 "Metal Support Assemblies"

1.03 REFERENCE STANDARDS

A. Reference Standard Editions: Comply with requirements of specified standards edition cited in applicable building code, or if not cited in code, with requirements of edition current at time of issuing of specifications.

B. American Architectural Manufacturer's Association (AAMA): www.aamanet.org:
   1. AAMA 621 - Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates
   2. AAMA 809.2 - Voluntary Specification Non-Drying Sealants

C. American Iron and Steel Institute (AISI): www.steel.org:

D. Standard for Cold-Formed Steel Framing - General Provisions American Society of Civil Engineers (ASCE): www.asce.org/codes-standards:
   1. ASCE 7 - Minimum Design Loads for Buildings and Other Structures

E. ASTM International (ASTM): www.astm.org:
   1. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
   2. ASTM A666 - Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar
5. ASTM B209 - Specification for Aluminum and Aluminum Alloy Sheet and Plate.
9. ASTM E72 - Test Methods of Conducting Strength Tests of Panels for Building Construction
11. ASTM E283 - Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen.

F. FM Global (FM): www.fmglobal.com:
1. ANSI/FM 4880 - Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings, and Exterior Wall Systems.

G. National Fire Protection Association (NFPA): www.nfpa.org:

H. Sheet Metal and Air Conditioning Contractors National Association, Inc. (SMACNA):

I. Underwriters Laboratories, Inc. (UL): www.ul.com:
1. UL 723 - Test for Surface Burning Characteristics of Building Materials.

1.04 QUALITY ASSURANCE
A. Manufacturer Qualifications: Manufacturer listed in this Section or approved for Project with minimum 5 years experience in manufacture of similar products in successful use in similar applications.

1. Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time period allowed for substitution review:
   a. Product data, including certified independent test data indicating compliance with requirements.
   b. Load span tables including evaluation of panel clip and panel side joint interaction.
   c. Samples of each component.
   d. Sample submittal from similar project.
   e. Project references: Minimum of 5 installations not less than 5 years old, with owner contact information.
   f. Sample warranty.

2. Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.

Metal Wall Rainscreen Panel With
Metal Wall Insulated Composite Backup Panel
& Integrated Glazing Frames
3. Approved manufacturers must meet separate requirements of Submittals Article.

B. Installer Qualifications: Experienced Installer with minimum of 5 successful completed projects of similar materials and scope and employing workers trained by manufacturer to install products of this section.

1.05 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate the installation of metal wall insulated composite backup panels system structural support and exterior metal wall rainscreen panels.

B. Preinstallation Meeting: Conduct preinstallation meeting at site attended by Owner, Architect, manufacturer's technical representative, and other trade contractors.

1. Coordinate building framing in relation to metal wall rainscreen panels and metal wall insulated composite backup panels.

2. Coordinate window, door, and other openings and penetrations of metal wall rainscreen panels and metal wall insulated composite backup panels.

1.06 ACTION SUBMITTALS

A. Product Data: Manufacturer’s data sheets for metal wall rainscreen panels, metal wall insulated composite backup panels and accessories and integrated window units.

B. Shop Drawings: Prepared by manufacturer or manufacturer's authorized dealer. Installation drawings for metal wall rainscreen panels, integrated glazing frames and metal wall insulated composite backup panels, flashing, accessories, and anchorage systems. Indicate dimensioned structural frame and erection layouts, openings in walls, special framing details, and construction details at corners, building intersections and flashing, location and type of mastic and metal filler strips.

1. Indicate coordination dimensions related to structural support system elements provided by others.

2. Indicate details of fastening, including clip spacing, supported by load span tables that include an evaluation of clip and panel side joint interaction.

3. Include structural data indicating compliance with performance requirements.

C. Samples for Verification: Provide minimum 10-inch (250-mm) square section of metal wall insulated composite backup panels panel showing finishes, interlocking joint, insulated core, and anchorage detail.

1.07 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Indicating compliance of products with requirements, from a qualified independent testing agency.

B. Qualification Information: For Installer firm, Installer’s field supervisor.

C. Manufacturer’s warranty: Submit sample warranty.

1.08 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.09 DELIVERY, STORAGE, AND HANDLING
A. Protect metal wall insulated composite backup panels during shipping, handling, and storage to prevent staining, denting, or other visible damage. Deliver, unload, store, and erect metal wall insulated composite backup panels and accessory items without misshaping panels or exposing panels to surface damage from weather or construction operations. Protect from exposure to sunlight.

1.10 WARRANTY

A. Special Manufacturer’s Warranty: On manufacturer’s standard form, in which manufacturer agrees to repair or replace components of metal wall rainscreen panel and metal wall insulated composite backup panel assemblies that fail in materials and workmanship within two (2) years from date of Substantial Completion.

B. Special Panel Finish Warranty: On manufacturer’s standard form, in which manufacturer agrees to repair or replace metal wall rainscreen panels, metal wall insulated composite backup panels and integrated glazing frames that evidence deterioration of finish within the following periods from the date of substantial completion:

1. Warranty Period: 20 years.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis of Design: CENTRIA, Econolap Metal Wall Rainscreen Panels with MetalWrap Insulated Composite Backup Panel and Formavue FV600S integrated windows. Provide basis of design products or comparable products of other manufacturer approved by Architect in accordance with Instructions to Bidders and Division 01 General Requirements.

1. CENTRIA Architectural Systems; Moon Township PA 15108-2944; (800)759-7474; (412)299-8000; info@CENTRIA.com; www.CENTRIA.com.

B. Approved alternate manufacturers:

1. Benchmark by Kingspan; Columbus, OH 43207; (877)638-3266; (614)444-0110; www.kingspanpanels.us/benchmark
2. Metl-Span; Lewisville, TX 75057; (877)585-9969; (972) 221-6656; info@metlspan.com; www.metlspan.com/

C. Single Source: Obtain metal wall insulated composite backup panels, metal wall rainscreen panels, louvers and integrated glazing frames through one source from a single approved manufacturer.

2.02 PERFORMANCE REQUIREMENTS

A. General: Provide metal wall rainscreen panel assemblies including backup panel system and integrated glazing frame meeting the performance requirements of this Article as determined by a qualified testing agency’s application of specified tests on manufacturer’s standard assemblies.

B. Recycled Content of Steel Sheet: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
C. Structural Performance: Provide metal wall insulated composite backup panel system fabricated to withstand effects of indicated loads and stresses within limits and under conditions indicated, when tested per ASTM E72.

1. Wind Load Test: Determine loads based on uniform pressure indicated on the drawings.
2. Deflection Limits Test: Withstand test pressures of 150 percent of inward and outward wind-load design pressures with maximum deflection of 1/120 of the span with no evidence of failure.
4. Secondary Metal Framing: Design secondary metal framing for metal wall rainscreen panel assembly according to AISI's "Standard for Cold-Formed Steel Framing - General Provisions."

D. Air Infiltration Test: Maximum 0.01 cfm/sq. ft. (0.05 L/s per sq. m) per ASTM E283 at a static-air-pressure difference of 6.24 lbf/sq. ft. (300 Pa).

E. Water Penetration Test: No uncontrolled water penetration at a static pressure of 15 lbf/sq. ft. (0.7 kPa) per ASTM E331.

F. Thermal Performance Test: Thermal Resistance (R-value) indicated, per ASTM C1363, corrected to 15 mph (24.1 k/h) outside and still air inside, as-installed condition including fastening and joints.

G. Thermal Movements: Allow for thermal movements from variations in both ambient and internal temperatures. Accommodate movement of support structure caused by thermal expansion and contraction.

H. Fire-Test-Response Characteristics: Provide metal wall insulated composite backup panel system with the following fire-test-response characteristics determined by the indicated test standard as applied by UL or other testing and inspection agency acceptable to authorities having jurisdiction.

1. Surface Burning Characteristics: Not greater than the following, per ASTM E84 or UL Standard 723, for foam core and interior surface:
   a. Flame spread index: 25 or less.
   b. Smoke developed index: 450 or less.

2. Intermediate Scale Multistory Fire Test: Representative mockup tested per NFPA 285.
3. Fire Performance of Insulated Wall: Approved as Class 1 wall panel per ANSI/FM 4880.

**2.03 SYSTEM DESCRIPTION**

A. Metal Wall Rainscreen Panels with Metal Wall Insulated Composite Backup Panel System and integrated glazing frames: Single-skin formed metal wall rainscreen panels with metal wall insulated composite backup panels installation consisting of foamed-insulation-core metal-skinned backup panels, attached to metal framing with specified clips, with integrated louvers and insulated window units serving as combined thermal, air, and moisture barrier.

**2.04 METAL WALL RAINSCREEN PANEL MATERIALS**

A. Metallic-Coated Steel Face Sheet: Coil-coated, ASTM A755/A755M.
1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A653/A653M, G90 (Class Z275), structural steel quality.
2. Aluminum-zinc alloy-coated Steel Sheet: ASTM A792/A792 M, Class AZ50 Grade 50 (Class AZM150, Grade 275), structural steel quality.
3. Face Sheet: Minimum 0.030 inch/22 gage (0.76 mm) nominal uncoated thickness.
5. Color: No. 9918 Dove Gray.

2.05 EXPOSED FASTENER PROFILE METAL WALL RAINSCREEN PANEL

A. Metal Wall Rainscreen Panels, General: Factory-formed, Exposed fastener panels with interconnecting side joints, fastened to supports with exposed fasteners, with field-applied sealants in side laps when required to meet performance requirements.

1. Symmetrical corrugated profile with lap joint. MWP#___:
   b. Panel Coverage: (34.66 inches) (880 mm).
   c. Panel Height: (0.75 inches) (19 mm).
   d. Corrugation Spacing: (2.66 inches) (68 mm) o.c.

2.06 EXPOSED FASTENER PROFILE METAL WALL RAINSCREEN PANEL ACCESSORIES

A. Metal Wall Insulated Composite Backup Panel System.

B. Metal Wall Rainscreen Panel Accessories, General

1. Provide complete metal wall rainscreen panel assembly incorporating trim, copings, fascias, parapet caps, soffits, sills, inside and outside corners, and miscellaneous flashings. Fabricate accessories in accordance with SMACNA 1793. Provide manufacturer's factory-formed clips, shims, flashings, gaskets, lap strips, closure strips, and caps for a complete installation as required for the following:
   a. Multi-component wall system, consisting of metal wall rainscreen panel application over metal wall insulated composite backup panel system with integrated insulated window units.

C. Extruded Trim

1. Manufacturer's complementary aluminum extrusions for head, jamb, sill, base, flush, reveal, inside and outside corner, end wall, and expansion joint details. Finish matching metal wall rainscreen panels.

D. Mitered Corners

1. Structurally-bonded horizontal interior and exterior trimless corners matching metal wall rainscreen panel material, profile, and factory-applied finish, fabricated and finished by metal wall rainscreen panel manufacturer.
   b. Welded, riveted, fastened, or field-fabricated corners do not meet the requirements of this specification.
E. Formed Flashing and Trim
   1. Match material, thickness, and color of metal wall rainscreen panel face sheets.

F. Sealants
   1. Type recommended by metal wall rainscreen panel manufacturer for application, meeting requirements of Section 07900 "Joint Sealants."

G. Flashing Tape
   1. 4-inch wide self-adhering butyl flashing tape.

H. Fasteners
   1. Self-tapping screws, bolts, nuts, and other acceptable fasteners recommended by panel manufacturer. Where exposed fasteners cannot be avoided, supply corrosion-resistant fasteners with heads matching color of metal wall rainscreen panels by means factory-applied coating.

2.07 SECONDARY METAL FRAMING

A. Miscellaneous Framing Components, General: Cold-formed metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z180).
   1. Hat Channels: (0.053 inch/16 ga.) (1.34 mm) minimum.
   2. Sill Channels: (0.053 inch/16 ga.) (1.34 mm) minimum.

2.08 METAL WALL RAINSCREEN PANEL FINISHES

A. Exposed Coil-Coated Finish System
   1. Fluoropolymer Two-Coat System: 0.2 mil primer with 0.8 mil 70 percent PVDF fluoropolymer color coat, AAMA 621.

B. 2 Color
   1. Exterior Surface:
      a. Basis of Design: CENTRIA 9918 Dove Gray
      b. As selected by Architect from manufacturer's standard colors.
   2. Interior Surface: Manufacturer's standard primer color.

2.09 METAL WALL INSULATED COMPOSITE BACKUP PANEL

A. Insulated Composite Backup Panels: Foamed-insulation-core metal-skinned panels with interlocking side joinery and butted end joints. Fabricate in factory with metal facings bonded to foamed-in-place core. Fabricate interior metal face with planking ribs. Form interlocking joinery to accept concealed fasteners for attachment to supports.
B. Panel Faces: 0.019-inch/26-ga. (0.483-mm) thick metallic-coated steel sheet: ASTM A653/A653M, G90 (Z275) coating designation; structural quality, with smooth surface.

C. Panel Face Finish: 0.2-mil (0.051-mm) thick primer coat.

D. Panel Core: Foamed-in-place modified polyisocyanurate, closed-cell, CFC and HCFC free, with minimum density of 2.4 lb/cu. ft. (39 kg/cu. m) and minimum compressive strength of 15 lb/sq. in. (103 kPa).

E. Panel Sealant/Vapor Seal: Factory-applied non-curing butyl.

F. Horizontal Metal Wall Insulated Composite Backup Panel Thickness and Thermal Resistance: 3 inches (76 mm); R-21.

G. Panel Width: 32 inches (813 mm).

H. Panel Configuration: Provide metal wall insulated composite backup panels configured for the following application system:

1. Horizontal metal wall insulated composite backup panels with integral pre-punched attachment system configured to serve as attachment points for manufacturer-furnished vertical subgirts to receive horizontal cladding.
2. Horizontal metal wall insulated composite backup panels for masonry veneer, with manufacturer-furnished veneer anchors in panel joints and attached at panel midpoints.

2.10 METAL WALL INSULATED COMPOSITE BACKUP PANEL ACCESSORIES

A. Subgirts: Metallic-coated steel sheet, ASTM A653/A653M, G90 (Z275) coating designation; structural quality, 0.051-inch/16-gage (1.29-mm) thick.


C. Self-Adhering Sheet Flashing: Minimum 25-mil (0.64-mm) modified bituminous sheet, recommended by panel manufacturer for application.

D. Joint Sealants:
   1. Concealed: Non-skinning butyl sealant, AAMA 809.2.
   2. Exposed: Elastomeric silicone sealant, ASTM C920, as recommended by panel manufacturer.

E. Fasteners: Corrosion-resistant, self-tapping and self-drilling screws, bolts, nuts, and other fasteners as recommended by panel manufacturer for application.

   1. Size fasteners to prevent penetration of interior panel facing.

2.11 SECONDARY METAL SUBGIRT FRAMING

A. Miscellaneous Framing Components, General: Cold-formed metallic-coated steel sheet, ASTM A653/A653M, G90 (Z180).

   1. Hat Channels: 0.053 inch/16 ga. (1.34 mm) minimum.
   2. Sill Channels: 0.053 inch/16 ga. (1.34 mm) minimum.
2.12 FABRICATION

A. General: Fabricate metal wall insulated composite backup panels at the factory, using manufacturer’s standard procedures and processes identical to tested units and as necessary to meet performance requirements.

1. Fabricate metal wall insulated composite backup panels with joints between panels designed to form weathertight seals.
2. Factory form metal wall insulated composite backup panels in a continuous process with no glues or adhesives between dissimilar materials. Trim and square edges of sheets with no displacement of face sheets or protrusion of core material.

2.13 GLAZING SYSTEMS

A. Glazing Frames: Integrated window glazing frames in sizes and shapes indicated. Provide extruded aluminum frames designed to interface with metal panels and provide the necessary joinery to comply with specified air and water infiltration requirements, thermal movement, and differential floor deflection of ¼ inch maximum.

1. Aluminum Extrusion Material: 6063-T5 alloy and temper; not less than 1/8-inch thickness for primary sections and 1/16-inch for trim, stops and accessories.
2. Mullions: Conventionally glazed design, designed to clad the vertical panel support tube in the vision area.
3. Window Head and Sill Members: Thermal break design with no through metal conductance from exterior to interior face of members; integrated with wall panels and provide nominal ½-inch capillary break and sloped drain shelf to produce rainscreen effect and pressure equalization chamber.
   a. Color: No. 9918 Dove Gray

B. Hardware: Provide manufacturer’s standard hardware fabricated from aluminum, stainless steel, carbon steel complying with AAMA 907, or other corrosion-resistant material compatible with aluminum; designed to smoothly operate, tightly close, and securely lock aluminum windows, and sized to accommodate sash or ventilator weight and dimensions. Do not use aluminum in frictional contact with other metals. Where exposed, provide extruded, cast or wrought aluminum; die-cast zinc with special coating finish; or nonmagnetic stainless steel.

1. Locks and Latches: Designed to allow unobstructed movement for the sash across adjacent sash in direction indicated and operated from the inside only.
2. Four or six bar friction hinges: comply with AAMA 904.

2.14 INTEGRATED WALL LOUVERS

A. General: C/ S 4” (101.6mm) Double Drainable Fixed Extruded Mullion Louver.

1. Material: Heads, sills, jambs and mullions to be integral to the metal wall panel system, having similar sightlines and joinery, to create a fully sealed system (caulking is not acceptable). Mullions shall be sliding interlock with internal drains. Blades to be one piece aluminum extrusions with gutters designed to catch and direct water to jamb and mullion drains. Compression gaskets shall be provided between bottom of mullion or jamb and top of sill to insure leak tight connections. Material thickness to be as follows: Heads, sills, jambs and mullions: 0.081” (2.06mm). Fixed blades 0.081” (2.06mm).
2. AMCA Performance: Louvers are to be tested in accordance with AMCA-500 test standards in an AMCA Certified Test Chamber. A 4’ x 4’ unit shall conform to the following:

a. Free area: 7.93 sq. ft. (0.74 sq. m.)
b. Free area velocity at the point being water penetration: 1123 FPM (342.3 m/min)
c. Intake Pressure drop at the point of beginning water penetration: 0.19 in. H₂O (2.91 mm)

2.15 INSECT SCREENS

A. General: Design windows and hardware to accommodate screens in a tight-fitting, removable arrangement, with a minimum of exposed fasteners and latches. Fabricate insect screens to fully integrate with window frame. Locate screens on inside of window and provide for each operable exterior ventilator.


B. Aluminum Insect Screen Frames: Manufacturer’s standard aluminum alloy complying with SMA 1004. Fabricate frames with mitered or coped joints or corner extrusions, concealed fasteners, and removable PVC spline/anchor concealing edge of frame.

1. Aluminum Tubular Framing Sections and Cross Braces: Roll formed from aluminum sheet with minimum wall thickness as required for class indicated.
2. Finish: match aluminum window members.

C. Aluminum Wire Fabric: 18-by-16 mesh of 0.011-inch diameter, coated aluminum wire.

1. Wire-Fabric Finish: As selected by Architect from manufacturer’s full range.

D. Wickets: Provide sliding wickets, framed and trimmed for a tight fit and for durability during handling.

PART 3 - EXECUTION

3.01 INSPECTION

A. Examine building structure with Installer present. Inspect for erection tolerances and other conditions that would adversely affect installation.

1. Inspect framing that will support metal wall insulated composite backup panel system to determine if support components are installed as indicated on approved shop drawings and are within tolerances acceptable to panel manufacturer.

   a. Maximum deviations acceptable to metal wall insulated composite backup panel system manufacturer:
      
   i. 3/8 inch (9.5 mm) in any 20-foot (6.1 m) length vertically or horizontally from the framing face plane.
   ii. 3/4 inch (19 mm) maximum deviation from the framing face plane on any building elevation.

B. Air/Moisture Barriers: Confirm that work has been completed, inspected, and tested as required.
C. Openings: Verify that window, door, louver and other penetrations match layout on shop drawings.

D. Correct out of tolerance work and other deficient conditions prior to proceeding with insulated composite backup panel installation.

3.02 METAL WALL INSULATED COMPOSITE BACKUP PANEL SYSTEM INSTALLATION

A. General: Install metal wall insulated composite backup panel system in accordance with approved shop drawings and manufacturer's recommendations.

B. Installation: Attach backup panels to supports at each panel connection point indicated on approved shop drawings.

1. Install with drain plane of panel facing weather side of installation.
2. Fasten metal wall insulated composite backup panel system to building framing with special clips and anchors provided by manufacturer utilizing recommended fasteners.
3. Horizontal Joinery: Working from base to top of metal wall insulated composite backup panel system installation, lap upper panel over lower panel to form a weather tight joint oriented to allow gravity drainage.
4. Vertical Joinery:

   a. Install vertical butt joints tight with no gap, set against continuous supports.
   b. Set panel ends in continuous bead of non-curing butyl sealant as indicated in manufacturer's installation details.
   c. Seal butt joints between adjacent panels with a continuous strip of self-adhering flashing at bottom row of panels and where additionally recommended by manufacturer or architect.

3.03 ERECTION TOLERANCES

A. Installation Tolerances: Align metal wall insulated composite backup panel system within installed tolerance of 1/4 inch in 20 feet (6 mm in 6.1 m), noncumulative, on level and plumb and location lines as indicated and within 1/8 inch (3 mm) offset of adjoining faces and of alignment of matching profiles.

3.04 SECONDARY FRAMING INSTALLATION

A. Secondary Metal Subgirt Framing: Install secondary metal framing components to tolerances indicated, as shown on approved shop drawings. Install secondary metal framing and other metal panel supports per ASTM C1007 and metal wall rainscreen panel and metal wall insulated composite backup panels manufacturer's recommendations.

3.05 METAL WALL RAINSCREEN PANEL INSTALLATION

A. General: Install metal wall rainscreen panels in accordance with approved shop drawings and manufacturer's recommendations. Install metal wall rainscreen panels in orientation, sizes, and locations indicated. Anchor metal wall rainscreen panels and other components securely in place. Provide for thermal and structural movement.

B. Attach panels to metal framing using recommended clips, screws, fasteners, sealants, and adhesives indicated on approved shop drawings.

1. Fasteners for Steel Wall Panels: Stainless-steel for exterior locations and locations exposed to moisture; carbon steel for interior use only.
2. Fasten metal wall rainscreen panels to supports with concealed clips at each joint at location, spacing, and with fasteners recommended by manufacturer. Install clips to supports with self-tapping fasteners.
3. Provide weatherproof escutcheons for pipe and conduit penetrating exterior walls.
4. Dissimilar Materials: Where elements of metal wall rainscreen panel and metal wall insulated composite backup panel systems will come into contact with dissimilar materials, treat faces and edges in contact with dissimilar materials as recommended by manufacturer.

C. Joint Sealers: Install joint sealants where indicated on approved shop drawings.

3.06 ACCESSORY INSTALLATION

A. General: Install metal wall rainscreen panel accessories with positive anchorage to building and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install related flashings and sheet metal trim per requirements of Section 07600 "Metal Flashing and Trim."
   2. Install components required for a complete metal wall rainscreen panel assembly, including trim, copings, corners, lap strips, flashings, sealants, fillers, closure strips, and similar items.
   3. Comply with performance requirements and manufacturer's written installation instructions.
   4. Provide concealed fasteners except where noted on approved shop drawings.
   5. Set units true to line and level as indicated.

3.07 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a service representative authorized by metal wall rainscreen panel and metal wall insulated composite backup panel manufacturer to inspect completed installation. Submit written report.

B. Correct deficiencies noted in manufacturer's report.

3.08 CLEANING AND PROTECTION

A. Remove temporary protective films. Clean finished surfaces as recommended by metal wall rainscreen panel and metal wall insulated composite backup panel manufacturer. Clear weep holes and drainage channels of obstructions, dirt, and sealant. Maintain in a clean condition during construction.

B. Replace damaged panels and accessories that cannot be repaired by finish touch-up or minor repair.

END OF SECTION
SECTION 07511

BUILT-UP HOT ASPHALT ROOFING

PART 1 - GENERAL

1.01 DESCRIPTION

A. The work of this section shall include but not necessarily limited to the installation of a Built-Up Hot Asphalt Hybrid Roofing System. The contractor shall be responsible for complete, water tight, warranted and inspected system. This system shall include but not necessarily be limited to the following:

1. Asphalt Flood Coat and Aggregate
2. SBS Modified Smooth Cap Sheet
3. Roofing Felts
4. Flashing
5. Adhesives
6. Infra-Red Scanning
7. Roof Insulation

B. The contractor shall be responsible for all materials, labor, equipment and storage.

1.02 RELATED DOCUMENTS

A. Related Sections:

1. Section 01060 “Regulatory Requirements and Safety”
2. Section 06100 “Rough Carpentry”
3. Section 07600 “Metal Flashing and Trim”
4. Section 07724 “Roof Hatches”
5. Section 07900 “Joint Sealants”
6. Section 08600 “Skylights”
7. Section 11011 “Fall Protection System”

B. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.03 CONTRACTOR RESPONSIBILITIES

A. General: Provide installed roofing membrane and base flashings that remain watertight; do not permit the passage of water; and resist specified uplift pressures, thermally induced movement, and exposure to weather without failure.

B. Material Compatibility: Provide roofing materials that are compatible with one another under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. FM Global (FMG) Listing: Provide roofing components that comply with the requirements in FMG 4450 and FMG 4470 as part of a roofing system and that are listed in FMG’s “Approval Guide” for Class 1 or noncombustible construction, as applicable. Identify materials with FMG markings.
1. Fire/Windstorm Classification: Class 1A-90.
2. Hail Resistance: SH.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other Work.

1. Base and counter flashings, cants, and membrane terminations.
2. Roof deck repairs
3. Scuppers and drain fabrication/installation

C. Design Requirements:
1. Uniform Wind Uplift Load Capacity
   a. Installed roof system shall withstand negative (uplift) design wind loading pressures complying with the following criteria.
      2. Importance Category:
         a. III.
      3. Importance Factor of:
         a. 1.15
      4. Wind Speed: 90 mph
      5. Ultimate Pullout Value: 456 pounds per each of the fastener
      6. Exposure Category:
         a. C.
      7. Design Roof Height: 30.0 feet.
      8. Minimum Building Width: 130.0 feet.
      9. Roof Pitch: 0.375 :12.
      10. Roof Area Design Uplift Pressure:
          a. Zone 1 - Field of roof 30.1 psf
          b. Zone 2 - Eaves, ridges, hips and rakes 45.8 psf
          c. Zone 3 - Corners 65.6 psf

2. Snow Load: per structural drawings
3. Live Load: 20 psf, or not to exceed original building design.
4. Dead Load:
   a. Installation of new roofing materials shall not exceed the dead load capacity of the existing roof structure.

D. Samples for Verification: Provide two (2) 12-by-12-inch samples for each of the following products:

1. Base-ply sheet.
2. Interply sheet.
4. Walkway pad or walkway cap sheet.
5. Flashing materials.
6. Two fasteners of each type, length, and finish.
7. Roofing aggregate.

E. Manufacturer Certificates:

1. Certify that materials are manufactured in the United States and conform to requirements specified herein, are chemically and physically compatible with each other, and are suitable for inclusion within the total roof system specified herein.

2. Signed by roofing manufacturer certifying that roofing system complies with requirements specified in “Performance Requirements” Article.
   a. Submit evidence of meeting performance requirements.

F. Installer Certificates: Signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install roofing system.

G. Qualification Data: For Installer, manufacturer and infrared scanning company

H. Product Test Reports: Submit test reports, prepared by an independent testing agency, for all modified bituminous sheet roofing, indicating compliance with ASTM D5147.

I. Research/Evaluation Reports and MSDS Sheets: For components of roofing system.

J. Maintenance Data: For roofing system to include in maintenance manuals.

K. Warranties: See special warranties specified in this Section.

L. Inspection Report: Copy of roofing system manufacturer’s inspection report of completed roofing installation.

1.05 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with not less than 12 years documented experience and have ISO 9001 certification.

   1. Manufacturer shall have FMG approval for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer’s product and that is eligible to receive manufacturer’s warranty.

C. Technical Inspector Qualifications: Contractor will engage a qualified manufacturer’s technical representative for the entire length of the roof project on a daily basis. Manufactures technical representative will be required to be on job site from the start of the work day to the completion of the work day. Manufacturer’s technical representative inspector shall perform roof inspections and tests and to prepare daily inspection and test
reports. Manufacturer’s technical representative inspector shall not be provided by an outside third party but from the manufacturer of the roofing system to be installed.

D. Testing Agency Qualifications: An independent testing agency with the experience and capability to conduct the testing indicated, as documented according to ASTM E 548.

E. Infra-red scan must be made to the completed roof prior to application of final surfacing. Infra-red scanner must be approved by the manufacturer issuing the warranty. Cost of this survey must be included in the Contractor’s Base Bid.

F. Products: Installed products must meet the following minimum physical properties:

1. Roofing Membrane Cap Sheet

<table>
<thead>
<tr>
<th>Property</th>
<th>Typical Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elongation @ 0 deg F +/- 3.6 deg F</td>
<td>5.1% MD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td></td>
<td>5.1% XMD</td>
<td></td>
</tr>
<tr>
<td>Elongation @ 73.4 deg F +/- 3.6 deg F</td>
<td>3.5% MD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td></td>
<td>3.5% XMD</td>
<td></td>
</tr>
<tr>
<td>Tensile Strength @ 0 deg F +/- 3.6 deg F</td>
<td>312 lbf/in MD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td></td>
<td>290 lbf/in XMD</td>
<td></td>
</tr>
<tr>
<td>Tensile Strength @ 73.4 deg F +/- 3.6 deg F</td>
<td>310 lbf/in MD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td></td>
<td>310 lbf/in XMD</td>
<td></td>
</tr>
<tr>
<td>Tear Strength @ 73.4 deg F +/- 3.6 deg F</td>
<td>500 lbf/in MD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td></td>
<td>500 lbf/in XMD</td>
<td></td>
</tr>
<tr>
<td>Thickness</td>
<td>2.667mm</td>
<td>ASTM D 5147/6162</td>
</tr>
</tbody>
</table>

2. Roofing Interply Felts

<table>
<thead>
<tr>
<th>Property</th>
<th>Typical Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile Strength</td>
<td>44 lb/in MD</td>
<td>ASTM D 2178 TYPE IV</td>
</tr>
<tr>
<td></td>
<td>44 lb/in XMD</td>
<td></td>
</tr>
<tr>
<td>Pliability, ½&quot;</td>
<td>No Failures</td>
<td>ASTM D 2178 TYPE IV</td>
</tr>
<tr>
<td>Net Dry Mass of Asphalt Impregnated Glass Felt</td>
<td>71 lb/100 ft²</td>
<td>ASTM D 2178 TYPE IV</td>
</tr>
<tr>
<td>Mass of Desaturated Glass Felt</td>
<td>1.7 lb/100 ft²</td>
<td>ASTM D 2178 TYPE IV</td>
</tr>
<tr>
<td>Bituminous Saturant (Asphalt)</td>
<td>3 lb/100 ft²</td>
<td>ASTM D 2178 TYPE IV</td>
</tr>
<tr>
<td>Ash</td>
<td>70%-88%</td>
<td></td>
</tr>
<tr>
<td>Roll Weight</td>
<td>33 lb/500 ft² roll</td>
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</tr>
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</table>

3. Roofing Membrane Base Ply Sheet

<table>
<thead>
<tr>
<th>Property</th>
<th>Typical Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pliability, 2° radius bend</td>
<td>No Failures</td>
<td>ASTM D 1490</td>
</tr>
<tr>
<td>Surfacing and Stabilizer</td>
<td>65% max</td>
<td>ASTM D 4601</td>
</tr>
<tr>
<td>Asphalt</td>
<td>10 lb/100 ft²</td>
<td>ASTM D 228-90a or ASTMD 5147</td>
</tr>
<tr>
<td>Weight</td>
<td>31 lb./100 ft² min</td>
<td>ASTM D 228-90a or ASTM D 5147</td>
</tr>
<tr>
<td>Tensile Strength</td>
<td>229 lbf/in. MD</td>
<td>ASTM D 4073 or ASTM D 5147</td>
</tr>
<tr>
<td>Tear Strength</td>
<td>370 lbf/in. MD</td>
<td>ASTM D 4073 or ASTM D 5147</td>
</tr>
<tr>
<td>Elongation</td>
<td>6.0% MD</td>
<td>ASTM D 4601 or ASTM D 5147</td>
</tr>
</tbody>
</table>
4. Roofing Flashing Cap Sheet

<table>
<thead>
<tr>
<th>Property</th>
<th>Typical Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elongation @ 0 deg F +/- 3.6 deg F</td>
<td>5.1% MD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td>Elongation @ 73.4 deg F +/- 3.6 deg F</td>
<td>3.5% MD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td>Tensile Strength @ 0 deg F +/- 3.6 deg F</td>
<td>290 lbf/in XMD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td>Tensile Strength @ 73.4 deg F +/- 3.6 deg F</td>
<td>310 lbf/in MD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td>Tear Strength @ 73.4 deg F +/- 3.6 deg F</td>
<td>500 lbf/in XMD</td>
<td>ASTM D 5147/6162</td>
</tr>
<tr>
<td>Thickness</td>
<td>2.667mm</td>
<td>ASTM D 5147/6162</td>
</tr>
</tbody>
</table>

5. Flashing Adhesive

<table>
<thead>
<tr>
<th>Property</th>
<th>Typical Value</th>
<th>Test Method</th>
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<tbody>
<tr>
<td>Asbestos content</td>
<td>None</td>
<td>ASTM D 276-87</td>
</tr>
<tr>
<td>Viscosity @ 77EF</td>
<td>160,000-200,000 cP min</td>
<td>ASTM D 276-87</td>
</tr>
<tr>
<td>Density @ 77 EF</td>
<td>8.6 lb/gal min</td>
<td>ASTM D 1475-85</td>
</tr>
<tr>
<td>Flash Point</td>
<td>80 deg F</td>
<td>ASTM D 93</td>
</tr>
<tr>
<td>VOC</td>
<td>300 g/L max</td>
<td></td>
</tr>
</tbody>
</table>

6. Asphalt Materials: Hot Bitumen Interply Adhesive, ASTM D312, Type IV special steep asphalt having the following characteristics:
   a. Softening Point 210°F - 225°F
   b. Flash Point 500°F
   c. Penetration @ 77°F 15-25 units
   d. Ductility @ 77°F 1.5 cm

7. Glass Fiber Fabric

<table>
<thead>
<tr>
<th>Property</th>
<th>Typical Value</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>9.0 lb/100ft²</td>
<td>ASTM D 146-90/1668</td>
</tr>
<tr>
<td>Moisture based on net weight</td>
<td>None</td>
<td>ASTM D 146-90/1668</td>
</tr>
<tr>
<td>Average tensile strength @ 70EF</td>
<td>65 lbf/in Warp Threads</td>
<td>ASTM D 1668</td>
</tr>
<tr>
<td></td>
<td>75 lbf/in Filling Threads</td>
<td></td>
</tr>
</tbody>
</table>

G. Source Limitations: Obtain components for roofing system approved by roofing system manufacturer.

H. Fire-Test-Response Characteristics: Provide roofing materials with the fire-test-response characteristics indicated as determined by testing identical products per test method below by UL, FMG, or another testing and inspecting agency acceptable to authorities having jurisdiction. Materials shall be identified with appropriate markings of applicable testing and inspecting agency.

1. Exterior Fire-Test Exposure: Class A; ASTM E 108, for application and roof slopes indicated.
2. Fire-Resistance Ratings: ASTM E 119, for fire-resistance-rated roof assemblies of which roofing system is a part.

I. Pre-Installation Conference: Convene a pre-roofing conference approximately two (2) weeks before scheduled commencement of modified bituminous roofing system installation and associated work. Comply with requirements for preinstallation conferences in Division 1 Section “Project Management and Coordination.” Review methods and procedures related to existing roof demolition, roof deck construction and/or repair and installation of new roofing system and associated work including, but not limited to, the following:

1. Meet with Owner, Architect, Owner’s insurer if applicable, testing and inspecting agency representative, all prime contractors, demolition contractor, 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 and finalize contractor proposal for Staging, Storage, Phasing and Protection.

3. Review methods and procedures related to roofing installation, including manufacturer’s written instructions.

4. Review and finalize construction schedule and verify availability of materials, Installer’s personnel, equipment, and facilities needed to make progress and avoid delays.

5. Examine deck substrate conditions and finishes for compliance with requirements, including flatness, pitch and fastening.

6. Review structural loading limitations of roof deck during and after roofing.

7. Review base flashings, special roofing details, roof drainage, roof penetrations, equipment curbs, and condition of other construction that will affect roofing system.

8. Review governing regulations and requirements for insurance and certificates if applicable.

9. Review temporary protection requirements for roofing system during and after installation.

10. Review procedures to test flow of existing and/or new roof leaders during and after roofing installation.

11. Review roof observation and repair procedures after roofing installation.

J. Immediately correct Roof leakage during construction. If the Contractor does not respond within twenty four (24) hours, the Owner has a right to hire a qualified contractor and backcharge the original contractor.

K. Final Moisture Analysis: Compliance with dampness and moisture controls will be verified upon completion of the Work by an infrared scan provided by the roofing manufacturer.
L. Insurance Certification: Assist Owner in preparation and submittal of roof installation acceptance certification as may be necessary in connection with fire and extended coverage insurance on roofing and associated work.

1.06 PROJECT CONDITIONS

A. All work shall be performed in accordance with rules, regulations, procedures, and safe practices of SEPTA, the Commonwealth of Pennsylvania, OSHA, and all other governmental agencies having jurisdiction over the Work.
B. Proceed with roofing work only when existing and forecasted weather conditions will permit unit of work to be installed in accordance with manufacturer’s recommendations and warranty requirements.
C. Do not apply roofing insulation or membrane to damp or frozen deck surface.
D. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

1.07 DELIVERY, STORAGE, AND HANDLING

A. The Contractor shall store equipment and materials at the job site in accordance with instructions of the SEPTA Project Manager and in conformance with applicable regulatory provisions. The Contractor shall not store unnecessary items at the job site.
B. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer’s name, product brand name and type, date of manufacture, and directions for storage.
C. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.
   1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.
D. Store and handle roofing sheets in a dry, well-ventilated, weather-tight place to ensure no possibility of significant moisture exposure. Store rolls of felt and other sheet materials on pallets or other raised surfaces. Stand all roll materials on end. Cover roll goods with a canvas tarpaulin or other breathable material (not polyethylene).
E. Handle and store roofing materials and place equipment in a manner to avoid permanent deflection of deck or other damage.
F. All loose material on platforms or other exposed locations shall be removed or secured at the end of each day to prevent dislodgment by train movement, wind, vandalism or other causes.
G. Do not leave unused materials on the roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.

1.08 MANUFACTURER’S INSPECTIONS

A. When the project is in progress, the roofing system manufacturer will provide the following:
   1. Keep the Architect or Owner informed as to the progress and quality of the work as observed.
   2. Provide inspector to be on site full-time for the duration of the work.
3. Report to the Architect in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor’s attention.

4. Provide verification that the roof slopes positively to drains/scuppers and that there are no low areas that may cause ponding.

B. When the project is complete, the roofing system manufacturer will provide the following:

1. Infra-red scan of project upon completion of the Work to confirm that the roof has been installed free of dampness and moisture. At the discretion of the manufacturer and approved by the Owner; large roof areas separated by dividers, completed sections can be scanned prior to completion of the entire roof installation. Cost of the scan shall be included in Contractor's base bid.

2. Confirm after completion that manufacturer has observed no applications procedures in conflict with the specifications other than those that may have been previously reported and corrected.

1.09 SEQUENCING AND SCHEDULING

A. Sequence installation of modified bituminous sheet roofing with related units of work specified in other sections to ensure that roof assemblies including roof accessories, flashing, trim and joint sealers are protected against damage from effects of weather, corrosion and adjacent construction activity.

B. Fully complete all modified bituminous membrane roofing field assembly work each day. Phased construction will not be accepted.

1.10 WARRANTY

A. When warranties are required, verify with Owner’s counsel that special warranties stated in this Article are not less than remedies available to Owner under prevailing local laws. Coordinate with Division 1.

B. Special Warranty: Manufacturer’s standard form, without monetary limitation, in which manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period. Failure includes roof leaks.

1. Special warranty includes roofing membrane, base flashings, roofing membrane accessories, roof insulation, fasteners, cover boards, substrate board, walkway products and other components of roofing system.

2. Warranty Period: 20 years from date of Substantial Completion, with the option to extend for 10 additional years.

3. Manufacturer will be responsible for providing an infrared scan of the roof upon completion of the Work.

4. Manufacturer will be responsible for inspecting the roof each year to determine if any maintenance or repairs need to be done to maintain the warranty. Manufacturer will inform SEPTA of any necessary maintenance, and inspect upon SEPTA’s completion of the work.
5. If the manufacturer fails to perform the yearly inspection and the roof develops a leak that year, the manufacturer shall hold SEPTA harmless and honor the full roof warranty.

C. Special Project Warranty: Submit roofing Installer’s warranty, on warranty form at end of this Section, signed by Installer, covering Work of this Section, including all components of roofing system such as roofing membrane, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

1. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide warranted systems by one of the following:

1. The Garland Company, Inc.
   3800 East 91st Street
   Cleveland, OH 44105
   Fax: 216-641-0633
   Phone: 216-641-7500
   Toll Free: 800-321-9336

2. Tremco, Inc.
   3735 Green Road
   Beachwood, Ohio 44122
   Phone: 216-292-5000
   Toll Free: 800-562-2728

3. Johns Manville Roofing
   717 17th Street
   Denver, Colorado 80202
   Phone: 303-978-2000
   Toll Free: 800-654-3103

4. Or approved equal manufacturers

B. Substitutions:

1. Products proposed as equal to the products specified in this Section shall be submitted in accordance with Bidding Requirements and Division 01 provisions.

2. Any item or materials submitted as a substitution to the manufacturer specified must comply in all respects as to the quality and performance of the brand name specified and the manufacturer shall provide all services specified. The Architect/Owner shall be the sole judge as to whether or not an item submitted as a substitute is truly equal.

3. Substitutions and/or Equals must be submitted for review a minimum of 5 working days prior to the bid opening. Sufficient information to evaluate the substitution must be supplied or the substitution will be rejected. It shall be at the Contractor’s risk to submit a substitution after being awarded the contract. If after evaluating the substitution SEPTA determines the substitution not equal to
the specified product then it shall be the Contractors responsibility to make good on the specified product with no extra cost to SEPTA.

2.02  BUILT UP ROOFING - MATERIALS

A. Roofing Membrane Cap Sheet: ASTM D 6162, Grade G, Type III composite polyester and glass-fiber-reinforced, SBS-modified asphalt sheet; asbestos-free, and suitable for application method specified.

1. The following products are acceptable. Other products may be considered but must meet or exceed all ASTM tests for elongation, tear strength, tensile strength and thickness.

   a. Garland StressPly Plus Membrane, Smooth
   b. Tremco POWERply 300 Smooth
   c. Johns Manville DynaMax Smooth Plus
   d. Approved Equal

B. Roofing Interply Sheets: ASTM D 2178 Type IV, asbestos free, glass-fiber felt.

1. The following products are acceptable. Other products may be considered but must meet or exceed all ASTM tests for pliability, weight, breaking strength and asphalt content.

   a. Garland HPR Glasfelts
   b. Tremco THERMglass Type IV
   c. Johns Manville GlasPly Premier
   d. Approved Equal

C. Roofing Membrane Base Ply Sheets: ASTM D 146, asphalt-impregnated, asbestos free, polyester and glass-fiber felt.

1. The following products are acceptable. Other products may be considered but must meet or exceed all ASTM tests for pliability, weight, breaking strength and asphalt content.

   a. Garland Tri-Base Sheets
   b. Tremco BURmastic Modified Premium Composite Ply
   c. Johns Manville DynaMax S Plus

D. Thermal Insulation Properties and Approved Insulation Boards.
1. Rigid Polyisocyanurate Roof Insulation; ASTM C1289:
   a. Qualities: Rigid, closed cell polyisocyanurate foam core bonded to heavy duty glass fiber mat facers.
   b. Thickness: Minimum 3”.
   c. R-Value: Minimum 18.
   e. Acceptable Products:
      1) ENRGY-3; Johns Manville
      2) Hytherm; Dow
      3) GAFTEMP Isotherm R; GAF

E. High Density Fiberboard Roof Insulation (Cover Board); ASTM C208
   a. Qualities: Rigid, composed of interlocking fibers factory blended treated with asphalt on the top side.
2.03 FLASHING MATERIALS

A. One layer of roofing membrane base ply sheet material.

B. One layer of granular surfaced cap sheet material conforming to ASTM D 6162, Grade G, Type III composite polyester and glass-fiber-reinforced, SBS-modified asphalt sheet; asbestos-free, and suitable for application method specified.

1. The following products are acceptable. Other products may be considered but must meet or exceed all ASTM tests for density, viscosity and nonvolatile matter.

   b. Tremco POWERPly 300 FR
   c. Johns Manville DynaMax FR Plus
   d. Or approved Equal

C. Flashing Adhesive: Roofing system manufacturer’s standard asphalt formulated for compatibility and use with membrane felt ply sheets.

D. Glass-Fiber Fabric: Woven glass cloth, treated with asphalt, complying with ASTM D 146.

E. Polyester Fabric: Stitchbonded polyester scrim for use with PermaFlash system, complying with ASTM D 412.

1. The following products are acceptable. Other products may be considered but must meet or exceed all ASTM tests for density, viscosity and nonvolatile matter.

   a. Garland HPR Garmesh
   b. Tremco BURmesh
   c. Johns Manville PermaFlash
   d. Approved Equal

2.04 ASPHALT MATERIALS

A. Asphalt Primer: ASTM D 41.

B. Membrane Interply adhesive:

   Hot Bitumen, ASTM D312, Type IV special steep asphalt having the following characteristics:

   1. Softening Point 210°F - 225°F
   2. Flash Point 500°F
   3. Penetration @ 77°F 15-25 units
4. Ductility @ 77°F  1.5 cm

2.05 AUXILIARY MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with built-up roofing.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FMG 4470, designed for fastening roof base sheets to substrate, and acceptable to roofing system manufacturer and meeting specified UL wind uplift ratings.

C. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required by roofing system manufacturer for application.

D. Mastic Sealant: Polyisobutylene, plain or modified bitumen, nonhardening, nonmigrating, nonskinning, and nondrying.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates meeting corrosion-resistance provisions in FM 4470; designed for fastening roofing membrane components to substrate; tested by manufacturer for required pullout strength; and acceptable to roofing system manufacturer.

F. Metal Flashing Sheet: Metal flashing sheet is specified in Section 07600 “Metal Flashing and Trim.”

G. Miscellaneous Accessories: Provide miscellaneous accessories recommended by roofing system manufacturer.

H. Walkway Pads: Mineral-granule-surfaced, reinforced asphaltic composition, slip-resisting pads manufactured as a traffic pad for foot traffic and acceptable to built-up roofing manufacturer, 1/2 inch thick minimum.

1. Pad size: 36 inches by 48 inches.

2.06 RELATED MATERIALS

A. Fiber Cant and Tapered Edge Strips: Performed rigid insulation units of sizes/shapes indicated, matching insulation board or of perlite or organic fiberboard, as per the approved manufacturer.

1. Acceptable Manufacturers:
   b. Celotex
   c. Johns Manville
   d. GAF
   e. Approved Equivalent

B. Asphalt: ASTM D312, Type IV Steep Asphalt

C. Fasteners: Corrosion resistant screw fastener as recommended by roof membrane manufacturer.
1. Factory Mutual Tested and Approved with three (3) inches coated disc for I-90 rating, length required to penetrate metal deck one inch.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with the following requirements and other conditions affecting performance of roofing system:

1. Verify that deck surfaces and project conditions are ready to receive work of this section.
2. Verify that deck is supported and secured to structural members.
3. Verify that deck surfaces are dry. Verify that metal deck flutes are clean and dry.
4. Verify that roof openings and penetrations are in place and set and braced and that roof drains are securely clamped in place.
5. Verify that insulation and cover boards are securely fastened to the roof deck and are ready to receive work of this section.
6. Verify that cants, blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
7. Verify that roof positively slopes to drain.
8. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer’s written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

C. Prime surface of concrete deck with asphalt primer at a rate of 3/4 gal./100 sq. ft. and allow primer to dry.

3.03 ROOFING MEMBRANE INSTALLATION, GENERAL

A. Install roofing membrane system according to roofing system manufacturer’s written instructions and applicable recommendations of ARMA/NRCA’s “Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing.”

1. Install roofing system according to applicable specification-plate classifications in NRCA’s “The NRCA Roofing and Waterproofing Manual” and requirements in this Section.
B. Start installation of roofing membrane in presence of roofing system manufacturer's technical personnel.

C. All slopes of greater than 1-1/2:12 require back-nailing to prevent slippage of the ply sheets. Use ring or spiral shank one (1) inch cap nails, or screws and plates at a rate of one (1) fastener per ply (including the modified membrane) at each insulation stop. Place insulation stops at 16 ft o.c. for slopes less than 3:12 and four (4) ft o.c. for slopes greater than 3:12. On non-insulated systems, nail each ply directly into the deck at the rate specified above. When slope exceeds 1 ½:12, install all plies parallel to the slope (strapping) to facilitate backnailing. Install four (4) additional fasteners at the upper edge of the modified bitumen sheet when strapping the plies.

D. Cooperate with testing and inspecting agencies engaged or required to perform services for installing roofing system.

E. Coordinate installing roofing system so insulation and other components of the roofing membrane system not permanently exposed are not subjected to precipitation or left uncovered at the end of the workday or when rain is forecast.

1. Provide tie-offs at end of each day’s work to cover exposed roofing membrane sheets and insulation with a course of coated felt set in roofing cement or hot roofing asphalt with joints and edges sealed.

2. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system.

3. Remove and discard temporary seals before beginning work on adjoining roofing.

F. Substrate-Joint Penetrations: Prevent roofing asphalt from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

3.04 MEMBRANE INSTALLATION

A. Install one (1) ply of Membrane Base Ply Sheets and two (2) plies of Membrane Interply Sheets according to roofing system manufacturer’s written instructions starting at low point of roofing system. Align base-ply and interply sheets without stretching. Shingle side laps of base-ply and interplay sheets uniformly to ensure required number of base-ply and interply sheets covers substrate at any point. Shingle in direction to shed water. Extend base-ply sheets over and terminate beyond cants.

B. Install modified bituminous roofing membrane cap sheet according to roofing manufacturer’s written instructions, starting at low point of roofing system. Extend roofing membrane sheets over and terminate beyond cants, installing as follows:

1. Adhere to substrate in hot-applied adhesive.

2. Unroll roofing membrane sheets and allow them to relax for minimum time period required by manufacturer.

C. Laps: Accurately align roofing membrane sheets, without stretching, and maintain uniform side and end laps. Stagger end laps. Completely bond and seal laps, leaving no voids.

1. Repair tears and voids in laps and lapped seams not completely sealed.

D. Install roofing membrane sheets so side and end laps shed water.

Built-Up Hot Asphalt Roofing 07511 - 14
E. Aggregate Surfacing: Promptly after installing roofing membrane, base flashing, and stripping, flood-coat roof surface with 70 lb/100 sq. ft. of hot roofing asphalt. While flood coat is hot and fluid, cast the following average weight of aggregate in a uniform course:

1. Aggregate Weight: 500 lb/100 sq. ft.
2. Aggregate shall be dry and placed in a manner required to form a compact, embedded overlay. To aid in proper embedment, lightly roll aggregate provided that there is no damage to the roofing membrane.

F. Walkway Pads: Install walkway pads using units of size indicated or, if not indicated, of manufacturer’s standard size according to walkway pad manufacturer’s written instructions.

1. Provide 2 inches between adjacent pads and sweep away loose aggregate surfacing and set walkway pads in additional flood coat of hot roofing asphalt.

3.05 FLASHING AND STRIPPING INSTALLATION

A. Install base flashing consisting of a base ply and a cap sheet over cant strips and other sloping and vertical surfaces, at roof edges, and at penetrations through roof, and secure to substrates according to roofing system manufacturer’s written instructions and as follows:

1. Prime substrates with asphalt primer as required by roofing system manufacturer.
2. Flashing Sheet Application: Adhere flashing sheet to substrate in hot or cold adhesive applied at rate required by roofing system manufacturer.

B. Extend base flashing up walls or parapets a minimum of 8 inches above roofing membrane, and a maximum of 24 inches up the vertical surface. Extend base flashing a minimum of 10 inches onto field of roofing membrane. Extend base flashing up and over perimeters and roof curbs covering top.

C. Seal all vertical laps of flashing membrane with a three-course application of trowel-grade roof mastic and fiberglass mesh.

D. Mechanically fasten top of base flashing securely at terminations and perimeter of roofing.


E. Install stripping, according to roofing system manufacturer’s written instructions, where metal flanges and edgings are set on roof membrane.

F. Built-up Stripping: Install stripping of not less than 2 roofing membrane base ply sheets, setting each ply in a continuous coating of cold applied asphalt and extend onto roofing membrane 6 inches and 3 inches, respectively.

G. Strip in base of flashing to roof system and vertical flashing laps, using a three course application of glass-fiber fabric set in Flashing Adhesive and covered with approved mastic.
H. Roof Drains: Set 30-by-30-inch metal flashing in bed of asphalt roofing cement on completed roofing membrane. Cover metal flashing with built-up roofing cap sheet stripping and extend a minimum of 4 inches beyond edge of metal flashing onto field of built-up roofing. Clamp built-up roofing, metal flashing, and stripping into roof-drain clamping ring.

1. Install flashing-sheet stripping by same method as installing base flashing.

2. Install stripping of not less than two roofing membrane ply sheets, each set in a continuous coating of asphalt roofing cement.

I. Coordinate roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices with the roofing system work.

3.06 INSULATION INSTALLATION

A. Attachment with Mechanical Fasteners
   1. Approved insulation board shall be fully attached to the deck with an approved mechanical fastening system. As a minimum, the amount of fasteners shall be in accordance with manufacturer’s recommendation for FM I-90 system. Otherwise, a minimum of one fastener per two square feet shall be installed.
   2. Filler pieces of insulation require at least two fasteners per piece if size of insulation is less than four square feet.
   3. Spacing pattern of fasteners shall be as per manufacturer’s recommendations to meet the FM requirements. Placement of any fastener from edge of insulation board shall be a minimum of three inches, and a maximum of six (6) inches.
   4. Minimum penetration into deck shall be as recommended by the fastener manufacturer. There is a one (1) inch minimum for metal deck.
   5. Approved recovery board one-half inch (1/2”) thickness shall be installed over the base layer of insulation using hot asphalt applied at the rate of approximately thirty (30) pounds per 100 square feet.

3.07 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to perform roof tests and inspections as required under provisions of Section 01410 “Testing and Inspection Services.”

B. Test Cuts: Test specimens will be removed to evaluate problems observed during quality-assurance inspections of roofing membrane as follows:

   1. Approximate quantities of components within roofing membrane will be determined according to ASTM D 3617.
   2. Test specimens will be examined for interply voids according to ASTM D 3617 and to comply with criteria established in Appendix 3 of ARMA/NRCA’s “Quality Control Guidelines for the Application of Polymer Modified Bitumen Roofing.”

C. Correct defects or irregularities discovered during field inspection.

D. Require daily attendance of roofing materials manufacturer’s representatives at site during installation of the roofing system.
3.08 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction will not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.09 FINAL INSPECTION

A. At completion of roofing installation and associated work, meet with Contractor, Architect, installer, installer of associated work, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system. Walk roof surface areas of the building, inspect perimeter building edges as well as flashing of roof penetrations, walls, curbs and other equipment. List all items requiring correction or completion and furnish copy of list to each party in attendance.

1. Notify Architect and Owner 48 hours in advance of date and time of inspection.

B. The Contractor shall flood roof and verify with project manager that entire roof flows adequately to drains.

C. The roofing system manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the Roofing Contractor.

D. If core cuts verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at his own expense.

E. Repair or replace deteriorated or defective work found at time above inspection as required to produce an installation which is free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

F. Notify the Architect and Owner upon completion of corrections.

G. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.10 ROOFING INSTALLER’S WARRANTY

A. WHEREAS <Insert name> of <Insert address>, herein called the “Roofing Installer,” has performed roofing and associated work (“work”) on the following project:

1. Owner: <Insert name of Owner.>
2. Address: <Insert address.>
3. Building Name/Type: <Insert information.>
4. Address: <Insert address.>
5. Area of Work: <Insert information.>
6. Acceptance Date: <Insert date.>
7. Warranty Period: <Insert time.>
8. Expiration Date: <Insert date.>

B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period the installer will, at the installer’s own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. lightning;
   b. peak gust wind speed exceeding <Insert wind speed> mph (m/sec);
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. vapor condensation on bottom of roofing; and
   g. Activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.
6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

7. This Warranty is recognized to be the only warranty of Roofing Installer on said work and shall not operate to restrict or cut off Owner from other remedies and resources lawfully available to Owner in cases of roofing failure. Specifically, this Warranty shall not operate to relieve Roofing Installer of responsibility for performance of original work according to requirements of the Contract Documents, regardless of whether Contract was a contract directly with Owner or a subcontract with Owner’s General Contractor.

E. IN WITNESS THEREOF, this instrument has been duly executed this <Insert day> day of <Insert month>, <Insert year>.

1. Authorized Signature: <Insert signature.>
2. Name: <Insert name.>
3. Title: <Insert title.>

END OF SECTION
SECTION 07600
METAL FLASHING AND TRIM

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes: Sheet metal flashing and trim including the following:
   1. Formed low-slope roof flashing and trim.
   2. Formed roof overflow scuppers.
   3. Formed wall flashing and trim.

B. Related Sections:
   1. Section 04200 "Masonry Unit"
   2. Section 06100 "Rough Carpentry"
   3. Section 07115 "Bituminous Dampproofing"
   4. Section 07140 "Cold Fluid-Applied Waterproofing"
   5. Section 07410 "Metal Wall Rainscreen Panel"
   6. Section 07511 "Built-Up Hot Asphalt Roofing"
   7. Section 07724 "Roof Hatches"
   8. Section 07900 "Joint Sealants"
   9. Section 08600 "Skylights"

1.03 PERFORMANCE REQUIREMENTS
A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

C. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

D. Fabricate and install flashings at roof edges as indicated on the drawings to comply with FM Global standards and recommendations of FM Loss Prevention Data Sheet 1-49 for the following wind zone: 1) Wind Zone 1: Wind pressures of 21 to 30 psf.

1.04 SUBMITTALS
A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
B. Shop Drawings: Show layouts of sheet metal flashing and trim, including plans and elevations. Distinguish between shop- and field-assembled work. Include the following:

1. Identify material, thickness, weight, and finish for each item and location in Project.
2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
3. Details for fastening, joining, supporting, and anchoring sheet metal flashing and trim, including fasteners, clips, cleats, and attachments to adjoining work.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Sheet Metal Flashing: 12 inches long. Include fasteners, cleats, clips, closures, and other attachments.

1.05 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

B. Preinstallation Conference: Conduct conference at Project site.

1. Meet with Owner, Architect, Owner's insurer if applicable, Installer, and installers whose work interfaces with or affects sheet metal flashing and trim including installers of roofing materials, roof accessories, unit skylights, and roof-mounted equipment.
2. Review methods and procedures related to sheet metal flashing and trim.
3. Examine substrate conditions for compliance with requirements, including flatness and attachment to structural members.
4. Document proceedings, including corrective measures and actions required, and furnish copy of record to each participant.

1.06 PRODUCT HANDLING

A. Deliver sheet metal flashing materials and fabrications undamaged. Protect sheet metal flashing and trim materials and fabrications during transportation and handling.

B. Unload, store, and install sheet metal flashing materials and fabrications in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack materials on platforms or pallets, covered with suitable weathertight and ventilated covering. Do not store sheet metal flashing and trim materials in contact with other materials that might cause staining, denting, or other surface damage.

1.07 COORDINATION

A. Coordinate installation of sheet metal flashing and trim with interfacing and adjoining construction to provide a leakproof, secure, and noncorrosive installation.

1.08 WARRANTY

A. Special Warranty on Painted Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace manufactured roof specialties that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Fluoropolymer Finish: Deterioration includes, but is not limited to, the following:
a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 SHEET METALS

A. Stainless-Steel Sheet: .015; ASTM A 240/A 240M, Type 304; finish No. 2D (dull, cold rolled).
B. Lead Sheet: ASTM B 749, Type L51121, copper-bearing lead sheet.

2.02 UNDERLAYMENT MATERIALS

B. Felts: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.
C. Slip Sheet: Rosin-sized paper, minimum 3 lb/100 sq. ft.

2.03 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.

C. Solder for Stainless Steel: ASTM B 32, Grade Sn60, with acid flux of type recommended by stainless-steel sheet manufacturer.

D. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

E. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

F. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, heavy bodied for hooked-type expansion joints with limited movement.

G. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

H. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.04 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.
   2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form nonexpansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.
   1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" and FMG Loss Prevention Data Sheet 1-49 for application but not less than thickness of metal being secured.

2.05 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Base Flashing: Aluminum; 0.015 inch thick.
   1. Finish: Clear mill finish.

B. Counterflashing: Stainless Steel; 0.015 inch thick.
   1. Finish: Clear mill finish, unless otherwise indicated.

C. Roof-Penetration Flashing: Lead; 4.0 lb/sq. ft., hard tempered.

D. Roof-Drain Flashing: Lead; 4.0 lb/sq. ft., hard tempered.

2.06 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch-long, but not exceeding 12 foot long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches beyond each side of wall openings. Form with 2-inch-high end dams.
1. Material: Stainless Steel; 0.0156 inch thick.

2.07 EXPOSED TRIM

A. Formed Water Table Flashing and Other Exposed Trim:
   1. Material: Stainless Steel; 0.015 inch thick.
   2. Finish: clear mill finish

2.08 FINISHES

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

   1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
   2. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

   1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

   1. Coat side of stainless-steel and lead sheet metal flashing and trim with bituminous coating where flashing and trim will contact wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing metal flashing directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet or install a course of polyethylene underlayment.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.
D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet with no joints allowed within 24 inches of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with butyl sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches for nails and not less than 3/4 inch for wood screws.
   1. Aluminum: Use aluminum or stainless-steel fasteners.
   2. Stainless Steel: Use stainless-steel fasteners.

H. Seal joints with butyl sealant as required for watertight construction.
   1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F, set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F.
   2. Prepare joints and apply sealants to comply with requirements in Section 07900 "Joint Sealants."

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches except where pretinned surface would show in finished Work.
   1. Pretinning is not required for lead.
   2. Stainless-Steel Soldering: Pretin edges of uncoated sheets to be soldered using solder recommended for stainless steel and phosphoric acid flux. Promptly wash off acid flux residue from metal after soldering.
   3. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

J. Stainless Steel Flashing: Rivet or weld joints in uncoated aluminum where necessary for strength.

3.03 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for butyl sealant, extending a minimum of 4 inches over base flashing. Install stainless-steel draw band and tighten.

C. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches over base flashing. Lap counterflashing joints a minimum of 4 inches and bed with butyl sealant.
   1. Secure in a waterproof manner by means of anchor and washer at 36-inch centers.
D. Roof-Penetration Flashing: Coordinate installation of roof-penetration flashing with installation of roofing and other items penetrating roof. Install flashing as follows:
   1. Turn lead flashing down inside vent piping, being careful not to block vent piping with flashing.
   2. Seal with butyl sealant and clamp flashing to pipes penetrating roof except for lead flashing on vent piping.

3.04 OVERFLOW SCUPPERS

A. Overflow Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.
   1. Anchor scupper closure trim flange to exterior wall and seal or solder to scupper.

3.05 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

3.06 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

D. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION
SECTION 07724

ROOF HATCHES

PART 1  GENERAL

1.01  RELATED DOCUMENTS

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

1.02  SUMMARY

A. Section Includes:

1. Roof hatches.
2. Safety systems integral with roof hatches.
3. Ladder up safety post

B. Related Sections:

1. Section 05500 "Metal Fabrications"
2. Section 06100 "Rough Carpentry".
3. Section 07511 “Built-Up Hot Asphalt Roofing”
4. Section 07600 "Metal Flashing and Trim"
5. Section 07900 “Joint Sealants”
6. Section 11011 “Fall Protection Systems”

1.03  SUBMITTALS

A. Product Data: For roof hatches. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: Show fabrication and installation details for roof hatches. Indicate dimensions, loadings, required clearances, method of field assembly, and components. Include plans, elevations, sections, details, and attachments to other work.

1.04  QUALITY ASSURANCE

A. Sheet Metal Standard: Comply with SMACNA's "Architectural Sheet Metal Manual" details for fabrication of units, including flanges and cap flashing to coordinate with type of roofing indicated.

1.05  PRODUCT HANDLING

A. Pack, handle, and ship roof hatches properly labeled in heavy-duty packaging to prevent damage.

1.06  PROJECT CONDITIONS

A. Field Measurements: Verify required openings for each roof hatch by field measurements before fabrication and indicate measurements on Shop Drawings.

1.07  COORDINATION

A. Coordinate layout and installation of roof hatches with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weathertight, secure, and noncorrosive installation.
1. With Architect's approval, adjust location of roof hatches that would interrupt roof drainage routes or roof expansion joints.

PART 2 PRODUCTS

2.01 METAL MATERIALS

A. Aluminum Sheet: ASTM B 209, alloy and temper recommended by manufacturer for type of use and mill finish.

2.02 MISCELLANEOUS MATERIALS

A. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.


C. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, nonperforated.


D. Fasteners: Same metal as metals being fastened, or nonmagnetic stainless steel or other noncorrosive metal as recommended by roof accessory manufacturer. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners.

E. Gaskets: Manufacturer's standard tubular or fingered design of neoprene, EPDM, or PVC; or flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C 920, silicone sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant, polyisobutylene plasticized, and heavy bodied for hooked-type expansion joints with limited movement.

H. Roofing Cement: ASTM D 4586, nonasbestos, fibrated asphalt cement designed for trowel application or other adhesive compatible with roofing system.

2.03 ROOF HATCHES

A. Roof Hatches: Fabricate roof hatches with insulated double-wall lids and insulated double-wall curb frame with integral deck mounting flange and lid frame counterflushing. Fabricate with welded or mechanically fastened and sealed corner joints. Provide continuous weathertight perimeter gasketing and equip with corrosion-resistant or hot-dip galvanized hardware.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Babcock Davis; Model BRHA, or comparable product by one of the following:

a. Bilco Company (The).
b. Milcor Inc.; a Gibraltar Company.
c. Nystrom, Inc.


3. Type and Size: Single-leaf lid, 36 by 36 inches.

4. Curb and Lid Material: Aluminum sheet, 0.090 inch thick.
a. Finish: Mill.

5. Insulation: Cellulosic-fiber, glass-fiber, or polyisocyanurate board.
6. Interior Lid Liner: Manufacturer's standard metal liner of same material and finish as outer metal lid.
7. Exterior Curb Liner: Manufacturer's standard metal liner of same material and finish as metal curb.
8. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.
9. Fabricate units to minimum height of 12 inches, unless otherwise indicated.
10. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate hatch curbs with height tapered to match slope to level tops of units, unless otherwise indicated.
11. Hardware: Stainless-steel spring latch with turn handles, butt- or pintle-type hinge system, and padlock hasps inside and outside.
12. Ladder Safety Post: Manufacturer's standard ladder safety post. Post to lock in place on full extension. Provide release mechanism to return post to closed position.
   a. Test Load: As required by authorities having jurisdiction.
   b. Height: 42 inches above finished roof deck, unless otherwise indicated.
   c. Material and Finish: Aluminum, mill finished.
   d. Diameter: Pipe with 1-5/8-inch OD tube.
13. Safety Railing System: Manufacturer's standard complete system including rails, clamps, fasteners, safety barrier at railing opening, and all accessories required for a complete installation.
   a. Test Load: As required by authorities having jurisdiction.
   b. Height: 42 inches above finished roof deck, unless otherwise indicated.
   c. Pipe or Tube: 1-1/4-inch ID galvanized pipe or 1-5/8-inch OD galvanized tube.
   d. Flat Bar: 2-inch-high by 3/8-inch-thick galvanized steel.
   e. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer's standard hinges and self-latching mechanism.
   f. Pipe Ends and Tops: Covered or plugged with weather-resistant material.
   g. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members that are exposed to exterior or to moisture from condensation or other sources.
   h. Fabricate joints that will be exposed to weather in a watertight manner.
   i. Close exposed ends of handrail and railing members with prefabricated end fittings.
   j. Fasteners: Manufacturer's standard.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of work.

   1. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored and is ready to receive roof hatches.
   2. Verify dimensions of roof openings for roof hatches.
   3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install roof hatches according to manufacturer's written instructions. Anchor roof hatches securely in place and capable of resisting forces specified. Use fasteners, separators, sealants, and other miscellaneous items as required for completing roof hatch installation. Install roof hatches to resist exposure to weather without failing, rattling, leaking, and fastener disengagement.
B. Install roof hatches to fit substrates and to result in watertight performance.

C. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Underlayment: Where installing exposed-to-view components of roof hatches directly on cementitious or wood substrates, install a course of felt underlayment and cover with a slip sheet, or install a course of polyethylene underlayment.

D. Install roof hatches level, plumb, true to line and elevation, and without warping, jogs in alignment, excessive oil canning, buckling, or tool marks.

E. Roof Hatch Installation:
   1. Check roof hatch for proper operation. Adjust operating mechanism as required. Clean and lubricate joints and hardware.
   2. Attach ladder safety post according to manufacturer's written instructions.
   3. Attach safety railing system to roof hatch curb.

F. Seal joints with elastomeric or butyl sealant as required by manufacturer of roof accessories.

3.03 CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

END OF SECTION
SECTION 07900

JOINT SEALANTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Joint sealants for the following applications, including those specified by reference to this Section:

1. Exterior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   b. Control and expansion joints in unit masonry.
   c. Joints between metal panels.
   d. Joints between different materials listed above.
   e. Perimeter joints between materials listed above and frames of doors, windows and louvers.
   f. Control and expansion joints in ceilings and other overhead surfaces.
   g. Other joints as indicated.

2. Exterior joints in the following horizontal traffic surfaces:
   a. Isolation and contraction joints in cast-in-place concrete slabs.
   b. Joints between different materials.
   c. Other joints as indicated.

3. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:
   a. Control and expansion joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints of exterior openings where indicated.
   c. Tile control and expansion joints.
   d. Vertical joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
   e. Perimeter joints between interior wall surfaces and frames of interior doors, windows and elevator entrances.
   f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   g. Joints between counters, backsplashes, and adjoining walls.
   h. Joist penetrations through interior walls and partitions, used in combination with sound attenuation insulation to seal openings.
   i. Other joints as indicated.

4. Interior joints in the following horizontal traffic surfaces:
   b. Control and expansion joints in tile flooring.
   c. Other joints as indicated.

B. Related Sections:

1. Section 04200 "Masonry Unit"
2. Section 07210 "Building Insulation"
3. Section 07410 “Metal Wall Rainscreen Panel”
4. Section 07511 “Built-Up Hot Asphalt Roofing”
5. Section 07600 “Metal Flashing and Trim”
6. Section 07724 “Roof Hatches”
7. Section 08413 “Glazed Aluminum Curtain Wall”
8. Section 08600 “Skylights”
9. Section 08810 “Glazing”
10. Section 09300 “Tile”

1.03 PERFORMANCE REQUIREMENTS

A. Provide elastomeric joint sealants for exterior applications that establish and maintain watertight and airtight continuous joint seals without staining or deteriorating joint substrates.

B. Provide joint sealants for interior applications that establish and maintain airtight and water-resistant continuous joint seals without staining or deteriorating joint substrates.

1.04 SUBMITTALS

A. Product Data: For each joint-sealant product indicated.

B. 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 type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Compatibility and Adhesion 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 needed for adhesion.

E. Product Test Reports: Based on comprehensive testing of product formulations performed by a qualified testing agency, indicating that sealants comply with requirements.

F. Warranties: Special warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. Installer Qualifications: A firm experienced in installing joint sealants similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful performance. Qualifications include having the necessary experience, staff, and training to install manufacturer’s products per specified requirements.
   1. Manufacturer’s authorized Installer who is approved or licensed for installation of elastomeric sealants required for this Project.

B. Source Limitations: Obtain each type of joint sealant through one source from a single manufacturer.

C. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
1. Use ASTM C 1087 or manufacturer’s standard test method to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Submit not fewer than eight pieces of each type of material, including joint substrates, shims, joint-sealant backings, secondary seals, and miscellaneous materials.

3. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.

4. For materials failing tests, obtain joint-sealant manufacturer’s written instructions for corrective measures including use of specially formulated primers.

5. Testing will not be required if joint-sealant manufacturers submit joint preparation data that are based on previous testing of current sealant products for adhesion to, and compatibility with, joint substrates and other materials matching those submitted.

D. Product Testing: Obtain test results for "Product Test Reports" Paragraph in "Submittals" Article from a qualified testing agency based on testing current sealant formulations within a 36-month period preceding the commencement of the Work.

1. Testing Agency Qualifications: An independent testing agency qualified according to ASTM C 1021 to conduct the testing indicated, as documented according to ASTM E 548.

2. Test elastomeric joint sealants for compliance with requirements specified by reference to ASTM C 920, and where applicable, to other standard test methods.

E. Mockups: Build mockups incorporating sealant joints, as follows, to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution:

1. Joints in mockups of assemblies specified in other Sections that are indicated to receive elastomeric joint sealants, which are specified by reference to this Section.

1.06 PROJECT CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer 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. Contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.07 WARRANTY

A. Special Installer’s Warranty: Installer’s standard form in which Installer agrees to repair or replace elastomeric joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 2 years from date of Substantial Completion.

B. Special Manufacturer’s Warranty: Manufacturer’s standard form in which elastomeric sealant manufacturer agrees to furnish elastomeric joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: 10 years from date of Substantial Completion.

C. Special warranties specified in this Article exclude deterioration or failure of elastomeric joint sealants from the following:
1. Movement of the structure resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression caused by structural settlement or errors attributable to design or construction.
2. Disintegration of joint substrates from natural 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

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products listed in the Joint Sealant Schedule at end of Part 3.

2.02 MATERIALS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer, based on testing and field experience.

B. VOC Content of Interior Sealants: Provide sealants and sealant primers for use inside the weatherproofing system that comply with the following limits for VOC content when calculated according to 40 CFR 59, Part 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

C. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range, unless otherwise indicated.

2.03 JOINT SEALANTS

A. Elastomeric Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

1. Suitability for Contact with Food: Where elastomeric sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

B. Latex Sealant: Comply with ASTM C 834, Type OP, Grade NF.

C. Acoustical Sealant for Exposed and Concealed Joints: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834 and the following:

1. 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.

D. Acoustical Sealant for Concealed Joints: Manufacturer's standard, nondrying, nonhardening, nonskinning, nonstaining, gunnable, synthetic-rubber sealant recommended for sealing interior concealed joints to reduce airborne sound transmission.
2.04 JOINT SEALANT BACKING

A. General: Provide sealant backings of material and type that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) 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 where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.05 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting joint-sealant performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include concrete, masonry and unglazed surfaces of ceramic tile.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.
Nonporous joint substrates include metal, glass, porcelain enamel, and glazed surfaces of ceramic tile.

B. Joint Priming: Prime joint substrates, where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer’s written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Acoustical Sealant Application Standard: Comply with recommendations in ASTM C 919 for use of joint sealants in acoustical applications as applicable to materials, applications, and conditions indicated.

D. Install sealant backings of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

E. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

F. 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.

G. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint configuration per Figure 5A in ASTM C 1193, unless otherwise indicated.
3.04 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed elastomeric sealant joints as follows:
   a. Perform 10 tests for the first 1000 feet of joint length for each type of elastomeric sealant and joint substrate.
   b. Perform 1 test for each 1000 feet of joint length thereafter or 1 test per each floor per elevation.

2. Test Method: Test joint sealants according to the first method below, in Appendix X1 in ASTM C 1193, or another of the listed methods as appropriate for type of joint-sealant application indicated:

3. For joints with dissimilar substrates, verify adhesion to each substrate separately; do this by extending cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

4. Inspect joints for complete fill, for absence of voids, and for joint configuration complying with specified requirements. Record results in a field-adhesion-test log.

5. Inspect tested joints and report on the following:
   a. 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 type of product and joint substrate. Compare these results to determine if adhesion passes sealant manufacturer's field-adhesion hand-pull test criteria.
   b. Whether sealants filled joint cavities and are free of voids.
   c. Whether sealant dimensions and configurations comply with specified requirements.

6. 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 fill, sealant configuration, and sealant dimensions.

7. 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 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.

3.05 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.

3.06 PROTECTION

A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or
deterioration occurs, cut out and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

3.07 JOINT SEALANT SCHEDULE

A. Single-Component Mildew-Resistant Neutral-Curing Silicone Sealant:
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Pecora Corporation; 898.
      b. Tremco; Tremsil 600 White.
   2. Type and Grade: S (single component) and NS (nonsag).
   4. Use Related to Exposure: NT (nontraffic).
   5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
   6. Applications: Perimeter joints of plumbing fixtures, counters and backsplashes; and perimeter joints in ceramic tile.

B. Single-Component Nonsag Urethane Sealant:
   1. Products: Subject to compliance with requirements, provide one of the following:
      b. Sonneborn, Division of ChemRex Inc.; Ultra.
      c. Sonneborn, Division of ChemRex Inc.; NP 1.
      d. Pecora Corporation; Dynatrol I-XL.
      e. Tremco; DyMonic.
   2. Type and Grade: S (single component) and NS (nonsag).
   4. Use Related to Exposure: T (traffic) and NT (nontraffic).
   5. Uses Related to Joint Substrates: M, G, A, and, as applicable to joint substrates indicated, O.
   6. Applications: Interior joints not indicated for another type of sealant.

C. Latex Sealant: Comply with ASTM C 834, Type OP, Grade NF.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. Bostik Findley; Chem-Calk 600.
      b. Pecora Corporation; AC-20+.
      c. Sonneborn, Division of ChemRex Inc.; Sonolac.
      d. Tremco; Tremflex 834.
   2. Applications: Interior non-movement and non-traffic joints not indicated for another type of sealant.

END OF SECTION
SECTION 08110
METAL DOORS AND FRAMES

PART 1 - GENERAL

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

1.02 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. Section 04200 "Masonry Unit"
      2. Section 08710 "Door Hardware"
      3. Section 08810 "Glazing"
      4. Section 09900 "Paints and Coatings"
      5. Section 13700 "Security Access Control"

   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.
         Means of a Hot Box Apparatus.
     10. ASTM E283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior
         Doors Under Specified Pressure Differences Across the Specimens.
     11. ASTM E1332 - Standard Classification for Determination of Outdoor-Indoor Transmission
         Class.
13. ANSI/SHMA A156.115 - Hardware Preparation in Steel Doors and Frames.
18. UL 10C - Positive Pressure Fire Tests of Door Assemblies.

1.03 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.

1.04 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, 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 NFPA 252 (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.

   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 ASTM C1363. 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 ASTM C1363 and meet or exceed the following requirements:
      a. Door Assembly Operable U-Factor and R-Value Ratings: U-Factor 0.29, R-Value 3.4, 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 Section 01200 "Project Progress 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.

1.05 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.

1.06 PROJECT CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.

1.07 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.

1.08 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

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. CECO Door Products.
2. Curries Company.
3. Member of NAAMM - Substitutions: Material from custom hollow metal door and frame fabricators will not be accepted without prior written and sample approval in accordance with requirements specified in Division 01. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

2.02 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.
2.03 STANDARD HOLLOW METAL DOORS

A. General: Provide 1-3/4 inch doors of design specified, 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. Energy Efficient Exterior Doors: 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, 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 0.29 and R-Value 3.4, including insulated door, thermal-break frame and threshold.
3. Level/Model: Level 2 and Physical Performance Level A (Heavy Duty), Minimum 18 gauge (0.042 inch - 1.1-mm) thick steel, Model 2.
4. 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).
5. Top and Bottom Edges: Reinforce tops and bottoms of doors with a continuous steel channel not less than 16 gauge, extending the full width of the door and welded to the face sheet. 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.
6. Hinge Reinforcement: Minimum 7 gauge (3/16") plate 1-1/4" x 9".
7. Hardware Reinforcements: Fabricate according to ANSI/SDI A250.6 with reinforcing plates from same material as door face sheets.

C. Manufacturers Basis of Design:


D. 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.

E. Manufacturers Basis of Design:


2.04 STANDARD HOLLOW METAL FRAMES

A. General: Comply with ANSI/SDI A250.8 and with details indicated for type and profile.


1. Fabricate frames with mitered or coped corners.

2. Fabricate frames, with the exception of knock down types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.

3. Provide thermally broken frame profiles available for use in both masonry and drywall construction. Fabricate with positive 3/8" vinyl thermal break and integral vinyl weatherstripping.

4. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.

5. Manufacturers Basis of Design:


C. Interior Frames: Fabricated from cold-rolled steel sheet that complies with ASTM A 1008/A 1008M.

1. Fabricate frames with mitered or coped corners.

2. Fabricate frames, with the exception of slip-on drywall types, with "closed and tight" miter seams continuously welded on face, finished smooth with no visible seam unless otherwise indicated.

3. Frames: Minimum 16 gauge (0.053-inch -1.3-mm) thick steel sheet.

4. Manufacturers Basis of Design:


D. Fire rated frames: Fabricate frames in accordance with NFPA 80, listed and labeled by a qualified testing agency, for fire-protection ratings indicated.

E. Hardware Reinforcement: Fabricate according to ANSI/SDI A250.6 Table 4 with reinforcement plates from same material as frames.

2.05 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.

2.06 LOUVERS

A. Metal Louvers: Door manufacturer's standard metal louvers unless otherwise indicated.

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.

2.07 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 Section 08810 "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.

2.08 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.
2.09 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 Section 08710 "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. Electrical Raceways: Provide hollow metal doors to receive electrified hardware with concealed wiring harness and standardized Molex™ plug connectors on both ends to accommodate up to twelve wires. Coordinate connectors on end of the wiring harness to plug directly into the electrified hardware and the through-wire transfer hardware or wiring harness specified in hardware sets in Section 08710 "Door Hardware". Wire nut connections are not acceptable.

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 flush face joints continuously; 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. 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.
   5. Mortar Guards: Provide guard boxes at back of hardware mortises in frames at all hinges and strike preps regardless of grouting requirements.
   6. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
   7. 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 o.c. 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.

8. 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 Section 08710 "Door Hardware."

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 Section 08710 "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.

2.10 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

3.01 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.

### 3.02 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 squareness, alignment, twist, and plumbness.

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.

### 3.03 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, 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.

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

D. Field Glazing: Comply with installation requirements in Section 08800 "Glazing" and with hollow metal manufacturer's written instructions.
3.04 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.

END OF SECTION
SECTION 08310
ACCESS DOORS AND PANELS

PART 1 GENERAL

1.01 RELATED DOCUMENTS
   A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. Section Includes: Wall access doors and frames.
   B. Provide access doors where required for access to concealed equipment, in sizes and locations as acceptable to Architect.
   C. Related Sections:
      1. Section 04200 "Masonry Unit"
      2. Section 07724 "Roof Hatches"
      3. Section 09900 "Painting and Coating"

1.03 SUBMITTALS
   A. Product Data: For each type of door and frame indicated. Include construction details relative to materials, individual components and profiles, and finishes for access doors and frames.
   B. Shop Drawings: Show fabrication and installation details of customized doors and frames. Include plans, elevations, sections, details, and attachments to other Work.
   C. Schedule: Provide complete door and frame schedule, including types, general locations, sizes, construction details, latching or locking provisions, and other data pertinent to installation.

1.04 QUALITY ASSURANCE
   A. Source Limitations: Obtain doors and frames through one source from a single manufacturer.

1.05 COORDINATION
   A. Verification: Determine specific locations and sizes for access doors needed to gain access to concealed equipment, and indicate on schedule specified in "Submittals" Article.

PART 2 PRODUCTS

2.01 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Bilco Company (The).
      2. J. L. Industries, Inc.

2.02 MATERIALS
   A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B, with A60 zinc-iron-alloy (galvannealed) coating or G60 mill-phosphatized zinc coating; stretcher-leveled standard of flatness; with minimum thickness indicated representing specified thickness according to ASTM A 924/A 924M.

2.03 PAINT
A. Shop Primers: Provide primers that comply with Section 09900 "Paints and Coatings."
B. Shop Primer for Metallic-Coated Steel: Organic zinc-rich primer complying with SSPC-Paint 20 and compatible with topcoat.

2.04 ACCESS DOORS AND FRAMES
A. Access Doors and Frames:
   1. Metal: Metallic-coated steel.
   2. Door: Minimum 0.060-inch-thick sheet metal, set flush with exposed face flange of frame.
   3. Frame: Minimum 0.060-inch-thick sheet metal.
   4. Frame Edge Condition: Surface-mounted trim.
   5. Hinges: Continuous piano hinge.
   6. Lock: Key-operated cylinder lock.

2.05 FABRICATION
A. General: Provide access door assemblies manufactured as integral units ready for installation.
B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
C. Steel Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access panels to types of supports indicated.
   1. Exposed Flanges: Nominal 1 to 1-1/2 inches wide around perimeter of frame.
   2. Provide mounting holes in frames to attach frames to metal or wood framing in plaster and drywall construction and to attach masonry anchors in masonry construction. Furnish adjustable metal masonry anchors.
D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
   1. For cylinder lock, furnish two keys per lock and key all locks alike.

2.06 METALLIC-COATED STEEL FINISHES
A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
   1. Finish metal fabrications after assembly.
B. Galvanizing of Steel Shapes and Plates: Hot-dip galvanize items indicated to comply with applicable standard listed below:
1. ASTM A 123/A 123M, for galvanizing steel and iron products.
2. ASTM A 153/A 153M, for galvanizing steel and iron hardware.

C. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. For galvanized surfaces, apply, after cleaning, a conversion coating suited to the organic coating to be applied over it. For metallic-coated surfaces, clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.


D. Factory Priming for Field-Painted Finish: Apply shop primer immediately after cleaning and pretreating.

PART 3 EXECUTION

3.01 PREPARATION

A. Advise installers of other work about specific requirements relating to access door installation, including sizes of openings to receive access door and frame, as well as locations of supports, inserts, and anchoring devices.

3.02 INSTALLATION

A. Comply with manufacturer's written instructions for installing access doors and frames.

B. Set frames accurately in position and attach securely to supports with plane of face panels aligned with adjacent finish surfaces.

3.03 ADJUSTING AND CLEANING

A. Adjust doors and hardware after installation for proper operation.

B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION
SECTION 08413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section includes glazed aluminum curtain walls.

1. Glazed.
2. Spandrel aluminum panels.

B. Related Requirements:

1. Section 07900 "Joint Sealants"
2. Section 08710 “Door Hardware”
3. Section 08810 “Glazing”

1.03 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 glazed aluminum curtain walls. Include plans, elevations, sections, full-size details, and attachments to other work.

1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
2. Include full-size isometric details of each vertical-to-horizontal intersection of glazed aluminum curtain walls, showing the following:
   a. Joinery, including concealed welds.
   b. Anchorage.
   c. Expansion provisions.
   d. Glazing.
   e. Flashing and drainage.
3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.

C. Samples for Initial Selection: For units with factory-applied color finishes.
D. Delegated-Design Submittal: For glazed aluminum curtain walls indicated to comply with performance requirements and design criteria, including of entire curtain wall system including anchorage details, anchors, and analysis data signed and sealed by the NJ licensed qualified professional engineer responsible for their preparation.

1.04 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For glazed aluminum curtain walls, for tests performed by manufacturer and witnessed by a qualified testing agency.

B. Sample Warranties: For special warranties.

1.05 CLOSEOUT SUBMITTALS

A. Maintenance Data: For glazed aluminum curtain walls to include in maintenance manuals.

1.06 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 revise intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If revisions are proposed, submit comprehensive explanatory data to Architect for review 15 days prior to project bid date. The architect's final product approval will be required in order to bid this project. Otherwise, no substitution products will be considered for the project.

1.07 WARRANTY

A. Special Assembly Warranty: Manufacturer agrees to repair or replace components of glazed aluminum curtain wall 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: Five (5) 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:
2. Warranty Period: Ten (10) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified Pennsylvania licensed professional engineer, to design glazed aluminum curtain walls. Include comprehensive engineering analysis.

B. General Performance: Comply with performance requirements specified, as determined by testing of glazed aluminum curtain walls representing those indicated for this Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Glazed aluminum curtain walls shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.
2. Failure also includes the following:
   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.

C. Structural Loads:

1. Wind Loads; Basic Wind Speed, Importance Factor and Exposure Category. Comply with PAIBC 2009.

D. Deflection of Framing Members: At design wind pressure, as follows:

1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches (4.1 m) and to 1/240 of clear span plus 1/4 inch (6.35 mm) for spans greater than 13 feet 6 inches (4.1 m) or an amount that restricts edge deflection of individual glazing lites to 3/4 inch (19.1 mm), whichever is less.
2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch (3.2 mm).

E. 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.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
   1. Fixed Framing and Glass Area:
      a. Maximum air leakage of 0.06 cfm/sq. ft. (0.30 L/s per sq. m) at a static-air-pressure differential of 6.24 lbf/sq. ft. (300 Pa).

G. 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 15 lbf/sq. ft. (720 Pa).

H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:
   1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft. (300 Pa).
   2. Maximum Water Leakage: According to AAMA 501.1. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

I. Interstory Drift: Accommodate design displacement of adjacent stories indicated.
   2. Test Performance: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.4 at design displacement and 1.5 times the design displacement.

J. Thermal Movements: Allow for thermal movements resulting from ambient and surface temperature changes:
   1. Temperature Change: 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
   2. Thermal Cycling: 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.
      a. High Exterior Ambient-Air Temperature: That which produces an exterior metal-surface temperature of 180 deg F (82 deg C).
      b. Low Exterior Ambient-Air Temperature: 0 deg F (minus 18 deg C).

2.02 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
   1. EFCO Corporation, System 5600, 2 ¼” X 7” curtain wall thermally improved system.
   3. Wausau Superwall

B. Source Limitations: Obtain all components of curtain wall system, including framing spandrel panels entrances and accessories, from single manufacturer.
2.03 FRAMING

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads. Refer to drawings.

2. Glazing System: Retained mechanically with gaskets on four sides.
6. Frame Depth: 7" deep.
7. Door Framing: Provide 5/8" aluminum sub-frame door inserts for aluminum framed entrance doors, or as recommended by manufacturer to fit with aluminum curtain wall system.
8. Provide internal steel reinforcements as recommended by manufacturer’s engineer.

B. Pressure Caps: Manufacturer’s standard aluminum components that mechanically retain glazing.

1. Include snap-on aluminum trim that conceals fasteners.

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.
   c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
   d. Structural Profiles: ASTM B 308/B 308M.

2.04 INSULATED SPANDREL PANELS

A. Manufacturer: Subject to compliance with requirements, provide systems by one of the following manufacturers:


B. Product Insulated Spandrel Panels: Laminated, metal-faced flat panels with no deviations in plane exceeding 0.8 percent of panel dimension in width or length.

1. Overall Panel Thickness: 1 inch (25.4 mm).
2. Exterior Skin: Aluminum.
   a. Thickness: Manufacturer’s standard for finish and texture indicated.
   b. Finish: Match framing system.
   c. Texture: Smooth.
   d. Backing Sheet: 1/8-inch- (3.2-mm-) thick, tempered hardboard.
3. Interior Skin: Aluminum.
   a. Thickness: Manufacturer's standard for finish and texture indicated.
   b. Finish: Mill finish.
   c. Texture: Smooth.
   d. Backing Sheet: 1/8-inch-(3.2-mm-) thick, tempered hardboard.

4. Thermal Insulation Core: Manufacturer's standard extruded-polystyrene board.

5. Color: As selected by Architect from manufacturer's full range of colors.

C. 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: Twenty-five (25) or less.
   2. Smoke-Developed Index: Four hundred and fifty (450) or less.

2.05 ENTRANCES

A. Framing Members: Manufacturer's extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads. Refer to drawings.

   2. Glazing System: Retained mechanically with gaskets on four sides.
   6. Frame Depth: 5" deep.
   7. Door Framing: Provide 5/8" aluminum sub-frame door inserts for aluminum framed entrance doors, or as recommended by manufacturer to fit with aluminum curtain wall system.
   8. Provide internal steel reinforcements as recommended by manufacturer's engineer.

B. Pressure Caps: Manufacturer's standard aluminum components that mechanically retain glazing.

   1. Include snap-on aluminum trim that conceals fasteners.

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.

      c. Extruded Structural Pipe and Tubes: ASTM B 429/B 429M.
      d. Structural Profiles: ASTM B 308/B 308M.
2.06 GLAZING

A. Glazing: Comply with Section 08810 "Glazing."

B. Glazing Gaskets: Manufacturer's standard sealed-corner pressure-glazing system of black, resilient elastomeric glazing gaskets, setting blocks, and shims or spacers. (Comply with Section 08810 "Glazing."

C. Glazing Sealants: As recommended by manufacturer.

2.07 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.

2.08 FABRICATION

A. Form or extrude aluminum shapes before finishing.

B. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

C. Fabricate components that, when assembled, have the following characteristics:

1. Profiles that are sharp, straight, and free of defects or deformations.

2. Accurately fitted joints with ends cope 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 vision glass and exterior for spandrel glazing or metal panels.

6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

7. Components curved to indicate radii.

D. Fabricate components to resist water penetration as follows:

1. Internal guttering system or other means to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.

2. Pressure-equalized system or double barrier design with primary air and vapor barrier at interior side of glazed aluminum curtain wall and secondary seal weeped and vented to exterior.

E. Curtain-Wall Framing: Fabricate components for assembly using shear-block system.

F. Factory-Assembled Frame Units:
1. Rigidly secure nonmovement joints.
2. Prepare surfaces that are in contact structural sealant according to sealant manufacturer's written instructions to ensure compatibility and adhesion.
3. Preparation includes, but is not limited to, cleaning and priming surfaces.
4. Seal joints watertight unless otherwise indicated.
5. Install glazing to comply with requirements in Section 08810 "Glazing."

G. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.09 ALUMINUM FINISHES

A. High-Performance Organic Finish at Exterior locations: 2-coat fluoropolymer finish complying with AAMA 2605 and containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pre-treat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.


PART 3 - EXECUTION

3.01 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.

3.02 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. Where welding is required, weld components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal 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 primer, applying sealant or tape, or installing nonconductive spacers as recommended by manufacturer for this purpose.

C. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within glazed aluminum curtain wall to exterior.
D. Install components plumb and true in alignment with established lines and grades.

E. Install 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 08810 "Glazing."

3.03  ERECTION TOLERANCES

A. Erection Tolerances: Install glazed aluminum curtain walls to comply with the following maximum tolerances:

1. Plumb: 1/8 inch in 10 feet (3.2 mm in 3 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
2. Level: 1/8 inch in 20 feet (3.2 mm in 6 m); 1/4 inch in 40 feet (6.35 mm in 12.2 m).
3. Alignment:
   a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2 inch (12.7 mm) wide, limit offset from true alignment to 1/16 inch (1.6 mm).
   b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch (12.7 to 25.4 mm) wide, limit offset from true alignment to 1/8 inch (3.2 mm).
   c. Where surfaces are separated by reveal or protruding element of 1 inch (25.4 mm) wide or more, limit offset from true alignment to 1/4 inch (6 mm).

4. Location: Limit variation from plane to 1/8 inch in 12 feet (3.2 mm in 3.6 m); 1/2 inch (12.7 mm) over total length.

END OF SECTION
SECTION 08600

SKYLIGHTS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Assemblies incorporating fiberglass sandwich panels and aluminum frame systems as follows:

1. Skylight assemblies.

B. Related Sections:

1. Section 07511 “Built-Up Hot Asphalt Roofing”
2. Section 07600 “Metal Flashing and Trim”
3. Section 07900 “Joint Sealants”
4. Section 11011 “Fall Protection Systems”

1.03 PERFORMANCE REQUIREMENTS

A. Provide assemblies, including anchorage, capable of withstanding, without failure, the effects of the following:

1. Structural loads.
2. Thermal movements.
3. Movements of supporting structure.
4. Dimensional tolerances of building frame and other adjacent construction.

B. Failure includes the following:

1. Deflection exceeding specified limits.
2. Water leakage.
3. Thermal stresses transferred to building structure.
4. Noise or vibration created by wind and thermal and structural movements.
5. Loosening or weakening of fasteners, attachments, and other components.
6. Delamination of fiberglass-sandwich-panel faces from panel cores.

C. Structural Loads:

1. Wind Loads: As indicated by structural design data on Drawings.
2. Snow Loads: As indicated by structural design data on Drawings.
3. Concentrated Live Loads on Overhead Assemblies: 300 lbf applied to assemblies at locations that will produce greatest stress or deflection.
4. Seismic Loads: As indicated by earthquake design data on Drawings.
5. Load Combinations: Calculate according to requirements of applicable code.

D. Deflection of Assemblies:

1. Vertical Assemblies: Limited to 1/60 of clear span for each assembly component.
2. Overhead Assemblies: Limited to 1/60 of clear span for each assembly component.
E. Roof Assemblies: Class A per ASTM E 108 or UL 790.

F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
   1. Temperature Change (Range): 120 deg F, ambient; 180 deg F, material surfaces.

1.04 PERFORMANCE TESTING

A. Provide assemblies that comply with test-performance requirements indicated, as evidenced by reports of tests performed on manufacturer's standard assemblies by a qualified independent testing agency.

B. Structural-Performance Test: ASTM E 330.
   1. Performance at Design Load: When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
   2. Performance at Maximum Test Load: When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, and permanent deformation of main supporting members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity but not less than 10 seconds.

C. Air-Infiltration Test: ASTM E 283.
   2. Maximum Air Leakage: 0.06 cfm/sq. ft.

D. Test for Water Penetration under Static Pressure: ASTM E 331.
   1. Minimum Static-Air-Pressure Difference: 20 percent of positive wind-load design pressure, but not less than 10 lbf/sq. ft.
   2. Water Leakage: None.

1.05 SUBMITTALS

A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for assemblies.

B. Shop Drawings: For assemblies. Include plans, elevations, sections, details, and attachments to other work.
   1. Include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Field quality-control test reports.

E. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for assemblies.

F. Maintenance Data: For assemblies to include in maintenance manuals.
G. Warranties: Special warranties specified in this Section.

1.06 QUALITY ASSURANCE

A. Installer Qualifications: Entity capable of assuming engineering responsibility, including preparation of Shop Drawings, and performing work of this Section and who is acceptable to manufacturer.

B. Manufacturer Qualifications: For fiberglass sandwich panels, a qualified manufacturer whose facilities, processes, and products are monitored by an independent, accredited quality-control agency for compliance with applicable requirements in ICBO ES AC04, "Sandwich Panels."

C. Testing Agency Qualifications: An independent agency qualified according to ASTM E 699 for testing indicated.

D. Product Options: Information on Drawings and in Specifications establishes requirements for assemblies' 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 testing conducted by an independent testing agency and in-service performance.

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.

E. Fire-Test-Response Characteristics: Where fire-test-response characteristics are indicated for assemblies and components, provide products identical to those tested per test method indicated by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

F. Welding: Qualify procedures and personnel according to AWS D1.2, "Structural Welding Code - Aluminum."

G. NFRC Certification: Provide fiberglass sandwich panels that are certified for U-factors indicated according to NFRC 100 and listed in its "National Fenestration Council Incorporated - Certified Products Directory."

H. Preinstallation Conference: Conduct conference at Project site.

1.07 PROJECT CONDITIONS

A. Field Measurements: Indicate measurements on Shop Drawings.

1.08 WARRANTY

A. Special Assembly Warranty: Manufacturer's standard form in which manufacturer and Installer agree to repair or replace components of assemblies 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. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   c. Water leakage.

2. Warranty Period: 10 year from date of Substantial Completion.
B. Special Fiberglass-Sandwich-Panel Warranty: Manufacturer's standard form in which manufacturer agrees to replace panels that exhibit defects in materials or workmanship.

1. Defects include, but are not limited to, the following:
   a. Fiberbloom.
   b. Delamination of coating, if any, from exterior face sheet.
   c. Discoloration of exterior face sheet of more than 8.0 units Delta E when measured according ASTM D 2244.
   d. Delamination of panel face sheets from panel cores.

2. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide the following products of Kalwall Corporation:

1. Skylight Assemblies: Skylight System.

B. Comparable Products: Subject to compliance with requirements, provide the basis-of-design products or comparable products by the following:

1. Structures Unlimited.

2.02 ALUMINUM FRAME SYSTEMS

A. Aluminum: Alloy and temper recommended in writing by manufacturer for type of use and finish indicated.

2. Extruded Bars, Rods, Profiles, and Tubes: ASTM B 221.

B. Components: Manufacturer's standard extruded-aluminum members of thickness required and reinforced as required to support imposed loads.

1. Construction: Thermally broken; framing members are composite assemblies of two separate extruded-aluminum components permanently bonded by a material of low thermal conductance.

C. Exposed Flashing and Closures: Manufacturer's standard aluminum components not less than 0.060 inch thick.

D. Frame-System Gaskets: Manufacturer's standard.

E. Frame-System Sealants: As recommended in writing by manufacturer and complying with requirements specified in Section 07900 "Joint Sealants."

1. Provide sealants for use inside of the weatherproofing system that have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

F. Anchors, Fasteners, and Accessorries: Manufacturer's standard, corrosion-resistant, nonstaining, and nonbleeding; compatible with adjacent materials.
1. At closures, retaining caps, or battens, use ASTM A 193/A 193M, 300 series stainless-steel screws.
2. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
3. At movement joints, use slip-joint linings, spacers, and sleeves of material and type recommended in writing by manufacturer.

G. 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.

H. Frame System Fabrication:
1. Fabricate components before finishing.
2. Fabricate components that, when assembled, have the following characteristics:
   a. Profiles that are sharp, straight, and free of defects or deformations.
   b. Accurately fitted joints with ends coped or mitered.
   c. Internal guttering systems or other means to drain water passing joints, condensation occurring within components, and moisture migrating within the assembly to exterior.
3. Fabricate sill closures with weep holes and for installation as continuous component.
4. Reinforce components as required to receive fastener threads.
5. Weld components in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

2.03 FIBERGLASS SANDWICH PANELS

A. Panel Construction: Assembly of uniformly colored, translucent, thermoset, fiberglass-reinforced-polymer face sheets bonded to both sides of a grid core and complying with requirements applicable to panel materials in ICBO ES AC04, "Sandwich Panels."

1. Face-Sheet, Self-Ignition Temperature: 650 deg F or more per ASTM D 1929.
2. Face-Sheet Burning Extent: 1 inch or less per ASTM D 635.
3. Face-Sheet, Smoke-Developed Index: 450 or less per ASTM E 84 or UL 723.
4. Interior Face-Sheet, Flame-Spread Index: Not more than 50 per ASTM E 84 or UL 723.
5. Roof-Covering Class: Class A, burning brand test (only) per ASTM E 108 or UL 790.


C. Light Transmission: Not less than 15 percent.

D. Panel U-Factor: Not more than 0.14, measured in Btu/sq. ft. x h x deg F according to NFRC 100 or ASTM C 1363 using procedures described in ASTM C 1199 and ASTM E 1423.

E. Panel Strength Characteristics:
1. Maximum Panel Deflection: 3-1/2 inches when a 4-by-12-foot panel is tested according to ASTM E 72 at 34 lbf/ sq. ft., with a maximum 0.090-inch set deflection after 5 minutes.
2. Panel Support Strength: Capable of supporting, without failure, a 300-lbf concentrated load when applied to a 3-inch-diameter disk according to ASTM E 661.

F. Grid Core: Mechanically interlocked extruded-aluminum I-beams, with a minimum flange width of 7/16 inch.
1. Extruded Aluminum: ASTM B 221, in alloy and temper recommended in writing by manufacturer.
2. I-Beam Construction: Thermally broken; two separate extruded-aluminum components permanently bonded by a material of low thermal conductance.


G. Exterior Face Sheet:

1. Thickness: 0.070 inches.
2. Color: Crystal.
4. Impact Resistance: No fracture or tear at impact of 70 ft. x lb by a 3-1/4-inch-diameter, 5-lb free-falling ball according to test procedure in UL 972.

H. Interior Face Sheet:

1. Thickness: 0.045 inch.


1. Compatible with facing and core materials.
2. Tensile and shear bond strength of aged adhesive ensures permanent adhesion of facings to cores, as evidenced by testing according to ASTM C 297 and ASTM D 1002 after accelerated aging procedures that comply with aging requirements for adhesives with high resistance to moisture in ICBO ES AC05, "Sandwich Panel Adhesives."

J. Panel Fabrication: Factory assemble and seal panels.

1. Laminate face sheets to grid core under a controlled process using heat and pressure to produce straight adhesive bonding lines that cover width of core members and that have sharp edges.
   a. White spots indicating lack of bond at intersections of grid-core members are limited in number to 4 for every 40 sq. ft. of panel and limited in diameter to 3/64 inch.

2. Fabricate with grid pattern that is symmetrical about centerlines of each panel.
3. Fabricate panel to allow condensation within panel to escape.
4. Reinforce panel corners.

2.04 ACCESSORY MATERIALS

A. Bituminous Paint: Cold-applied asphalt-mastic paint complying with SSPC-Paint 12 requirements except containing no asbestos, formulated for 30-mil thickness per coat.

2.05 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.
 PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General:

1. Comply with manufacturer's written instructions.
2. Do not install damaged components.
3. Fit joints between aluminum components 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. Weld aluminum components in concealed locations to minimize distortion or discoloration of finish. Protect glazing surfaces from welding.
7. Seal joints watertight, unless otherwise indicated.

B. Metal Protection: Where aluminum components will contact dissimilar materials, protect against galvanic action by painting contact surfaces with bituminous paint or by installing nonconductive spacers as recommended in writing by manufacturer for this purpose.

C. Install continuous aluminum sill closure with weatherproof expansion joints and locked and sealed or welded corners. Locate weep holes at rafters.

D. Install components to drain water passing joints, condensation occurring within aluminum members and panels, and moisture migrating within assembly to exterior.

E. Install components plumb and true in alignment with established lines and elevations.

F. Erection Tolerances: Install assemblies to comply with the following maximum tolerances:

1. Alignment: Limit offset from true alignment to 1/32 inch where surfaces abut in line, edge to edge, at corners, or where a reveal or protruding element separates aligned surfaces by less than 3 inches; otherwise, limit offset to 1/8 inch.
2. Location and Plane: Limit variation from true location and plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.03 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Testing Services: Testing and inspecting of representative areas to determine compliance of installed assemblies with specified requirements shall take place as follows and in successive stages as indicated on Drawings. Do not proceed with installation of the next area until test results for previously completed areas show compliance with requirements.

1. Water-Spray Test: Before installation of interior finishes has begun, assemblies shall be tested according to AAMA 501.2 and shall not evidence water penetration.
C. Repair or remove work where test results and inspections indicate that it does not comply with specified requirements.

D. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

END OF SECTION
SECTION 08710
DOOR HARDWARE

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes commercial door hardware for the following:

1. Swinging doors.
2. Other doors to the extent indicated.

B. Door hardware includes, but is not necessarily limited to, the following:

1. Mechanical door hardware.
2. Electromechanical door hardware, power supplies, back-ups and surge protection.
3. Cylinders specified for doors in other sections.

C. Related Sections:

1. Section 08110 “Metal Doors and Frames”
2. Section 08413 “Glazed aluminum Curtain Wall”
3. Section 13700 “Security Access Control”

D. Codes and References: Comply with the version year adopted by the Authority Having Jurisdiction.

5. NFPA 105 - Installation of Smoke Door Assemblies.

E. Standards: All hardware specified herein shall comply with the following industry standards:

1. ANSI/BHMA Certified Product Standards - A156 Series
2. UL10C – Positive Pressure Fire Tests of Door Assemblies

1.03 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. 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.
2. Electrical Coordination: Coordinate with related Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.

D. Proof of Certification: Provide copy of manufacturer(s) official certification or accreditation document indicating proof of status as a qualified and authorized provider of the primary Integrated Wiegand Access Control Products.

E. 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.

F. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as Hardware 08710-2
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.

G. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.04 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. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders 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.

C. 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 in good standing 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.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

D. Integrated Wiegand Access Control Products Supplier Qualifications: Integrated access control products and accessories are required to be supplied and installed through current members of the manufacturers "Authorized Channel Partner" (ACP) and "Certified Integrator" (CI) programs. Suppliers are to be factory trained, certified prior to project bid, and a direct purchaser of the specified product. Installers are to be factory trained, certified prior to project bid, and are responsible for commissioning, servicing, and warranting the installed equipment specified for the project.

E. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier 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. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:

1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
   a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.
   b. Door Closers: Comply with the following maximum opening-force requirements indicated:
      1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
      2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
   c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.

3. NFPA 101: Comply with the following for means of egress doors:
   a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
   b. Thresholds: Not more than 1/2 inch high.

4. Fire-Rated Door Assemblies: Provide door hardware for 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 NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
   a. Test Pressure: Positive pressure labeling.

G. Each unit to bear third party permanent label demonstrating compliance with the referenced standards.

H. Keying Conference: Conduct conference to comply with requirements in Section 01200 "Project Progress 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.

I. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Section 01200 "Project Progress 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.

J. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.05 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".

1.06 COORDINATION

A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.

C. Door and Frame Preparation: Section 08110 "Metal Doors and Frames" and Section 08413 "Glazed Aluminum Curtain Wall" 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.

1.07 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.

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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. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

D. Special Warranty Periods:
   1. Ten years for mortise locks and latches.
   2. Twenty five years for manual surface door closers.
   3. Ten years for heavy duty floor closers.
   4. Two years for electromechanical door hardware.

1.08 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.

B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.01 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

   1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:

      a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

B. Substitutions: Requests for substitution and product approval for inclusive mechanical and electromechanical door hardware in compliance with the specifications must be submitted in writing and in accordance with the procedures and time frames outlined in Division 01, Substitution Procedures. Approval of requests is at the discretion of the architect, owner, and their designated consultants.

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2.02  HANGING DEVICES

A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.

1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
   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 where indicated in the Hardware Sets or on Drawings:
   a. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
      1) Out-swinging exterior doors.
      2) Out-swinging access controlled doors.
      3) Out-swinging lockable doors.

5. Acceptable Manufacturers:
   a. Bommer Industries (BO).
   b. Hager Companies (HA).
   c. McKinney Products (MK).

B. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90 minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.

1. Acceptable Manufacturers:
   a. Bommer Industries (BO).
2.03 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. Acceptable Manufacturers:
   a. Securitron (SU) - EL-CEPT Series.
   b. Von Duprin (VD) - EPT-10 Series.

2.04 DOOR OPERATING TRIM

A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. 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. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.

1. Acceptable Manufacturers:
   a. Door Controls International (DC).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

B. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.

1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with beveled edges, secured with exposed screws unless otherwise indicated.
2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.

   a. Acceptable Manufacturers:
      1) Hiawatha, Inc. (HI).
      2) Rockwood Manufacturing (RO).
      3) Trimco (TC).
2.05 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.

B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.

1. Acceptable Manufacturers:
   a. Yale Locks and Hardware (YA).

C. Cylinders: Original manufacturer cylinders complying with the following:

1. Mortise Type: Threaded cylinders with rings and straight- or clover-type cam.
2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
3. Bored-Lock Type: Cylinders with tailpieces to suit locks.
4. 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.

D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:

1. Removable Cores: Core insert, removable by use of a special key, and for use with only the core manufacturer's cylinder and door hardware. Provide removable core (small or large format) as specified in Hardware Sets.

E. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:

1. Existing System: Master key or grand master key locks to Owner's existing system.

F. Key Quantity: Provide the following minimum number of keys:

1. Top Master Key: One (1)
2. Change Keys per Cylinder: Two (2)
3. Master Keys (per Master Key Group): Two (2)
4. Grand Master Keys (per Grand Master Key Group): Two (2)
5. Construction Keys (where required): Ten (10)
6. Construction Control Keys (where required): Two (2)
7. Permanent Control Keys (where required): Two (2)

G. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".

H. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
I. 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. Acceptable Manufacturers:
   a. Lund Equipment (LU).
   b. MMF Industries (MM).
   c. Telkee (TK).

2.06 MECHANICAL LOCKS AND LATCHING DEVICES

A. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.

1. Acceptable Manufacturers:

B. Lock Trim Design: As specified in Hardware Sets.

2.07 INTEGRATED WIEGAND OUTPUT ACCESS CONTROL LOCKING DEVICES

A. Integrated Wiegand Output Mortise Locks: Wiegand output ANSI A156.13, Grade 1, mortise lockset with integrated proximity card reader, request-to-exit signaling, door position status switch, and latchbolt monitoring in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle trim, 3/4" deadlocking anti-friction latch, and 1" case-hardened steel deadbolt. Lock is U.L listed and labeled for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand compatible access control systems. Latchbolt monitoring and door position switch act in conjunction to report door-in-frame (DPS) and door latched (door closed and latched) conditions.

2. Reader supports either HID 125 kHz proximity (up to 39 bits, including Corporate 1000) or 13.56 MHz (2K-32K) iClass® credentials.

3. 12VDC external power supply required for reader and lock, with optional 24VDC operation available with iClass® reader (125 kHz reader is always 12VDC). Fail safe or fail secure options.

4. Installation requires only one cable run from the lock to the access control panel without requirements for additional proprietary lock panel interface boards or modules.

5. Installation to include manufacturer's access control panel interface board or module where required for Wiegand output protocol.

a. Acceptable Manufacturers:
   1) Corbin Russwin Hardware (RU) - Access 600 - ML20600 RNE1 Series.

2.08 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.

B. Standards: Comply with the following:

2. Dustproof Strikes: BHMA A156.16.

2.09 CONVENTIONAL EXIT DEVICES

A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:

1. 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.
2. 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.
3. 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.
4. 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 not acceptable except in any case where the door light extends behind the device as in a full glass configuration.
5. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
   a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
   b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.
7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
8. Rail Sizing: Provide exit device rails factory sized for proper door width application.
9. 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 panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.

1. Acceptable Manufacturers:
   a. Corbin Russwin Hardware (RU) - ED5000 Series.
   b. Von Duprin (VD) - 98 XP Series.
   c. Yale Locks and Hardware (YA) - 7000 Series.

C. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish. Provide keyed removable feature, stabilizers, and mounting brackets as specified in the Hardware Sets. At openings designed for severe wind load conditions due to hurricanes or tornadoes, provide manufacturers approved mullion and accessories to meet applicable state and local windstorm codes.

1. Acceptable Manufacturers:
   a. Corbin Russwin Hardware (RU) - 700/900 Series.
   b. Von Duprin (VD) - 9954 Series.
   c. Yale Locks and Hardware (YA) - M200 Series.

2.10 INTEGRATED WIEGAND OUTPUT ACCESS CONTROL EXIT DEVICES

A. Wiegand Output Integrated Card Reader Exit Hardware: Wiegand output ANSI 156.3 Grade 1 rim, mortise, and vertical rod exit device hardware with integrated proximity card reader, latchbolt and touchbar monitoring, and request-to-exit signaling, in one complete unit. Hard wired, solenoid driven locking/unlocking control of the lever handle exit trim with 3/4" throw latch bolt. U.L listed and labeled for either panic or "fire exit hardware" for use on up to 3 hour fire rated openings. Available with or without keyed high security cylinder override.

1. Open architecture, hard wired platform supports centralized control of locking units with new or existing Wiegand compatible access control systems. Inside push bar (request-to-exit) signaling and door position (open/closed status) monitoring (via separately connected DPS).
2. Reader supports either HID 125 kHz proximity (up to 39 bits, including Corporate 1000) or 13.56 MHz (2K-32K) iClass® credentials.
3. 12VDC external power supply required for reader, with optional 24VDC operation available with iClass® reader (125 kHz reader is always 12VDC). 24VDC required for solenoid operated exit trim (12VDC if applicable). Fail safe or fail secure options.
4. Installation to include manufacturer's access control panel interface board or module where required for Wiegand output protocol.
5. Acceptable Manufacturers:
   a. Corbin Russwin Hardware (RU) - Access 600 - ED5000 RNE1 Series.
   b. Schlage (SC) - AD300 Series.
   c. Yale Security (YA) - Symphony -7100 SYM Series.
2.11 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 including installation and adjusting information on inside of cover.
2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
3. Cycle Testing: Provide closers which have surpassed 15 million cycles in a test witnessed and verified by UL.
4. 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 physically handicapped, provide units complying with ANSI ICC/A117.1.
5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
   a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
   b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
   c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
   d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
6. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.

B. Door Closers, Surface Mounted (Large Body Cast Iron): ANSI/BHMA A156.4, Grade 1 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 body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

   1. Acceptable Manufacturers:
      a. Corbin Russwin Hardware (RU) - DC8000 Series.
      b. LCN Closers (LC) - 4040XP Series.
      c. Norton Door Controls (NO) – 9500 Series.

2.12 ARCHITECTURAL TRIM

A. Door Protective Trim

   1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.

3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following:
   a. Stainless Steel: 300 series, 050-inch thick, with countersunk screw holes (CSK).

4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.

5. Acceptable Manufacturers:
   a. Hiawatha, Inc. (HI).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

2.13 DOOR STOPS AND HOLDERS

A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.

B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified 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. Acceptable Manufacturers:
   a. Hiawatha, Inc. (HI).
   b. Rockwood Manufacturing (RO).
   c. Trimco (TC).

C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified 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. Acceptable Manufacturers:
   a. Rixson Door Controls (RF).
   b. Rockwood Manufacturing (RO).
   c. Sargent Manufacturing (SA).

2.14 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 UBC 7-2, 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, based on testing according to ASTM E 1408.

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. Acceptable Manufacturers:

1. Pemko Manufacturing (PE).
2. Reese Enterprises, Inc. (RS).

2.15 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. Acceptable Manufacturers:
   a. Sargent Manufacturing (SA) – 3280 Series.
   b. Security Door Controls (SD) - DPS Series.
   c. Securitron (SU) - DPS Series.

B. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Acceptable Manufacturers:
   a. Corbin Russwin Hardware (RU) – 782.
   b. Securitron (SU) - BPS Series.
   c. Von Duprin (VO) - PS.
   d. Yale Locks and Hardware (YA) 782.
2.16 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.

2.17 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

3.01 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.

3.02 PREPARATION

A. Hollow Metal Doors and Frames: Comply with ANSI/DHI A115 series.


3.03 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:

Hardware 08710-16
2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
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. Integrated Wiegand access control products are required to be installed through current members of the manufacturers "Certified Integrator" (CI) program.

D. 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.

E. Thresholds: Set thresholds for exterior and acoustical doors in full bed of sealant complying with requirements specified in Section 07900 "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.

3.04 FIELD QUALITY CONTROL

A. Field Inspection: Supplier will perform a final inspection of installed door hardware and state in report whether work complies with or deviates from requirements, including whether door hardware is properly installed, operating and adjusted.

3.05 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.

3.06 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, and provide final protection and maintain conditions that ensure door hardware is without damage or deterioration at time of owner occupancy.
3.07 DEMONSTRATION
A. Instruct Owner's maintenance personnel to adjust, operate, and maintain mechanical and electromechanical door hardware.

3.08 DOOR HARDWARE SCHEDULE
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.

B. Manufacturer’s Abbreviations:

1. MK - McKinney
2. RF - Rixson
3. RO - Rockwood
4. VD - Von Duprin
5. SA - Sargent
6. RU - Corbin Russwin
7. SH - Schlage Electronic Security
8. YA - Yale
9. FO - Folger Adam
10. LC - LCN Closers
11. PE - Pemko
12. SU - Securitron

Hardware Schedule

Set: 1.0
Doors: 200.1

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Manufacturer</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>Continuous Hinge</td>
<td>MCK-12HD EPT x LAR</td>
<td>CL MK</td>
<td></td>
</tr>
<tr>
<td>1</td>
<td>Mullion</td>
<td>KR4954 x LAR</td>
<td>SP28 VD</td>
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<tr>
<td>1</td>
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<td>RX SD-EL 98L-NL-OP</td>
<td>US32D VD</td>
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<td>US32D VD</td>
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<tr>
<td>1</td>
<td>Rim Cylinder</td>
<td>1193</td>
<td>626 YA</td>
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<tr>
<td>3</td>
<td>Mortise Cylinder</td>
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<tr>
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<td>2</td>
<td>Overhead Stop</td>
<td>6-X36</td>
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<tr>
<td>2</td>
<td>eLynx Frame Harness</td>
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<td>eLynx Door Harness</td>
<td>QC-C*** (Length / Type as Required)</td>
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<td>Electric Power Transfer</td>
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<td>2</td>
<td>Position Switch</td>
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Hardware 08710-18
Notes: Electronic opening to operate as follows: Outside, Card reader (Furnished by Security) signals power supply to retract exit device latch allowing entry by pull. Inside, Free egress at all times by exit device. Exit device includes request to exit features. Key override. Perimeter and meeting stile gasket by door / frame manufacturer.

**Set: 2.0**

**Doors: 100.1**

<table>
<thead>
<tr>
<th>Item Description</th>
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<tr>
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<td>1 Mullion</td>
<td>KR4954 x LAR</td>
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<td>1 Rim Exit Device</td>
<td>CD 98EO</td>
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<td>US32D</td>
</tr>
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<td>1 Rim Cylinder</td>
<td>1193</td>
<td></td>
<td>626</td>
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<tr>
<td>3 Mortise Cylinder</td>
<td>2196 x Length / Cam as Req.</td>
<td></td>
<td>626</td>
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<tr>
<td>2 Door Pull</td>
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<td>US32D</td>
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<tr>
<td>2 Door Closer</td>
<td>4040XP EDA</td>
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<td>AL</td>
</tr>
<tr>
<td>2 Overhead Stop</td>
<td>6-X36</td>
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<td>630</td>
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<tr>
<td>1 Threshold</td>
<td>273x224AFGT x LAR MSES25SS</td>
<td></td>
<td>PE</td>
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<tr>
<td>2 Sweep</td>
<td>3452CNB x LAR</td>
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<td>PE</td>
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<tr>
<td>2 Position Switch</td>
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Notes: Perimeter and meeting stile gasket by door / frame manufacturer.

**Set: 3.0**

**Doors: 200.2**

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<td>1 Rim Exit Device</td>
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<td>1 Electronic Trim w/ Card Reader</td>
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<td>1 Rim Cylinder</td>
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<tr>
<td>1 Door Closer</td>
<td>4040XP SHCUSH</td>
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<td>AL</td>
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<tr>
<td>1 Kick Plate</td>
<td>K1050 10&quot; high 4BE CSK</td>
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<td>1 Threshold</td>
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<tr>
<td>1 Gasketing</td>
<td>2891APK (Head)</td>
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<tr>
<td>2 Gasketing</td>
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<tr>
<td>1 Rain Guard</td>
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<tr>
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<td></td>
<td>PE</td>
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<tr>
<td>1 eLynx Frame Harness</td>
<td>QC-C1500P</td>
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<td>1 Position Switch</td>
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<td>1 Wiring Diagram</td>
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<td>1 Power Supply</td>
<td>BPS (size &amp; type as required)</td>
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</table>

Notes: Electronic opening to operate as follows: Outside, Card reader (Integrated in trim) signals power supply to release fall secure lever allowing entry by lever. Inside, Free egress at all times by exit device. Exit device includes door position switch and request to exit features. Key override.

**Set: 4.0**

**Doors: C103.1**

<table>
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<th>Item Description</th>
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<td>1 Door Closer</td>
<td>4040XP SHCUSH</td>
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<td>AL</td>
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</table>

Hardware 08710-19
1. Kick Plate: K1050 10" high 4BE CSK, US32D RO
2. Threshold: 273x224AFGT x LAR MSES25SS PE
3. Gasketing: 2891APK (Head) PE
4. Gasketing: 290APK (Jamb) PE
5. Rain Guard: 346C x Door Width " PE
6. Sweep: 3452CNB x LAR PE
7. Position Switch: DPS-M-BK SU

**Set: 5.0**

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
<th>Notes</th>
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<td>626 YA</td>
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<tr>
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<tr>
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<td>4040XP SHCUSH</td>
<td>AL LC</td>
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<tr>
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<td>Threshold</td>
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<td>PE</td>
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<td>Gasketing</td>
<td>2891APK (Head)</td>
<td>PE</td>
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<tr>
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<td>290APK (Jamb)</td>
<td>PE</td>
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<tr>
<td>1</td>
<td>Rain Guard</td>
<td>346C x Door Width &quot;</td>
<td>PE</td>
</tr>
<tr>
<td>1</td>
<td>Sweep</td>
<td>3452CNB x LAR</td>
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<tr>
<td>1</td>
<td>Position Switch</td>
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<td>Wiring Diagram</td>
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**Set: 6.0**

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<td>AL LC</td>
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<td>Rain Guard</td>
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<td>Wiring Diagram</td>
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<tr>
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<td>Power Supply</td>
<td>BPS (size &amp; type as required)</td>
<td>SU</td>
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</table>

Notes: Electronic opening to operate as follows: Outside, Card reader (Integrated in trim) signals power supply to release fail secure electric lock allowing entry by lever. Inside, Free egress at all times by lever. Lock includes door position switch and request to exit features. Key override. Overlapping astragal furnished by door supplier.
### Set: 7.0
Doors: 132.1

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<thead>
<tr>
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<th>Make/Model</th>
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<tr>
<td>1 Mortise Lock w/ Card Reader</td>
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<td>RU</td>
</tr>
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<td>2196 x Length / Cam as Req.</td>
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Notes: Electronic opening to operate as follows: Outside, Card reader (Integrated in trim) signals power supply to release fail secure electric lock allowing entry by lever. Inside, Free egress at all times by lever. Lock includes door position switch and request to exit features. Key override.

### Set: 8.0
Doors: 100.2

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<td>KR4954 x LAR</td>
<td>SP28</td>
<td>VD</td>
</tr>
<tr>
<td>1 Rim Exit Device</td>
<td>LD RX 98L-NL Less Trim</td>
<td>US32D</td>
<td>VD</td>
</tr>
<tr>
<td>1 Rim Exit Device</td>
<td>LD RX 98EO</td>
<td>US32D</td>
<td>VD</td>
</tr>
<tr>
<td>1 Electronic Trim w/ Card Reader</td>
<td>AD-300-993R-70 MT</td>
<td>626</td>
<td>SH</td>
</tr>
<tr>
<td>1 Rim Cylinder</td>
<td>1193</td>
<td>626</td>
<td>YA</td>
</tr>
<tr>
<td>1 Mortise Cylinder</td>
<td>2196 x Length / Cam as Req.</td>
<td>626</td>
<td>YA</td>
</tr>
<tr>
<td>2 Door Closer</td>
<td>4040XP CUSH</td>
<td>AL</td>
<td>LC</td>
</tr>
<tr>
<td>2 Kick Plate</td>
<td>K1050 10&quot; high 4BE CSK</td>
<td>US32D</td>
<td>RO</td>
</tr>
<tr>
<td>2 Silencer</td>
<td>608</td>
<td>RO</td>
<td></td>
</tr>
<tr>
<td>2 eLynx Frame Harness</td>
<td>QC-C1500P</td>
<td>MK</td>
<td></td>
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<tr>
<td>2 eLynx Door Harness</td>
<td>QC-*** (Length / Type as Required)</td>
<td>MK</td>
<td></td>
</tr>
<tr>
<td>1 Interface Board</td>
<td>PIB300-2D BAA</td>
<td>SH</td>
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</tr>
<tr>
<td>2 Electric Power Transfer</td>
<td>EL-CEPT</td>
<td>SU</td>
<td></td>
</tr>
<tr>
<td>1 Position Switch</td>
<td>DPS-M-BK</td>
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</tr>
<tr>
<td>1 Wiring Diagram</td>
<td>WD-SYSPK (Elevations and Point to Point)</td>
<td>SU</td>
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</tr>
<tr>
<td>1 Power Supply</td>
<td>BPS (size &amp; type as required)</td>
<td>SU</td>
<td></td>
</tr>
</tbody>
</table>

Notes: Electronic opening to operate as follows: Outside, Card reader (Integrated in trim) signals power supply to release fail secure lever allowing entry by lever. Inside, Free egress at all times by exit device. Exit device includes door position switch and request to exit features. Key override.

### Set: 9.0
Doors: C101.1

<table>
<thead>
<tr>
<th>Item</th>
<th>Make/Model</th>
<th>Grade</th>
<th>Finish</th>
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<tbody>
<tr>
<td>1 Continuous Hinge</td>
<td>MCK-25HD EPT x LAR</td>
<td>CL</td>
<td>MK</td>
</tr>
<tr>
<td>1 Rim Exit Device</td>
<td>LD RX 98L-NL Less Trim</td>
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<td>VD</td>
</tr>
<tr>
<td>1 Electronic Trim w/ Card Reader</td>
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<td>626</td>
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</tr>
<tr>
<td>1 Rim Cylinder</td>
<td>1193</td>
<td>626</td>
<td>YA</td>
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</table>

Hardware 08710-21
<table>
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<tr>
<th>Item Description</th>
<th>Model/Specification</th>
<th>Quantity</th>
<th>Notes</th>
</tr>
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<tbody>
<tr>
<td>1 Door Closer</td>
<td>4040XP CUSH AL LC</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>K1050 10&quot; high 4BE CSK US32D RO</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>3 Silencer</td>
<td>608</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1 eLynx Frame Harness</td>
<td>QC-C1500P</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1 eLynx Door Harness</td>
<td>QC-C*** (Length / Type as Required) MK</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1 Interface Board</td>
<td>PIB300-2D BAA</td>
<td>1</td>
<td></td>
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<tr>
<td>1 Electric Power Transfer</td>
<td>EL-CEPT SU</td>
<td>1</td>
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</tr>
<tr>
<td>1 Wiring Diagram</td>
<td>WD-SYSPK (Elevations and Point to Point)</td>
<td>1</td>
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</tr>
<tr>
<td>1 Power Supply</td>
<td>BPS (size &amp; type as required) SU</td>
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Notes: Electronic opening to operate as follows: Outside, Card reader (Integrated in trim) signals power supply to release fail secure lever allowing entry by lever. Inside, Free egress at all times by exit device. Exit device includes door position switch and request to exit features. Key override.

**Set: 10.0**
Doors: 100.3

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<td>2 Continuous Hinge</td>
<td>MCK-25HD x LAR</td>
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<td>1 Mullion</td>
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<td>SP28 VD</td>
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<td>CD 98L 06 996L(Std)</td>
<td>2</td>
<td>US32D VD</td>
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<tr>
<td>2 Rim Cylinder</td>
<td>1193</td>
<td>2</td>
<td>626 YA</td>
</tr>
<tr>
<td>3 Mortise Cylinder</td>
<td>2196 x Length / Cam as Req, 626 YA</td>
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<tr>
<td>2 Door Closer</td>
<td>4040XP CUSH AL LC</td>
<td>2</td>
<td>AL LC</td>
</tr>
<tr>
<td>2 Kick Plate</td>
<td>K1050 10&quot; high 4BE CSK US32D RO</td>
<td>2</td>
<td>US32D RO</td>
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<tr>
<td>2 Silencer</td>
<td>608</td>
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**Set: 11.0**
Doors: 121.2

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<th>Item Description</th>
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<tr>
<td>3 Hinge (heavy weight)</td>
<td>T4A3786 NRP 4-1/2&quot; x 4-1/2&quot; US26D MK</td>
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<td>1 Kick Plate</td>
<td>K1050 10&quot; high 4BE CSK US32D RO</td>
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<tr>
<td>3 Silencer</td>
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**Set: 12.0**
Doors: 132A.1

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<tr>
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<tr>
<td>1 Mortise Lock (storeroom)</td>
<td>ML2057 NSA LC 626 RU</td>
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<tr>
<td>1 Mortise Cylinder</td>
<td>2196 x Length / Cam as Req, 626 YA</td>
<td>1</td>
<td></td>
</tr>
<tr>
<td>1 Door Stop</td>
<td>409</td>
<td>1</td>
<td>US32D RO</td>
</tr>
<tr>
<td>3 Silencer</td>
<td>608</td>
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**Set: 13.0**
Doors: 101A.1, 101B.1, 105.1, 107.1

<table>
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<tr>
<th>Item Description</th>
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<td>1 Mortise Cylinder</td>
<td>2196 x Length / Cam as Req, 626 YA</td>
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<tr>
<td>1 Door Closer</td>
<td>4040XP REG AL LC</td>
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<td>AL LC</td>
</tr>
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<td>1 Kick Plate</td>
<td>K1050 10&quot; high 4BE CSK US32D RO</td>
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<td>US32D RO</td>
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<tr>
<td>1 Door Stop</td>
<td>409</td>
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<td>US32D RO</td>
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Hardware 08710-22
3 Silencer       608        RO

**Set: 14.0**
Doors: 123.1

3 Hinge       TA2714 NRP 4-1/2" x 4-1/2"       US26D MK
1 Mortise Lock (storeroom) ML2057 NSA LC     626 RU
1 Mortise Cylinder 2196 x Length / Cam as Req, 626 YA
1 Door Closer 4040XP CUSH       AL LC
1 Kick Plate K1050 10" high 4BE CSK       US32D RO
3 Silencer 608        RO

**Set: 15.0**
Doors: 104.1, 106.1, 110.1, 125.1

3 Hinge       TA2714 4-1/2" x 4-1/2"       US26D MK
1 Mortise Lock (office) ML2051 NSA LC     626 RU
1 Mortise Cylinder 2196 x Length / Cam as Req, 626 YA
1 Door Stop 409        US32D RO
3 Silencer 608        RO

**Set: 16.0**
Doors: 112A.1, 112A.2

6 Hinge       TA2714 NRP 4-1/2" x 4-1/2"       US26D MK
2 Manual Flush Bolt 555        US26D RO
1 Dust Proof Strike 570        US26D RO
1 Mortise Lock (classroom) ML2055 NSA LC     626 RU
1 Mortise Cylinder 2196 x Length / Cam as Req, 626 YA
2 Surface Overhead Stop 10-036 630 RF
2 Silencer 608        RO

**Set: 17.0**
Doors: 108.1, 112.1

3 Hinge       TA2714 4-1/2" x 4-1/2"       US26D MK
1 Mortise Lock (classroom) ML2055 NSA LC     626 RU
1 Mortise Cylinder 2196 x Length / Cam as Req, 626 YA
1 Door Stop 409        US32D RO
3 Silencer 608        RO

**Set: 18.0**
Doors: 126.1

3 Hinge       TA2714 4-1/2" x 4-1/2"       US26D MK
1 Mortise Lock (classroom) ML2055 NSA LC     626 RU
1 Mortise Cylinder 2196 x Length / Cam as Req, 626 YA
1 Door Closer 4040XP REG AL LC
1 Kick Plate K1050 10" high 4BE CSK       US32D RO
1 Door Stop 409        US32D RO
3 Silencer 608        RO

**Set: 19.0**
Doors: 101.1

Hardware 08710-23
<table>
<thead>
<tr>
<th>Set: 20.0</th>
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<td>1 Mortise Lock (classroom)</td>
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</tr>
<tr>
<td>1 Mortise Cylinder</td>
<td>2196 x Length / Cam as Req.</td>
</tr>
<tr>
<td>1 Surface Overhead Stop</td>
<td>10-036</td>
</tr>
<tr>
<td>1 Door Closer</td>
<td>4040XP REG</td>
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<tr>
<td>1 Kick Plate</td>
<td>K1050 10&quot; high 4BE CSK</td>
</tr>
<tr>
<td>3 Silencer</td>
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<table>
<thead>
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</thead>
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<td>TA2714 4-1/2&quot; x 4-1/2&quot;</td>
</tr>
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<td>1 Mortise Lock (privacy)</td>
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<td>1 Kick Plate</td>
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<tr>
<td>1 Door Stop</td>
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</tr>
<tr>
<td>3 Silencer</td>
<td>608</td>
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<td>1 Coat Hook</td>
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| END OF SECTION |

**Hardware**

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<th>Set: 22.0</th>
<th>Doors: 122.1, 124.1</th>
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<tr>
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<td>ML20606-TCRNE1-SEC NSA M8XX LC</td>
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</tr>
<tr>
<td>1 Door Closer</td>
<td>4040XP REG</td>
</tr>
<tr>
<td>1 Kick Plate</td>
<td>K1050 10&quot; high 4BE CSK</td>
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<tr>
<td>1 Door Stop</td>
<td>409</td>
</tr>
<tr>
<td>3 Silencer</td>
<td>608</td>
</tr>
<tr>
<td>1 eLynx Frame Harness</td>
<td>QC-C1500P</td>
</tr>
<tr>
<td>1 eLynx Door Harness</td>
<td>QC-C*** (Length / Type as Required)</td>
</tr>
<tr>
<td>1 Electric Power Transfer</td>
<td>EL-CEPT</td>
</tr>
<tr>
<td>1 Wiring Diagram</td>
<td>WD-SYSPK (Elevations and Point to Point)</td>
</tr>
<tr>
<td>1 Power Supply</td>
<td>BPS (size &amp; type as required)</td>
</tr>
</tbody>
</table>

Notes: Electronic opening to operate as follows: Outside, Card reader (Integrated in trim) signals power supply to release fail secure electric lock allowing entry by lever. Inside, Free egress at all times by lever. Lock includes door position switch and request to exit features. Key override.
SECTION 08810

GLAZING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Windows.
2. Doors.
3. Glazed Aluminum Curtain Wall System
4. Interior glazing.

1.03 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.

C. Interspace: Space between lites of an insulating-glass unit.

1.04 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: defective manufacture, fabrication, or installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.

B. Delegated Design: Design glass, including comprehensive engineering analysis according to ASTM E 1300 by a qualified professional engineer, using the following design criteria:

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. Vertical Glazing: For glass surfaces sloped 15 degrees or less from vertical, design glass to resist design wind pressure based on glass type factors for short-duration load.

3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.

4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.

1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.
1.05 SUBMITTALS

A. Product Data: For each glass product and glazing material indicated.

B. Glass Samples: For each type of glass product other than clear monolithic vision glass 12 inches square.

C. Glazing Accessory Samples: For gaskets, sealants and colored spacers, in 12-inch lengths. Install sealant Samples between two strips of material representative in color of the adjoining framing system.

D. Delegated-Design Submittal: For glass indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

E. Qualification Data: For installers.

F. Product Certificates: For glass and glazing products, from manufacturer.

G. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for insulating glass, glazing sealants and glazing gaskets.
   1. For glazing sealants, provide test reports based on testing current sealant formulations within previous 36-month period.

H. Warranties: Sample of special warranties.

1.06 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.

B. Glass Testing Agency Qualifications: A qualified independent testing agency accredited according to the NFRC CAP 1 Certification Agency Program.

C. Source Limitations for Glass: Obtain laminated glass and insulating glass from single source from single manufacturer for each glass type.

D. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

E. Glazing Publications: Comply with published recommendations of glass product 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.

F. Safety Glazing Labeling: Where safety glazing labeling is indicated, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

G. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.
H. 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 glazing during and after installation.

1.07 PRODUCT 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 recommendations for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.08 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 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 below 40 deg F.

1.09 WARRANTY

A. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form in which 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: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form in which 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. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

   1. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 GLASS PRODUCTS, GENERAL

A. Thickness: Where glass thickness is indicated, it is a minimum. Provide glass lites in thicknesses as needed to comply with requirements indicated.

   1. Minimum Glass Thickness for Exterior Lites: Not less than 6.0 mm.

B. Strength: Where float glass is indicated, provide annealed float glass, Kind HS heat-treated float glass, or Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened glass is indicated, provide Kind HS heat-treated float glass or
Kind FT heat-treated float glass as needed to comply with "Performance Requirements" Article. Where fully tempered glass is indicated, provide Kind FT heat-treated float glass.

2.02 GLASS PRODUCTS

A. Float Glass: ASTM C 1036, Type I, Quality-Q3, Class I (clear) unless otherwise indicated.

B. Fully Tempered Float Glass: ASTM C 1048; Kind FT, (clear) Low E unless otherwise indicated; of kind and condition indicated.
   1. Fabrication Process: Glass heat-treated by horizontal (roller hearth) process with inherent roller wave distortion parallel to the bottom edge of the glass as installed when specified.
   2. For uncoated glass, comply with requirements for Condition A.
   3. For coated vision glass, comply with requirements for Condition C (other coated glass).

2.03 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172, and complying with testing requirements in 16 CFR 1201 for Category II materials, and with other requirements specified. 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 to comply with interlayer manufacturer's written recommendations.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.

B. Glass: Comply with applicable requirements in "Glass Products" Article as indicated by descriptions in "Glass Types" Article.

2.04 INSULATING GLASS

A. Manufacturers: Basis of Design; Guardian Industries Corp.; Sunguard Architectural Glass; Subject to compliance with requirements, provide products by one of the following:
   1. Guardian Industries Corp.
   2. Oldcastle Glass.
   3. PPG Industries, Inc.

B. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190, and complying with other requirements specified.
   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary.
   2. Spacer: Aluminum with mill or clear anodic finish.
   3. Desiccant: Molecular sieve or silica gel, or blend of both.

C. Glass: Comply with applicable requirements in "Glass Products" Article and in "Laminated Glass" Article as indicated by descriptions in "Insulating-Glass Types" Article and in "Glass Types" Article.

2.05 GLAZING GASKETS

A. Dense Compression Gaskets: Molded or extruded gaskets of profile and hardness required to maintain watertight seal, made from one of the following:
   1. EPDM complying with ASTM C 864.
2. Silicone complying with ASTM C 1115.
3. Thermoplastic polyolefin rubber complying with ASTM C 1115.

B. Soft Compression Gaskets: Extruded or molded, closed-cell, integral-skinned EPDM, silicone or thermoplastic polyolefin rubber gaskets complying with ASTM C 509, Type II, black; of profile and hardness required to maintain watertight seal.

   1. Application: Use where soft compression gaskets will be compressed by inserting dense compression gaskets on opposite side of glazing or pressure applied by means of pressure-glazing stops on opposite side of glazing.

2.06 GLAZING SEALANTS

A. General:

   1. Compatibility: Provide glazing sealants that are compatible with one another and with other materials they will 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.

2.07 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

   1. AAMA 804.3 tape, where indicated.
   2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
   3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

   1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
   2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.08 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. 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.

2.09 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.

2.10 GLASS TYPES

A. Typical Interior Glass Type G3: Clear tempered glass.
   1. Thickness: 6.0 mm.
   2. Provide tempered glazing labeling.

B. Typical Exterior Glass Type G2: Low-e-coated, clear insulating laminated glass.
   2. Overall Unit Thickness: 1 inch.
   3. Indoor Lite: Clear laminated glass with two plies of float glass.
      a. Thickness of Each Glass Ply: 3.0 mm.
      b. Interlayer Thickness: 0.060 inch; PVB of Artic Snow
   4. Outdoor Lite: Fully tempered float glass; 6.0 mm thick.
   5. Interspace Content: Argon.
   7. Ultraviolet Transmittance: 42 percent.
   8. Visible Light Transmittance: 54 percent minimum.
   12. Winter Nighttime U-Factor: 0.29 maximum.
   13. Summer Daytime U-Factor: 0.27 maximum.
   14. Shading Coefficient: 0.71.
   15. Solar Heat Gain Coefficient: 0.28 maximum.
   16. Provide safety glazing labeling.

C. Typical Exterior Glass Type G1: Low-e-coated, clear insulating laminated glass.
   2. Overall Unit Thickness: 1 inch.
   3. Outdoor Lite: Clear tempered glass
      a. Thickness of Each Glass Ply: 3mm
   4. Indoor Lite: Clear laminated glass with two plies of float glass.
      a. Thickness of Each Glass Ply: 3mm
      b. Interlayer Thickness: 0.060 inch; Clear PVB
   5. Interspace Content: Argon
7. Ultraviolet Transmittance: 42 percent.
12. Winter Nighttime U-Factor: 0.29 maximum.
13. Summer Daytime U-Factor: 0.27 maximum.
14. Shading Coefficient: 0.71.
15. Solar Heat Gain Coefficient: 0.26 maximum.
16. Provide safety glazing labeling.

PART 3 EXECUTION

3.01 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.

3.02 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 will leave visible marks in the completed work.

3.03 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. Adjust glazing channel dimensions as required by Project conditions during installation to provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances.
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 in each series with uniform pattern, draw, bow, and similar characteristics.

J. Set glass lites with proper orientation so that coatings face exterior or interior as specified.

K. 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.

L. 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.

3.04 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 if required to comply with performance requirements.

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, at locations where fixed stop is located on exterior.

3.05 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.

3.06 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.

3.07 CLEANING AND PROTECTION

A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels and clean surfaces.

B. Protect glass from contact with contaminating substances resulting from construction operations. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer.

C. 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; remove as recommended in writing by glass manufacturer.

D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.

E. 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 09100
METAL SUPPORT ASSEMBLIES

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes: Non-load-bearing steel framing members for the following applications:
   1. Interior framing systems, including supports for partition walls, framed soffits, furring, and similar conditions.
   2. Interior suspension systems, including supports for ceilings, suspended soffits, and similar conditions.

B. Related Sections:
   1. Section 09250 “Gypsum Board”
   2. Section 11011 “Fall Protection Systems”

1.03 SUBMITTALS
A. Product Data: For each type of product indicated.

PART 2 PRODUCTS

2.01 NON-LOAD-BEARING STEEL FRAMING, GENERAL
A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.
   1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal, unless otherwise indicated.

2.02 SUSPENSION SYSTEM COMPONENTS
A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.0625-inch-diameter wire, or double strand of 0.0475-inch-diameter wire.

B. Hanger Attachments to Concrete:
   1. Anchors: Fabricated from corrosion-resistant materials with holes or loops for attaching wire hangers and capable of sustaining, without failure, a load equal to 5 times that imposed by construction as determined by testing according to ASTM E 488 by an independent testing agency.
   2. Powder-Actuated Fasteners: Suitable for application indicated, fabricated from corrosion-resistant materials with clips or other devices for attaching hangers of type indicated, and capable of sustaining, without failure, a load equal to 10 times that imposed by construction as determined by testing according to ASTM E 1190 by an independent testing agency.

C. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.162-inch diameter.
D. Flat Hangers: Steel sheet, 1 by 3/16 inch unless otherwise indicated.

E. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
   1. Depth: 2-1/2 inches, unless otherwise indicated.

F. Furring Channels (Furring Members):
   1. Steel Studs: ASTM C 645.
      a. Minimum Base-Metal Thickness: 0.0312 inch.
      b. Depth: 3-5/8 inches, unless otherwise indicated.
      a. Minimum Base Metal Thickness: 0.0312 inch.

2.03 STEEL FRAMING FOR FRAMED ASSEMBLIES

A. Steel Studs and Runners: ASTM C 645.
   1. Minimum Base-Metal Thickness: 0.0312 inch (20 gage).
   2. Depth: 3-5/8 inches, unless otherwise indicated.

B. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Metal Thickness: 0.0312 inch.

C. Cold-Rolled Channel Bridging: 0.0538-inch bare-steel thickness, with minimum 1/2-inch-wide flanges.
   1. Depth: 1-1/2 inches, unless otherwise indicated.
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.
   1. Minimum Base Metal Thickness: 0.0179 inch, unless otherwise indicated.
   2. Depth: 7/8 inch, unless otherwise indicated.

2.04 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.
   1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Foam gasket; adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, with Installer present, and including cast-in anchors and structural framing, for compliance with requirements and other conditions affecting performance.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.03 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754, except comply with framing sizes and spacing indicated.

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, or similar construction.

C. Install bracing at terminations in assemblies.

3.04 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components in sizes and spacings indicated on Drawings, but not less than those required by referenced installation standards for assembly types and other assembly components indicated.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.

2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
5. Do not attach hangers to steel roof deck.
6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.

E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.

F. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

3.05 INSTALLING FRAMED ASSEMBLIES

A. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.

B. Install studs so flanges within framing system point in same direction.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
   a. Install two studs at each jamb, unless otherwise indicated.
   b. Where one-piece control joints are indicated or required at door heads, install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings, unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

D. Direct Furring: Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.

E. 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 09250

GYPSUM BOARD

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Interior gypsum board.

B. Related Sections:
   1. Section 09100 "Metal Support Assemblies".
   2. Section 09900 "Paints and Coatings".

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 STORAGE AND HANDLING

A. Store materials inside under cover and keep them dry and protected against damage from weather, condensation, direct sunlight, construction traffic, and other causes. Stack panels flat to prevent sagging.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or 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, 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

2.01 PANELS, GENERAL

A. Size: Provide in maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.
2.02 INTERIOR GYPSUM BOARD

A. Abuse-Resistant Type: Manufactured to produce greater resistance to surface indentation, through-penetration (impact resistance), and abrasion than standard, regular-type and Type X gypsum board.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. G-P Gypsum; ToughRock Abuse-Resistant Gypsum Board.

2. Core: 5/8 inch.

B. Moisture- and Mold-Resistant Type: With moisture- and mold-resistant core and surfaces.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. G-P Gypsum; DensArmor Interior Guard.
   b. National Gypsum Company; XP Wallboard.
   c. USG Corporation; SHEETROCK Brand HUMITEK.
   d. USG Corporation; FIBEROCK Brand, Aqua Tough Interior Panels.

2. Core: 5/8 inch, Type X.

2.03 EXTERIOR GYPSUM SHEATHING

1. Products: Subject to compliance with requirements, provide one of the following:
   a. G-P Gypsum; DensArmor Interior Guard.
   b. National Gypsum Company; XP Wallboard.
   c. USG Corporation; SHEETROCK Brand HUMITEK.
   d. USG Corporation; FIBEROCK Brand, Aqua Tough Interior Panels.

2. Core: 5/8 inch, Type X.

2.04 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, or paper-faced galvanized steel sheet.
2. Shapes:
   a. Cornerbead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.
   c. Expansion (control) joint.

2.05 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use setting-type taping or drying-type, all-purpose compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping or drying-type, all-purpose compound.
4. Finish Coat: For third coat, use setting-type, sandable topping or drying-type, all-purpose compound.

2.06 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.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas and substrates, 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.

3.02 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 at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
3.03 APPLYING INTERIOR GYPSUM BOARD

A. Install abuse-resistant gypsum board for vertical surfaces, unless otherwise indicated.

B. Install moisture- and mold-resistant interior gypsum board for ceiling and soffit surfaces, unless otherwise indicated.

C. Single-Layer Application:
   1. On ceilings, apply gypsum panels at right angles to framing, unless otherwise indicated.
   2. Fastening Methods: Apply gypsum panels to supports with steel drill screws.

D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer’s written recommendations and temporarily brace or fasten gypsum panels until fastening adhesive has set.

3.04 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. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners, unless otherwise indicated.
   2. LC-Bead: Use at exposed panel edges.
   3. U-Bead: Do not use.

3.05 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, 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 and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for 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 4: At panel surfaces that will be exposed to view, unless otherwise indicated.

3.06 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, 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 09300

TILE

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Ceramic mosaic tile for floors.

B. Related Sections:

1. Section 07900 "Joint Sealants"

1.03 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.


1.04 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM C 1028:

1. Level Surfaces: Minimum 0.6.

1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: For each type of tile and grout indicated. Include Samples of accessories involving color selection.

C. Samples for Verification:

1. Full-size units of each type and composition of tile and for each color and finish required. For ceramic mosaic tile in color blend patterns, provide full sheets of each color blend.

2. Full-size units of each type of trim and accessory for each color and finish required.


D. Qualification Data: For qualified Installer.

E. Master Grade Certificates: For each shipment, type, and composition of tile, signed by tile manufacturer and Installer.

F. Product Certificates: For each type of product, signed by product manufacturer.
G. Material Test Reports: For each tile-setting and -grouting product and special purpose tile.

1.06 QUALITY ASSURANCE

A. Source Limitations for Tile: Obtain tile of each type 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. Preinstallation Conference: Conduct conference at Project site.
   1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.07 PRODUCT 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 liquid materials in unopened containers and protected from freezing.

D. 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.

1.08 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.

1.09 EXTRA MATERIALS

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.

PART 2 PRODUCTS

2.01 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.

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 TCA installation methods specified in tile installation schedules, and other requirements specified.
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.

2.02 TILE PRODUCTS

A. Floor Tile: Factory-mounted unglazed ceramic mosaic tile.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Olean; Division of Dal-Tile International Inc.
   b. Crossville, Inc.
   c. Daltile; Division of Dal-Tile International Inc.

2. Composition: Porcelain.
4. Thickness: 1/4 inch.
5. Face: Plain with cushion edges.
7. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
8. Grout Color: As selected by Architect from manufacturer's full range.

B. Wall Base: Glazed tile.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Olean; Division of Dal-Tile International Inc.
   b. Crossville, Inc.
   c. Daltile; Division of Dal-Tile International Inc.

2. Composition: Porcelain.
3. Glazed Finish: Match one of the following:
   a. American Olean; Satinlo.
   b. Daltile; Matte.

4. Shapes: Provide shapes as follows, selected from manufacturer's standard shapes:
   a. Wall Base: Coved with surface bullnose top edge, face size 6 by 8 inches.
   b. External Corners: Surface bullnose.
   c. Internal Corners: Cove.

5. Tile Color and Pattern: As selected by Architect from manufacturer's full range.
6. Grout Color: As selected by Architect from manufacturer's full range.

2.03 THRESHOLDS

A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.

1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch or less above adjacent floor surface.
B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 12 per ASTM C 1353 or ASTM C 241 and with honed finish.
   1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.04 SETTING MATERIALS

A. Water-Cleanable, Tile-Setting Epoxy: ANSI A118.3.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Bostik, Inc.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
   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.

2.05 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      b. Bostik, Inc.
      c. Laticrete International, Inc.
      d. MAPEI Corporation.
   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.

2.06 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. Temporary Protective Coating: Either product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; compatible with tile, mortar, and grout products; and easily removable after grouting is completed without damaging grout or tile.
   1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F per ASTM D 87.
   2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as temporary protective coating for tile.

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.
2.07 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

3.01 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm, dry, clean, free of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with adhesives, bonded mortar bed or thin-set mortar comply with surface finish requirements in ANSI A108.01 for installations indicated.

a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.

b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with adhesives or thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.

B. 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.

C. Field-Applied Temporary Protective Coating: If needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.03 TILE INSTALLATION

A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA 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 TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

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, install tile with the following joint widths:

2. Tile Base: 1/16 inch.

F. 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 07900 "Joint Sealants."

G. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.

3.04 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. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.05 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Floor Installations, Concrete Subfloor:

1. Tile Installation F131: Water-cleanable, tile-setting epoxy; epoxy grout; TCA F131.
   a. Grout: Water-cleanable epoxy grout.

END OF SECTION
SECTION 09510
ACOUSTICAL PANEL CEILINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Acoustical panels and exposed suspension systems for ceilings.

B. Related Sections:
   1. Section 13930 “Wet Pipe Fire Suppression Sprinklers.”
   2. Section 16510 "Interior Luminaires."

C. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Coordination Drawings: Reflected ceiling plans drawn to scale and coordinating penetrations and ceiling-mounted items. Show the following:
   1. Ceiling suspension members.
   2. Method of attaching hangers to building structure.
      a. Furnish layouts for cast-in-place anchors, clips, and other ceiling attachment devices whose installation is specified in other Sections.
   3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

C. Samples for Initial Selection: For components with factory-applied color finishes.

D. 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 6-inch-square Samples of each type, color, pattern, and texture.
   2. Exposed Suspension System Members, Moldings, and Trim: Set of 12-inch-long Samples of each type, finish, and color.

E. Maintenance Data: For finishes to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system through one source from a single manufacturer.

B. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:
1. **Surface-Burning Characteristics:** Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
   
   a. **Smoke-Developed Index:** 450 or less.

C. **Seismic Standard:** Provide acoustical panel ceilings designed and installed to withstand the effects of earthquake motions according to the following:
   
   1. **Standard for Ceiling Suspension Systems Requiring Seismic Restraint:** Comply with ASTM E 580.
   2. **CISCA’s Recommendations for Acoustical Ceilings:** Comply with CISCA’s “Recommendations for Direct-Hung Acoustical Tile and Lay-in Panel Ceilings--Seismic Zones 0-2.”

D. **Mockups:** Build mockups to verify selections made under sample Submittals and to demonstrate aesthetic effects and qualities of materials and execution.
   
   1. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

E. **Preinstallation Conference:** Conduct conference at Project site.

### 1.05 PRODUCT 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.

### 1.06 PROJECT 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.

### 1.07 COORDINATION

A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

### 1.08 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. **Acoustical Ceiling Panels:** Full-size panels equal to 2.0 percent of quantity installed.
   2. **Suspension System Components:** Quantity of each exposed component equal to 2.0 percent of quantity installed.
   3. **Hold-Down Clips:** Equal to 2.0 percent of amount installed.
PART 2 PRODUCTS

2.01 ACOUSTICAL PANELS, GENERAL

A. 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 per ASTM E 795.

B. Acoustical Panel Colors and Patterns: Match appearance characteristics indicated for each product type.

1. Where appearance characteristics of acoustical panels are indicated by referencing pattern designations in ASTM E 1264 and not manufacturers' proprietary product designations, provide products selected by Architect from each manufacturer's full range that comply with requirements indicated for type, pattern, color, light reflectance, acoustical performance, edge detail, and size.

2.02 ACOUSTICAL PANELS

A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:

1. USG Interiors, Inc.
2. Armstrong World Industries, Inc.


C. Classification: Provide panels complying with ASTM E 1264 for Type III, mineral base with painted finish; Form 2, water felted; and pattern as follows:

1. Pattern: CE (perforated, small holes and lightly textured).

D. Panel Characteristics:

2. LR: Not less than 0.84.
3. NRC: Not less than 0.55.
4. CAC: Not less than 35.
5. Edge Detail: Square.
7. Size: 24 by 48 inches.

2.03 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.

B. Finishes and Colors, General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes. Provide manufacturer's standard factory-applied finish for type of system indicated.

C. Attachment Devices: Size for five times the design load indicated in ASTM C 635, Table 1, "Direct Hung," unless otherwise indicated.
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 per ASTM E 488 or ASTM E 1512 as applicable, conducted by a qualified testing and inspecting agency.
   a. Type: Cast-in-place anchors, postinstalled expansion anchors or postinstalled adhesive 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.

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 per ASTM E 1190, conducted by a qualified testing and inspecting agency.

D. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
   2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch-diameter wire.

E. Hanger Rods or Flat Hangers: Mild steel, zinc coated or protected with rust-inhibitive paint.

F. 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.

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.

2.04 METAL EDGE MOLDINGS AND TRIM

A. 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 fit acoustical panel edge details and suspension systems indicated; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension system runners.
   1. For lay-in panels, provide edge molding of same depth and width as that formed between edge of panel and flange at exposed suspension member.
   2. For circular penetrations of ceiling, provide edge moldings fabricated to diameter required to fit penetration exactly.

B. 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 the following requirements:
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 for alloy and temper 6063-T5.

2. Finish designations prefixed by AA comply with system established by the Aluminum Association for designating aluminum finishes.


   a. Organic Coating: Thermosetting, primer/topcoat system with a minimum dry film thickness of 0.8 to 1.2 mils.

PART 3 EXECUTION

3.01 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. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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.

3.03 INSTALLATION, GENERAL

A. General: Install acoustical panel ceilings to comply with ASTM C 636 and seismic requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

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 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. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
   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 structure to which hangers are attached and 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. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. 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.

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. Miters 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 square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.
   2. For reveal-edged panels on suspension system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.
   3. 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.
   4. Install hold-down clips in areas indicated; space as recommended by panel manufacturer’s written instructions, unless otherwise indicated.

3.04 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 09620

RESINOUS Poured IN PLACE RESILENT FLOORING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: high performance resinous flooring systems for moisture control for the following applications:

1. Concrete slabs on grade.

B. Related Sections:

1. Section 03300 “Cast-in-Place Concrete”
2. Section 09650 “Resilient Base and Accessories”

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Samples for Initial Selection: Manufacturer's color charts showing colors and glosses available for flooring and game-line and marker paints.

C. Samples for Verification: For each color, gloss, and texture of flooring required, 12 inches square, applied to a rigid backing. Include sample sets showing the game-line paint and marker paint colors applied to the flooring.

D. Qualification Data: For Installer.

E. Maintenance Data: For fluid-applied flooring to include in maintenance manuals.

F. Warranties: Special warranties specified in this Section.

1.04 QUALITY ASSURANCE

A. Installer Qualifications: An installer (applicator) who is approved, trained, or certified by fluid-applied flooring manufacturer with skilled mechanics having not less than 5 years satisfactory experience in installation of specified systems.

B. Preinstallation Conference: Conduct conference at Project site. Review methods and procedures related to flooring application including, but not limited to, the following:

1. Substrate conditions, including moisture content.

C. Mock-Ups:

1. Apply mock-up sample where directed by Architect to verify selections submitted and confirm adhesion to substrate.
a) Mock up will demonstrate substrate preparation, products, colors, sheen, mil thickness, number of coats, and desired slip resistance.

b) Modify sample as directed until accepted by Architect.

c) Perform adhesion test per ASTM D 3359 after full cure time as recommended by the manufacturer for the use intended and under proper temperature and relative humidity conditions Report in writing the results of the test.

2. Upon acceptance of Architect, sample area will be the standard of workmanship quality throughout the project.

D. Delivery, Storage, And Handling

1. Store materials in accordance with manufacturer's instructions and with seals and labels intact and legible. Maintain temperatures within required range and keep from freezing. Do not use materials that exceed manufacturer's maximum recommended shelf life.

2. Store and dispose of solvent-based materials and materials used with solvent-based materials in accordance with requirements of local authorities having jurisdiction. Maintain a clean, dry storage area, to prevent contamination or damage to coatings.

3. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

1.05 PROJECT CONDITIONS

A. Environmental: Condition minimum slab temperature to 50 degrees F for 48 hours before commencing installation, during installation, and for at least 72 hours after completing installation. Maintain substrate temperature at least 5 degrees F above dew point during installation.

B. Maintain lighting at a minimum uniform level of 50 or more foot candles in areas where flooring system is being installed

C. Do not apply coatings in areas where dust is being generated.

D. Repair leaks from pipes and other sources prior to installation.

E. Provide adequate continuous ventilation for 24 hours before, during and 48 hours after application of finishes.

1.06 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fluid-applied athletic flooring installation that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 3 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 FLUID-APPLIED FLOORING

A. Basis-of-Design: Design is based on brand of products as manufactured by The Sherwin Williams Company/General Polymers and set required quality standard.

B. No Substitutions:
2.02 MATERIALS - COATINGS

A. General: Have good flowing and installation properties capable of drying or curing free of streaks or sags. See Schedule of Systems in PART 3 of this Section for required high performance resinous coatings.

B. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.

2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

   1. Floor Coatings: 100 g/L.

2.03 MATERIALS - ACCESSORIES

A. Patching and Fill Materials: Install resinous patching and filler products to fill holes, depressions, imperfections, damages, and deteriorated concrete as recommended by manufacturer of products used.

B. Joint Sealant: Install products as recommended by manufacturer for type of service and joint condition indicated.

C. Application Equipment: Drip cloths, warning signs, and other ancillary accessories required to complete coating work and as recommended by coating manufacturer.

2.04 MIXING

A. Mix and prepare painting materials in accordance with manufacturer’s published directions.

B. Maintain containers used in mixing and application of coatings in a clean condition, free of foreign materials and residue.

C. Stir materials before application to produce a mixture of uniform density, and stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

D. Do not thin coating materials unless recommended by manufacturer. When thinning is permitted, comply with manufacturer’s printed instructions using only thinners approved by floor coating manufacturer.

2.05 COLORS

A. Match colors as indicated.

B. Allow for various colors when submitting bid. Refer to initial color selections as indicated or noted on approved shop drawings.
2.06 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample coating materials. Contractor will be notified in advance and may be present when samples are taken. If coating materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
2. Testing agency will perform tests for compliance with product requirements.
3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove non-complying coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 EXECUTION

3.01 EXAMINATION

Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work, unless coating manufacturer states in writing that moisture testing is not required.

A. Verify each drain in installation area is working and at actual finished elevation of flooring system.
B. Proceed with installation only after unsatisfactory conditions have been corrected. Proceeding with the Work indicates acceptance of surfaces and conditions.

3.02 PREPARATION

A. Surface must be clean, dry, and in sound condition. Remove stains, oil, dust, grease, dirt, rust, release agents, curing compounds and hardeners, salts, efflorescence, laitance, and other contaminants and foreign material to ensure adequate adhesion.
C. Provide Concrete Surface Profile (CSP) as recommended by manufacturer for specified systems.
D. Minimum substrate cure is 7 days at 75 degrees F.
E. Visit jobsite prior to installation of flooring system to evaluate substrate condition, quantity and severity of cracking, and extent of repairs needed. Repair substrate imperfections only after mechanical preparation of substrate.
   1. If surface deterioration presents an unacceptable surface, follow manufacturers written instructions for patching and resurfacing defective areas.
F. Fill cracks, voids, bug holes and joints with appropriate filler, joint sealant, or patching material as recommended by manufacturer.
G. Plug floor drains prior to application of resinous flooring to prevent materials from running into drains.
H. Protect surrounding substrates and surfaces, as well as in-place equipment during surface preparation and system installation.

3.03 APPLICATION

A. Apply each flooring system component in compliance with manufacturer’s written installation instructions strictly adhering to mixing and installation methods, recoat windows, cure times, environmental restrictions, and with approved shop drawings.

B. Use applicators and techniques suited for coating and substrate indicated. Keep applicators clean, free from contaminants, and suitable for required finish.

C. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp lines and color breaks.

D. Terminate flooring system at edge of isolation and expansion joints and install integral cover base as designated on Contract Documents.

1. Honor isolation, expansion, and other joints through flooring system.

E. If undercoats or other conditions show through final coat, apply additional coats until cured coating has a uniform finish, color, and appearance.

F. Allow materials to cure in compliance with manufacturer’s directions. Prevent contamination during stages of application and prior to completion of curing process.

3.04 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.

2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer’s written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer’s written recommendations.

3.05 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. Remove spilled, splashed, or spattered coating materials promptly from other surfaces being careful not to damage surface finish of item being cleaned.

C. Follow manufacturer’s recommendations for touch-up, repair, and restoring of damaged finish; leave project in first class condition. Repair any defects that will hinder coating performance.

D. Clean flooring system just prior to Substantial Inspection using materials and procedures recommended by system manufacturer.

E. Protect flooring System from damage and wear during other phases of construction operations. Use temporary coverings as recommended by manufacturer, if required. Remove temporary covering just prior to Substantial Completion.
3.06 FLOORING SYSTEM SCHEDULE

A. Paragraphs below identify specific floor coating materials and appropriate specified systems as indicated on Drawings.

B. Decorative Epoxy Flooring system

1. Primer: GP 3479 WB Epoxy.
2. Broadcast: Decorative 1/8" vinyl flake (SEPTA standard, custom black and gray 9412420)
3. Topcoat: GP4844 PAce-Cote

END OF SECTION
SECTION 09650

RESILIENT BASE AND ACCESSORIES

PART 1  GENERAL

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

1.02  SUMMARY
A. Section Includes:
   1. Resilient base.
   2. Resilient molding accessories.
B. Related Sections:
   1. Section 09620 "Resinous Poured in Place Resilient Flooring"
   2. Section 12320 "Manufactured Plastic-Laminate-Faced Casework"

1.03  SUBMITTALS
A. Product Data: For each type of product indicated.
B. Samples for Initial Selection: For each type of product indicated.
C. Samples for Verification: For each type of product indicated, in manufacturer's standard-size Samples but not less than 12 inches long, of each resilient product color, texture, and pattern required.

1.04  QUALITY ASSURANCE
A. Fire-Test-Response Characteristics: 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.

1.05  PRODUCT 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.

1.06  PROJECT 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. 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.

1.07 EXTRA MATERIALS

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.

PART 2 PRODUCTS

2.01 RESILIENT BASE

A. Basis-of-Design Product: Subject to compliance with requirements, provide Roppe Corporation, USA; Pinnacle Rubber, or comparable product by one of the following:

1. Armstrong World Industries, Inc.
2. Johnsonite.


1. Material Requirement: Type TS (rubber, vulcanized thermoset).
3. Style: Butt to (fit-to-floor).

C. Minimum Thickness: 0.125 inch.

D. Height: 4 inches, unless otherwise indicated.

E. Lengths: Coils in manufacturer's standard length.

F. Outside Corners: Preformed.

G. Inside Corners: Preformed.

H. Finish: As selected by Architect from manufacturer's full range.

I. Colors and Patterns: Roppe wall base; 174, ‘Smoke’.

2.02 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

C. Stair-Tread-Nose Filler: Two-part epoxy compound recommended by resilient tread manufacturer to fill nosing substrates that do not conform to tread contours.
PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Resilient Stair Treads and Accessories: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
   4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.
      a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.
      b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.
   1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.03 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 practicable without gaps at seams and with tops of adjacent pieces aligned.
D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Preformed Corners: Install preformed corners before installing straight pieces.

3.04 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Stair Accessories:
   1. Use stair-tread-nose filler to fill nosing substrates that do not conform to tread contours.
   2. Tightly adhere to substrates throughout length of each piece.
   3. For treads installed as separate, equal-length units, install to produce a flush joint between units.

C. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of resilient floor covering that would otherwise be exposed.

3.05 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product 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 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 until Substantial Completion.

END OF SECTION
SECTION 09900

PAINTS AND COATINGS

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Surface preparation and field painting of the following:

1. Exposed exterior items and surfaces.
2. Exposed interior items and surfaces.
3. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
4. Exposed duckwork as noted including in Operator’s Lounge.

B. Paint exposed surfaces, except where the paint schedules indicate that a surface or material is not to be painted or is to remain natural. If the paint schedules do not specifically mention an item or a surface, paint the item or surface the same as similar adjacent materials or surfaces whether or not schedules indicate colors. If the schedules do not indicate color or finish, the Architect will select from standard colors and finishes available.

1. Painting includes field painting of exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

C. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.

1. Prefinished items include the following factory-finished components:
   a. Toilet compartments.
   b. Prefinished lockers.
   c. Finished mechanical and electrical equipment.
   d. Light fixtures.
   e. Acoustic metal deck

2. Concealed surfaces include walls or ceilings in the following generally inaccessible spaces:
   a. Foundation spaces.
   b. Furred areas.
   c. Ceiling plenums.
   d. Utility tunnels.
   e. Pipe spaces.
   f. Duct shafts.

3. Finished metal surfaces include the following:
   a. Anodized aluminum.
   b. Stainless steel.
   c. Chromium plate.
   d. Copper.
   e. Bronze and brass.
4. Operating parts include moving parts of operating equipment and the following:
   a. Valve and damper operators.
   b. Linkages.
   c. Sensing devices.
   d. Motor and fan shafts.

5. Labels: Do not paint over Underwriters Laboratories (UL), Factory Mutual (FM), or other
   code-required labels or equipment name, identification, performance rating, or nomenclature
   plates.

D. Related Sections:

1. Section 05120 “Structural Steel”
2. Section 05310 “Steel Deck”.
3. Section 05500 “Metal Fabrications”.
4. Section 06400 “Architectural Woodwork”
5. Section 08110 “Metal Doors and Frames”
6. Section 08310 “Access Doors and Panels”
6. Section 09250 “Gypsum Board”

1.03 SUBMITTALS

A. Product Data: For each paint system specified. Include block fillers and primers.

B. Samples for Initial Selection: Manufacturer's color charts showing the full range of colors available
   for each type of finish-coat material indicated.

C. Samples for Verification: Of each color and material to be applied, with texture to simulate actual
   conditions, on representative Samples of the actual substrate.
   1. Provide a list of materials and applications for each coat of each sample. Label each sample
      for location and application.

D. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to
   demonstrate their capabilities and experience. Include lists of completed projects with project
   names and addresses, names and addresses of architects and owners, and other information
   specified.

1.04 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system
   applications similar in material and extent to that indicated for this Project with a record of
   successful in-service performance.

B. Source Limitations: Obtain block fillers, primers, and undercoat materials for each coating system
   from the same manufacturer as the finish coats.

C. Benchmark Samples (Mockups): Provide a full-coat benchmark finish sample of each type of
   coating and substrate required on the Project. Comply with procedures specified in PDCA P5.
   Duplicate finish of approved prepared samples.
   1. The Architect will select one room or surface to represent surfaces and conditions for each
      type of coating and substrate to be painted.
      a. Wall Surfaces: Provide samples on at least 100 sq. ft. of wall surface.
      b. Small Areas and Items: The Architect will designate an item or area as required.
2. After permanent lighting and other environmental services have been activated, apply coatings in this room or to each surface according to the Schedule or as specified. Provide required sheen, color, and texture on each surface.
   a. After finishes are accepted, the Architect will use the room or surface to evaluate coating systems of a similar nature.

3. Final approval of colors will be from job-applied samples.

1.05 PRODUCT HANDLING

A. Deliver materials to the Project Site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label.

B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain containers used in storage in a clean condition, free of foreign materials and residue.

   1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily. Take necessary measures to ensure that workers and work areas are protected from fire and health hazards resulting from handling, mixing, and application.

1.06 PROJECT CONDITIONS

A. Apply water-based paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 50 and 90 deg F.

B. Apply solvent-thinned paints only when the temperature of surfaces to be painted and surrounding air temperatures are between 45 and 95 deg F.

C. Do not apply paint in snow, rain, fog, or mist; or when the relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

   1. Painting may continue during inclement weather if surfaces and areas to be painted are enclosed and heated within temperature limits specified by manufacturer during application and drying periods.

D. Provide adequate ventilation, including mechanical ventilation, to remove paint odors and fumes from areas of the building where odors might migrate to occupied spaces.

1.07 EXTRA MATERIALS

A. Furnish extra paint materials from the same production run as the materials applied in the quantities described below. Package paint materials in unopened, factory-sealed containers for storage and identify with labels describing contents. Deliver extra materials to area designated by Owner.

   1. Quantity: Furnish the Owner with an additional 5 percent, but not less than 1 gal. or 1 case, as appropriate, of each material and color applied.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide one of the products in the paint schedules, or an approved equal product of another acceptable manufacturer.
B. Manufacturers Names: The following manufacturers are referred to in the paint schedules by use of shortened versions of their names, which are shown in parentheses:

2. M. A. Bruder & Sons (MAB).
3. Duron, Inc. (Duron)
4. Finnaren & Haley (F&H).
6. PPG Industries, Inc. (PPG).

2.02 PAINT MATERIALS, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. VOC Content of Field-Applied Interior Paints and Coatings: Provide products that comply with the following limits for VOC content, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24); these requirements do not apply to paints and coatings that are applied in a fabrication or finishing shop:

1. Flat Paints, Coatings, and Primers: VOC content of not more than 50 g/L.
2. Nonflat Paints, Coatings, and Primers: VOC content of not more than 150 g/L.
3. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: VOC not more than 250 g/L.
4. Floor Coatings: VOC not more than 100 g/L.

C. Material Quality: Provide manufacturer’s best-quality paint material of the various coating types specified. Paint-material containers not displaying manufacturer's product identification will not be acceptable.

1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

D. Colors: Provide color selections made by the Architect from manufacturer's full range of available colors. Where directed, provide custom colors of the finished paint systems to match the Architect's samples.

2.03 EPOXY FLOOR COATING WITH SLIP-RESISTANT FINISH

A. Aggregate: Walnut shell granules of particle sizes, shape, and minimum hardness recommended in writing by traffic coating manufacturer.

1. Spreading Rate: As recommended by manufacturer for substrate and service conditions indicated, but not less than required to achieve slip-resistant finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with the Applicator present, under which painting will be performed for compliance with paint application requirements.
1. Do not begin to apply paint until unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.

2. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.

1. Notify the Architect about anticipated problems using the materials specified over substrates primed by others.

3.02 PREPARATION

A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of the size or weight of the item, provide surface-applied protection before surface preparation and painting.

1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.

B. Preparing Previously Painted Wood Surfaces: Remove existing paint from wood surfaces using scrapers or chemical paint stripper as follows:

1. Strip loose, chipped, alligatored or otherwise deteriorated paint using methods that will not damage existing woodwork.
2. Remove paint to sound substrate. Sound, well-adhered paint may remain on surface.
3. Allow surfaces to dry and sand smooth.
4. Clean surfaces so they are free of dust and dirt.
5. Fill cracks, gouges and nail holes with wood filler prior to application of first coat.
6. Complete surface preparation to produce a smooth, uniform substrate suitable for application of primer and finish coats specified.

C. Preparing Previously Painted Metal Surfaces: Remove existing paint from ferrous metal surfaces as follows:

1. Scrape to remove paint, exercising care not to damage metalwork.
2. Following paint stripping, rub steel surfaces to remove rust bloom, and solvent clean prior to priming. Ferrous metal surfaces may be rinsed with water.
3. Prior to application of finish materials, clean all surfaces so they are free of dust and dirt.
4. Following initial priming, fill gouges, holes and other surface imperfections with epoxy filler. Spot prime filled areas and allow to dry prior to application of first finish coat.

D. Cleaning: Before applying paint or other surface treatments, clean the substrates of substances that could impair the bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

E. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and reprime.
2. Cementitious Materials: Prepare concrete and masonry surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer’s written instructions.
c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.

3. Wood: Clean surfaces of dirt, oil, and other foreign substances with scrapers, mineral spirits, and sandpaper, as required. Sand surfaces exposed to view smooth and dust off.

a. Scrape and clean small, dry, seasoned knots, and apply a thin coat of white shellac or other recommended knot sealer before applying primer. After priming, fill holes and imperfections in finish surfaces with putty or plastic wood filler. Sand smooth when dried.
b. Prime, stain, or seal wood to be painted immediately on delivery. Prime edges, ends, faces, undersides, and backsides of wood, including cabinets, counters, cases, and paneling.

4. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with the Steel Structures Painting Council’s (SSPC) recommendations.

a. Blast steel surfaces clean as recommended by paint system manufacturer and according to requirements of SSPC-SP 10.
b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturer, and touch up with the same primer as the shop coat.

5. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.

F. Materials Preparation: Mix and prepare paint materials according to manufacturer’s written instructions.

1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.
3. Use only thinners approved by paint manufacturer and only within recommended limits.

G. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of the same material are applied. Tint undercoats to match the color of the finish coat, but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.03 APPLICATION

A. General: Apply paint according to manufacturer’s written instructions. Use applicators and techniques best suited for substrate and type of material being applied.

1. Surface treatments and finishes are indicated in the schedules.
2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
3. Provide finish coats that are compatible with primers used.
4. The term “exposed surfaces” includes areas visible when permanent or built-in fixtures, convector covers, covers for finned-tube radiation, grilles, and similar components are in place. Extend coatings in these areas, as required, to maintain the system integrity and provide desired protection.
5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before the final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
6. Paint interior surfaces of ducts with a flat, nonspecular black paint where visible through registers or grilles.
7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
9. Sand lightly between each succeeding enamel or varnish coat.

B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. The number of coats and the film thickness required are the same regardless of application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer’s written instructions, sand between applications.
2. Omit primer on metal surfaces that have been shop primed and touchup painted.
3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give special attention to ensure edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.
4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, does not deform or feel sticky under moderate thumb pressure, and where application of another coat of paint does not cause the undercoat to lift or lose adhesion.

C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.

1. Brushes: Use brushes best suited for the type of material applied. Use brush of appropriate size for the surface or item being painted.
2. Rollers: Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.
3. Spray Equipment: Use airless spray equipment with orifice size as recommended by the manufacturer for the material and texture required.

D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate. Provide the total dry film thickness of the entire system as recommended by the manufacturer.

E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and in occupied spaces.

F. Mechanical items to be painted by General Contractor to include, but are not limited to, the following:

1. Piping, pipe hangers, and supports.
2. Tanks.
3. Exposed ductwork.
4. Insulation.
5. Supports.
6. Motors and mechanical equipment.
7. Accessory items.
G. Electrical items to be painted include, but are not limited to, the following:

1. Conduit and fittings.
2. Panelboards.

H. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

1. Provide a smooth, uniform finish, appearance, and coverage. Spotting, laps, roller marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

I. Prime Coats: Before applying finish coats, apply a prime coat of material, as recommended by the manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn through or other defects due to insufficient sealing.

J. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.04 FIELD QUALITY CONTROL

A. The Owner reserves the right to invoke the following test procedure at any time and as often as the Owner deems necessary during the period when paint is being applied:

1. The Owner will engage the services of an independent testing agency to sample the paint material being used. Samples of material delivered to the Project will be taken, identified, sealed, and certified in the presence of the Contractor.
2. The testing agency will perform appropriate tests for the following characteristics as required by the Owner:

   a. Quantitative material analysis.
   b. Abrasion resistance.
   c. Apparent reflectivity.
   d. Flexibility.
   e. Washability.
   f. Absorption.
   g. Accelerated weathering.
   h. Dry opacity.
   i. Accelerated yellowness.
   j. Recoating.
   k. Skinning.
   l. Color retention.
   m. Alkali and mildew resistance.

3. The Owner may direct the Contractor to stop painting if test results show material being used does not comply with specified requirements. The Contractor shall remove noncomplying paint from the site, pay for testing, and repaint surfaces previously coated with the rejected paint. If necessary, the Contractor may be required to remove rejected paint from previously painted surfaces if, on repainting with specified paint, the 2 coatings are incompatible.

3.05 CLEANING AND PROTECTION
A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping. Be careful not to scratch or damage adjacent finished surfaces.

B. Protect work of other trades, whether being painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.

C. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others to protect their work after completing painting operations.

1. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.06 EXTERIOR PAINT SCHEDULE

A. General: Provide the finish systems scheduled for each material type indicated, applied at spreading rate recommended by manufacturer to achieve the total dry film thickness (DFT) listed.

1. Provide 2 finish coats over the listed base coats (primer, filler, bond coat) except as otherwise indicated.

B. Exterior Concrete Masonry Units (CMU):

1. Full-Gloss, Acrylic-Enamel Finish:
   
   a. Block Filler: 4.0 mils DFT.

   1) S-W: Heavy-Duty Block Filler B42W46.
   2) Moore: Moorcraft Interior & Exterior Block Filler #173.
   3) PPG: 6-7 Speedhide Interior/Exterior Masonry Latex Block Filler.
   4) MAB: Block Kote #2000.

   b. First and Second Coats: 2.4 mils DFT.

   1) S-W: DTM Acrylic Coating Gloss (Waterborne) B66W100 Series.
   2) Moore: Impervex Enamel #309.
   4) MAB: Rust-O-Lastic Gloss Acrylic Enamel.

C. Exterior Ferrous Metal:

1. Semigloss, Acrylic-Enamel Finish:

   a. Primer: 1.3 mils DFT.

   1) F&H: Corrosion Fighting Primer.
   2) MAB: Rust-O-Lastic Anti-Corrosive Primer.
   4) PPG: 6-208 Speedhide Interior/Exterior Rust Inhibitive Steel Primer.

   b. First and Second Coats: 2.6 mils DFT.

   2) MAB: Sea Shore/Four Seasons Acrylic Trim Enamel.
   3) Moore: MoorGlo Latex House & Trim Paint #096.
D. Exterior Zinc-Coated Metal:

1. Semigloss, Acrylic-Enamel Finish:
   a. Pretreatment Surface Preparation: As recommended by coating manufacturer.
   b. Primer: 1.2 mils DFT.
      1) MAB: Rust-O-Lastic Hydro-Prime II.
      2) Moore: IronClad Galvanized Metal Latex Primer #155.
   c. First and Second Coats: 2.6 mils DFT.
      1) MAB: Sea Shore/Four Seasons Acrylic Trim Enamel.
      2) Moore: MoorGlo Latex House & Trim Paint #096.
      3) PPG: 78 Line Sun-Proof Semi-Gloss Acrylic Latex House and Trim Paint.

3.07 INTERIOR PAINT SCHEDULE

A. General: Provide the finish systems scheduled for each material type indicated, applied at spreading rate recommended by manufacturer to achieve the total dry film thickness (DFT) listed.

1. Provide 2 finish coats over the listed base coats (primer, filler, bond coat) except as otherwise indicated.

B. Interior Concrete; Non-Traffic Surfaces:

1. Water-Reducible Epoxy Coating System:
   a. Primer or Filler: As recommended by coating manufacturer.
   b. First and Second Coats:
      1) S-W: Water Based Catalyzed Epoxy, B70-200 Series; 3.0 mils DFT.
         Semi-Gloss, 051 Line; 2.0 mils DFT.
      2) Duron: Acrylic Epoxy Semi-Gloss, 901 Series; 1.5 mils DFT.
      3) F&H: Water Based 191 Epoxy; 2.0 mils DFT.
      4) MAB: Ply-Tile 530 Water Reducible Acrylic Epoxy

C. Interior Concrete; Traffic Surfaces:

1. Urethane Finish with Slip-Resistant Aggregate Finish: For mechanical room, technology room, and electrical room.
   a. First and Second Coats: water-based urethane.
      1) S-W: Moisture Cured Urethane Pigmented: 2 coats SW ArmorSeal Rexthane1 with non-skid additive.
      2) Color: Architect to select from full range of colors.

2. Epoxy Finish: For storage rooms.
   a. Primer: Latex sealer undercoat.
   b. First Coat: Latex enamel.
   c. Second Coat: Two-component, high build epoxy.
D. Interior Concrete Masonry Units (CMU); Typical Locations:

1. Water-Reducible Epoxy Coating System:
   a. Primer or Filler: As recommended by coating manufacturer.
   b. First and Second Coats:
      1) S-W: Water Based Catalyzed Epoxy, B70-200 Series; 3.0 mils DFT.
      2) Duron: Acrylic Epoxy Semi-Gloss, 901 Series; 1.5 mils DFT.
      3) F&H: Water Based 191 Epoxy; 2.0 mils DFT.
      4) MAB: Ply-Tile 530 Water Reducible Acrylic Epoxy Semi-Gloss, 051 Line; 2.0 mils DFT.

E. Interior Concrete Masonry Units (CMU); Mechanical, Service and Storage Areas:

1. High-Performance, Polyamide-Epoxy Coating System: Total system thickness not less than 4 mils DFT.
   a. Filler Coat:
      1) S-W: KEM Cati-Coat Epoxy Filler/Sealer #B42WA8-Part A; #B42WA9-Part B.
      3) MAB: Block-Kote #2000.
   b. First and Second Coats:
      2) Moore: Ironclad Chemical and Water Resistant Epoxy Enamel 182.
      3) PPG: 97-1 Series Aquapon Polyamide-Epoxy.
      4) MAB: Ply-Tile 520 HB.

F. Interior Gypsum Board:

1. Water-Reducible Epoxy Coating System:
   a. Primer:
      1) S-W: PrepRite 200 Latex Primer; 1.4 mils DFT.
      2) Duron: Acrylic Enamel Undercoater, 04-123; 1.6 mils DFT.
      3) F&H: TCD Acrylic Primer Sealer; 1.5 mils DFT.
      4) MAB: Rich Lux Latex Sealer Undercoater 037-154; 1.5 mils DFT.
   b. First and Second Coats:
      1) S-W: Water Based Catalyzed Epoxy, B70-200 Series; 3.0 mils DFT.
      2) Duron: Acrylic Epoxy Semi-Gloss, 901 Series; 1.5 mils DFT.
      3) F&H: Water Based 191 Epoxy; 2.0 mils DFT.
      4) MAB: Ply-Tile 530 Water Reducible Acrylic Epoxy Semi-Gloss, 051 Line; 2.0 mils DFT.

G. Interior Woodwork: Including wood doors and trim.

1. Semigloss, Acrylic-Enamel, Low-VOC Finish:
   a. Primer: 0.8 mil DFT.
      1) S-W: Harmony Low Odor Interior Latex Primer.
      2) Duron: Terminator 2 Water Based Primer/Sealer.
3) Moore: Pristine Eco Spec Interior Latex Primer Sealer 231.
4) MAB: Enviro-Pure Primer.

b. First and Second Coats: 2.8 mils DFT.

1) S-W: Harmony Low Odor Interior Latex Semigloss.
4) MAB: Enviro-Pure Latex Semi-Gloss, 047 line.

H. Interior Ferrous Metal:

1. Semigloss, Acrylic-Enamel, Low-VOC Finish:

   a. Primer: 0.8 mil DFT.

   1) S-W: Procryl Universal Water Based Primer.
   2) Duron: Terminator 2 Water Based Primer/Sealer.
   4) MAB: Rich Lux Latex Sealer Undercoater.

   b. First and Second Coats: 2.8 mils DFT.

   1) S-W: Harmony Low Odor Interior Latex Semigloss.
   4) MAB: Enviro-Pure Latex Semi-Gloss Enamel, 047 line.

END OF SECTION
SECTION 10160
TOILET COMPARTMENTS

PART 1 GENERAL

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

1.02 SUMMARY
   A. Section Includes: Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.
   B. Related Sections:
      1. Section 10800 "Toilet Accessories"

1.03 SUBMITTALS
   A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
   B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
      1. Show locations of cutouts for compartment-mounted toilet accessories.
      2. Show locations of centerlines of toilet fixtures.
   C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.
   D. Samples for Verification: For the following products, in manufacturer's standard sizes unless otherwise indicated:
      1. Each type of material, color, and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
      2. Each type of hardware and accessory.
   E. Product Certificates: For each type of toilet compartment, from manufacturer.
   F. Maintenance Data: For toilet compartments to include in maintenance manuals.

1.04 QUALITY ASSURANCE
   A. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board’s "Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities" and ICC/ANSI A117.1 for toilet compartments designated as accessible.
1.05 PROJECT CONDITIONS

A. Field Measurements: Verify actual locations of toilet fixtures, walls, columns, ceilings, and other construction contiguous with toilet compartments by field measurements before fabrication.

PART 2 PRODUCTS

2.01 MATERIALS

A. Stainless-Steel Castings: ASTM A 743/A 743M.

2.02 SOLID-POLYMER UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Accurate Partitions Corporation.
2. Ampco, Inc.
4. Santana Products, Inc.

B. Toilet-Enclosure Style: Overhead braced.

C. Urinal-Screen Style: Wall hung.

D. Door, Panel, Screen, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.

1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
2. Heat-Sink Strip: Manufacturer's standard continuous, stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
3. Color and Pattern: One color and pattern in each room, unless otherwise indicated, as selected by Architect from manufacturer's full range.

E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.

F. Brackets (Fittings): Stirrup type; ear or U-brackets; stainless steel.

2.03 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.

3. Latch and Keeper: Manufacturer's standard latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.
C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.04 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.

PART 3 EXECUTION

3.01 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:
   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.02 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION
SECTION 10400
IDENTIFYING DEVICES

PART 1 GENERAL

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

1.02 SUMMARY
  A. Section Includes:
     1. Dimensional characters for exterior building identification signage.
     2. Interior panel signs.

1.03 DEFINITIONS

1.04 SUBMITTALS
  A. Product Data: For each type of product indicated.
  B. Shop Drawings: Show fabrication and installation details for signs.
     1. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
     2. Provide message list, typestyles, graphic elements, including tactile characters and Braille, and layout for each sign.
  C. Samples for Initial Selection: Manufacturer's color charts consisting of actual units or sections of units showing the full range of colors available for plastic holders and sign inserts.
  D. Samples for Verification: For the full range of color, texture, and sign material indicated, of sizes indicated:
     1. Aluminum for Dimensional Characters: For finish and color indicated, on squares of sheet at least 4 by 4 inches.
     2. Panel Sign: Not less than 12 inches square including frame.
  E. Sign Schedule: Use same designations indicated on Drawings.
  F. Maintenance Data: For signs to include in maintenance manuals.

1.05 QUALITY ASSURANCE
  A. Source Limitations for Signs: Obtain panel signs from one source from a single manufacturer.
PART 2 PRODUCTS

2.01 MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated, and with at least the strength and durability properties of Alloy 5005-H32.

2.02 DIMENSIONAL CHARACTERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide products of Metal Designs, LLC (www.metaldesignslc.com), or a comparable product by one of the following:

1. Shiner Sign Products.
2. Woodland Manufacturing.

B. Cutout Characters: Provide characters with square-cut, smooth edges, waterjet cut to produce inside radiuses not more than 0.02 inch. Comply with the following requirements:

1. Stainless Steel type 316: 0.50 inch thick.
   a. Color: TBD from full range of custom and standard colors.
3. Dimensional Character Characteristics:
   a. Font: TBD; provide font types for selection by Architect.
   b. Character Size: 8 inches high.
   c. Text/Message: As indicated on Drawings.

2.03 PANEL SIGNS

A. Basis-of-Design Product: Subject to compliance with requirements, provide APCO Graphics, Inc., Atlanta GA (404-688-9000, www.apcosigns.com); SignMatch, or a comparable product by one of the following:

1. Best Sign Systems Inc.

B. Interior Panel Signs: Provide smooth sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner, complying with the following requirements:

1. Sign Holder: Integrally colored, injection molded high-impact UV-resistant plastic alloy.
2. Sign Inserts: Melamine plastic laminate with raised graphics and Braille.
3. Edge Condition: Square cut.
5. Colors: As selected by Architect from manufacturer's full range.
6. Tactile Characters: Characters and Grade 2 Braille raised 1/32 inch above surface with contrasting colors.

C. Changeable Message Inserts: Fabricate signs to allow insertion of changeable messages in the form of transparent covers with paper inserts printed by Owner.

D. Tactile and Braille Sign Copy: Manufacturer's standard process for producing text and symbols complying with ADA-ABA Accessibility Guidelines and with ICC/ANSI A117.1. Text shall be
accompanied by Grade 2 Braille. Produce precisely formed characters with square-cut edges free from burrs and cut marks; Braille dots with domed or rounded shape.

1. Raised-Copy Thickness: Not less than 1/32 inch.

2.04 FINISHES, GENERAL

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.05 ALUMINUM FINISHES

A. Color Anodic Finish: Manufacturer's standard Class 1 integrally colored or electrolytically deposited color anodic coating, 0.018 mm or thicker, in medium bronze applied over manufacturer's standard mechanical finish, complying with AAMA 611.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of work.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Locate signs and accessories where indicated, using mounting methods of types described and complying with manufacturer's written instructions.

1. Install signs level, plumb, and at heights indicated, with sign surfaces free of distortion and other defects in appearance.

2. Interior Wall Signs: Install signs on walls adjacent to latch side of door where applicable. Where not indicated or possible, such as double doors, install signs on nearest adjacent walls. Locate to allow approach within 3 inches of sign without encountering protruding objects or standing within swing of door.

B. Wall-Mounted Signs: Comply with sign manufacturer's written instructions except where more stringent requirements apply.

1. Mechanical Fasteners: Use non-removable mechanical fasteners placed through predrilled holes in frame. Attach sign frames with fasteners and anchors suitable for secure attachment to substrate as recommended in writing by sign manufacturer.

2. Two-Face Tape: Mount sign insert panels to frame.

C. Dimensional Characters: Mount characters using standard fastening methods to comply with manufacturer's written instructions for character form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish character spacing and to locate holes for fasteners.
1. Projected Mounting: Mount characters at projection distance of 1/2 inch from wall surface.

3.03 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to manufacturer's written instructions. Protect signs from damage until acceptance by Owner.

END OF SECTION
SECTION 10415
BULLETIN BOARDS

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Tackboards.
   2. Enclosed Tackboards

1.03 DEFINITIONS
A. Tackboard: Framed, tackable, visual display board assembly.

1.04 SUBMITTALS
A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for visual display surfaces.
B. Shop Drawings: For visual display surfaces. Include plans, elevations, sections, details, and attachments to other work.
   1. Include sections of typical trim members.
C. Samples for Initial Selection: For each type of visual display surface indicated, for units with factory-applied color finishes, and as follows:
   1. Actual sections of porcelain-enamel face sheet.
   2. Include accessory Samples to verify color selected.
D. Samples for Verification: For each type of visual display surface indicated.
   1. Visual Display Surface: Not less than 8-1/2 by 11 inches, mounted on substrate indicated for final Work. Include one panel for each type, color, and texture required.
   2. Trim: 6-inch-long sections of each trim profile.
   3. Accessories: Full-size Sample of each type of accessory.
E. Product Schedule: For visual display surfaces. Use same designations indicated on Drawings.
F. Maintenance Data: For visual display surfaces to include in maintenance manuals.

1.05 QUALITY ASSURANCE
A. Source Limitations: Obtain visual display surfaces from single source from single manufacturer.
1.06 PRODUCT HANDLING

A. Deliver factory-built visual display surfaces, including factory-applied trim where indicated, completely assembled in one piece without joints, where possible. If dimensions exceed maximum manufactured panel size, provide two or more pieces of equal length as acceptable to Architect. When overall dimensions require delivery in separate units, prefabricate components at the factory, disassemble for delivery, and make final joints at the site.

B. Store bulletin boards vertically with packing materials between each unit.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install visual display surfaces 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 occupancy levels during the remainder of the construction period.

1.08 WARRANTY

A. Warranty: Manufacturer's standard form.

1. Warranty Period: 5 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS, GENERAL

A. Natural Cork Sheet: Seamless, single-layer, compressed fine-grain cork sheet; bulletin board quality; face sanded for natural finish with surface-burning characteristics indicated.

   Particleboard: ANSI A208.1, Grade M-1, made with binder containing no urea formaldehyde.

B. Fiberboard: ASTM C 208, made with binder containing no urea formaldehyde.

C. Extruded Aluminum: ASTM B 221, Alloy 6063.

2.02 TACKBOARD ASSEMBLIES

1. Basis-of-Design Product: Subject to compliance with requirements, provide Claridge Products and Equipment, Inc.; Series 1, or comparable product by one of the following:

   b. PolyVision Corporation; a Steelcase company.

A. Natural-Cork Tackboard: 1/4-inch-thick, natural cork sheet factory laminated to 1/4-inch-thick particleboard backing.


B. Size: 6'-0" x 4'-0"

C. Location and Type: Tack board (TB) and Glass Enclosed Tack Board (GTB) [Bulletin Board Cabinet], as noted on drawings.

D. Mounting Height: Bottom at 3'-0" above finished floor unless noted otherwise.
F. Type: Tack board (TB) and Glass Enclosed Tack Board (GTB) [Bulletin Board Cabinet]

2.03 FABRICATION

A. Porcelain-Enamel Visual Display Assemblies: Laminate porcelain-enamel face sheet and backing sheet to core material under heat and pressure with manufacturer's standard flexible, waterproof adhesive.

B. Bulletin Boards: Factory assemble boards unless otherwise indicated.
1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display boards at manufacturer's factory before shipment.

C. Aluminum Frames and Trim: Fabricate units straight and of single lengths, keeping joints to a minimum. Miter corners to a neat, hairline closure.
1. Where factory-applied trim is indicated, trim shall be assembled and attached to visual display units at manufacturer's factory before shipment.

2.04 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.05 ALUMINUM FINISHES

A. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, surface conditions of wall, and other conditions affecting performance of the Work.

B. Examine walls and partitions for proper preparation and backing for visual display surfaces.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Comply with manufacturer's written instructions for surface preparation.

B. Clean substrates of substances that could impair the performance of and affect the smooth, finished surfaces of visual display boards, including dirt, mold, and mildew.

C. Prepare surfaces to achieve a smooth, dry, clean surface free of flaking, unsound coatings, cracks, defects, projections, depressions, and substances that will impair bond between visual display surfaces and wall surfaces.
3.03 INSTALLATION

A. General: Install visual display surfaces in locations and at mounting heights indicated on Drawings, or if not indicated, at heights as directed by Architect. Keep perimeter lines straight, level, and plumb. Provide grounds, clips, backing materials, adhesives, brackets, anchors, trim, and accessories necessary for complete installation.

B. Bulletin Boards: Attach concealed clips, hangers, and grounds to wall surfaces and to visual display boards with fasteners at not more than 16 inches o.c. Secure both top and bottom of boards to walls.

3.04 CLEANING AND PROTECTION

A. Clean Bulletin Boards surfaces according to manufacturer's written instructions. Attach one cleaning label to visual display surface in each room.

B. Cover and protect visual display surfaces after installation and cleaning.

END OF SECTION
SECTION 10505
METAL LOCKERS

PART 1 GENERAL

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

1.02 SUMMARY
A. Section Includes: Heavy-duty metal lockers.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of metal locker.
B. Shop Drawings: For metal lockers. Include plans, elevations, sections, details, and attachments to other work.
   1. Show locker trim and accessories.
C. Samples for Initial Selection: For units with factory-applied color finishes.
D. Samples for Verification: For metal lockers, in manufacturer’s standard sizes.
E. Maintenance Data: For adjusting, repairing, and replacing locker doors and latching mechanisms to include in maintenance manuals.
F. Warranty: Sample of special warranty.

1.04 QUALITY ASSURANCE
A. Installer Qualifications: Manufacturer’s authorized representative who is trained and approved for installation of units required for this Project.
B. Source Limitations: Obtain metal lockers and accessories from single source from single manufacturer.

1.05 PRODUCT HANDLING
A. Do not deliver metal lockers until spaces to receive them are clean, dry, and ready for their installation.

1.06 PROJECT CONDITIONS
A. Field Measurements: Verify actual dimensions of recessed openings by field measurements before fabrication.
1.07  COORDINATION

A. Coordinate sizes and locations of framing, blocking, furring, reinforcements, and other related units of work specified in other Sections to ensure that metal lockers can be supported and installed as indicated.

1.08  WARRANTY

A. Special Warranty: Manufacturer’s standard form in which manufacturer agrees to repair or replace components of metal lockers that fail in materials or workmanship, excluding finish, within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures.
   b. Faulty operation of latches and other door hardware.

2. Damage from deliberate destruction and vandalism is excluded.

3. Warranty Period: 10 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01  MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B, suitable for exposed applications.

B. Fasteners: Zinc- or nickel-plated steel, slotless-type, exposed bolt heads; with self-locking nuts or lock washers for nuts on moving parts.

C. Anchors: Material, type, and size required for secure anchorage to each substrate.

   1. Provide nonferrous-metal or hot-dip galvanized anchors and inserts on inside face of exterior walls, and elsewhere as indicated, for corrosion resistance.
   2. Provide toothed-steel or lead expansion sleeves for drilled-in-place anchors.

2.02  HEAVY-DUTY METAL LOCKERS

A. Products: Subject to compliance with requirements, provide one of the following:

   2. Lyon Workspace Products, LLC; All-Welded Lockers.
   3. Penco Products, Inc.; All-Welded Lockers.

B. Locker Arrangement for Five tier box Lockers:

   1. Size: Lockers shall be 15” wide x 15” deep x 5’-0” tall nominal.

C. Material: Cold-rolled steel sheet.

D. Body: Assembled by welding body components together. Fabricate from unperforated steel sheet with thicknesses as follows:

   1. Tops, Bottoms, and Sides: 0.060-inch nominal thickness.
   2. Backs: 0.048-inch nominal thickness.
   3. Shelves: 0.060-inch nominal thickness, with double bend at front and single bend at sides and back.
E. Frames: Channel formed; fabricated from 0.060-inch nominal-thickness steel sheet; lapped and factory welded at corners; with top and bottom main frames factory welded into vertical main frames. Form continuous, integral door strike full height on vertical main frames.

1. Cross Frames between Tiers: Channel formed and fabricated from same material as main frames; welded to vertical main frames.

F. Doors: One piece; fabricated from 0.075-inch nominal-thickness steel sheet; formed into channel shape with double bend at vertical edges and with right-angle single bend at horizontal edges.

1. Reinforcement: Manufacturer's standard reinforcing angles, channels, or stiffeners for doors more than 15 inches wide; welded to inner face of doors.
2. Door Style: Louvered vents; no fewer than six louver openings at top and bottom for single-tier and three louver openings at top and bottom for double-tier lockers.

G. Hinges: Welded to door and attached to door frame with no fewer than two factory-installed rivets per hinge that are completely concealed and tamper resistant when door is closed; fabricated to swing 180 degrees.

1. Continuous Hinges: Manufacturer's standard, steel, full height.

H. Recessed Door Handle and Latch: Stainless-steel cup with integral door pull, recessed so locking device does not protrude beyond face of door; pry and vandal resistant.

1. Single-Point Latching: Nonmoving latch hook with steel padlock loop that projects through recessed cup and is finished to match metal locker body.
   a. Latch Hook: Equip each door with one latch hook, fabricated from 0.120-inch nominal-thickness steel sheet; welded midway up full-height door strike; with resilient silencer.

I. Equipment: Equip each metal locker with identification plate and the following unless otherwise indicated:

1. Single-Tier Units: Shelf, one double-prong ceiling hook, and two single-prong wall hooks.
2. Double-Tier Units: One double-prong ceiling hook and two single-prong wall hooks.

J. Accessories:

1. Continuous Zee Base: Fabricated from, manufacturer's standard thickness, but not less than 0.060-inch nominal-thickness steel sheet.
   a. Height: 4 inches.

2. Continuous Sloping Tops for Staff Lockers: Fabricated from 0.048-inch nominal-thickness steel sheet, with a pitch of approximately 20 degrees.
   a. Closures: Vertical-end type.

3. Recess Trim: Fabricated from 0.048-inch nominal-thickness steel sheet.
4. Filler Panels: Fabricated from 0.048-inch nominal-thickness steel sheet.

K. Finish: Baked enamel or powder coat.

1. Colors: As selected by Architect from manufacturer's full range.

2.03 FABRICATION

A. Fabricate metal lockers square, rigid, and without warp and with metal faces flat and free of dents or distortion. Make exposed metal edges safe to touch and free of sharp edges and burrs.
1. Form body panels, doors, shelves, and accessories from one-piece steel sheet unless otherwise indicated.
2. Provide fasteners, filler plates, supports, clips, and closures as required for complete installation.

B. Fabricate each metal locker with an individual door and frame; individual top, bottom, and back; and common intermediate uprights separating compartments. Factory weld frame members of each metal locker together to form a rigid, one-piece assembly.

C. All-Welded Construction: Factory preassemble metal lockers by welding all joints, seams, and connections; with no bolts, nuts, screws, or rivets used in assembly of main locker groups. Factory weld main locker groups into one-piece structures. Grind exposed welds flush.

D. Hooks: Manufacturer's standard ball-pointed type, aluminum or steel; zinc plated.

E. Identification Plates: Manufacturer's standard, etched, embossed, or stamped aluminum or plastic plates, with numbers and letters at least 3/8 inch high.

F. Continuous Base: Formed into channel or zee profile for stiffness, and fabricated in lengths as long as practical to enclose base and base ends of metal lockers; finished to match lockers.

G. Continuous Sloping Tops: Fabricated in lengths as long as practical, without visible fasteners at splice locations; finished to match lockers.

1. Sloping-top corner fillers, mitered.

H. Recess Trim: Fabricated with minimum 2-1/2-inch face width and in lengths as long as practical; finished to match lockers.

I. Filler Panels: Fabricated in an unequal leg angle shape; finished to match lockers. Provide slip-joint filler angle formed to receive filler panel.

J. Finished End Panels: Designed for concealing unused penetrations and fasteners, except for perimeter fasteners, at exposed ends of nonrecessed metal lockers; finished to match lockers.

1. Provide one-piece panels for double-row (back-to-back) locker ends.

2.04 STEEL SHEET FINISHES

A. Factory finish steel surfaces and accessories except stainless-steel and chrome-plated surfaces.

B. Baked-Enamel Finish: Immediately after cleaning, pretreating, and phosphatizing, apply manufacturer's standard thermosetting baked-enamel finish. Comply with paint manufacturer's written instructions for application, baking, and minimum dry film thickness.

C. Powder-Coat Finish: Immediately after cleaning and pretreating, electrostatically apply manufacturer's standard, baked-polymer, thermosetting powder finish. Comply with resin manufacturer's written instructions for application, baking, and minimum dry film thickness.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install level, plumb, and true; shim as required, using concealed shims.

1. Anchor locker runs at ends and at intervals recommended by manufacturer, but not more than 36 inches o.c. Using concealed fasteners, install anchors through backup reinforcing plates, channels, or blocking as required to prevent metal distortion.

2. Anchor single rows of metal lockers to walls near top of lockers, and bottom of lockers or to floor.

B. All-Welded Metal Lockers: Connect groups together with standard fasteners, with no exposed fasteners on face frames.

C. Equipment and Accessories: Fit exposed connections of trim, fillers, and closures accurately together to form tight, hairline joints, with concealed fasteners and splice plates.

1. Attach hooks with at least two fasteners.

2. Identification Plates: Identify metal lockers with identification indicated on Drawings.

   a. Attach plates to each locker door, near top, centered, with at least two aluminum rivets.

3. Attach recess trim to recessed metal lockers with concealed clips.

4. Attach filler panels with concealed fasteners. Locate filler panels where indicated on Drawings.

5. Attach sloping-top units to metal lockers, with closures at exposed ends.

6. Attach finished end panels with fasteners only at perimeter to conceal exposed ends of nonrecessed metal lockers.

3.03 ADJUSTING, CLEANING, AND PROTECTION

A. Clean, lubricate, and adjust hardware. Adjust doors and latches to operate easily without binding.

B. Protect metal lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

C. Touch up marred finishes, or replace metal lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION
SECTION 10522

FIRE EXTINGUISHER CABINET

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes: Fire protection cabinets for the following:

1. Portable fire extinguishers.

B. Related Sections:

1. Section 10523 "Fire Extinguishers."

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fire protection cabinets.

1. Fire Protection Cabinets: Include roughing-in dimensions, details showing mounting methods, relationships of box and trim to surrounding construction, door hardware, cabinet type, trim style, and panel style.

B. Shop Drawings: For fire protection cabinets. Include plans, elevations, sections, details, and attachments to other work.

C. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below:

1. Size: 6 by 6 inches square.

D. Maintenance Data: For fire protection cabinets to include in maintenance manuals.

1.04 COORDINATION

A. Coordinate size of fire protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.

B. Coordinate sizes and locations of fire protection cabinets with wall depths.

PART 2 PRODUCTS

2.01 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.

B. Acrylic Bubble: One piece.
2.02 FIRE PROTECTION CABINET

A. Cabinet Type: Suitable for fire extinguisher.
   1. Basis-of-Design Products: Subject to compliance with requirements, provide J. L. Industries, Inc.; Clear Vu, models as follows for applications indicated:
   2. Comparable Products: Subject to compliance with requirements, provide the basis-of-design products or comparable products by one of the following:
      a. Larsen's Manufacturing Company.
      b. Nystrom Building Products.

B. Cabinet Material: Steel sheet.

C. Recessed Cabinet: Cabinet box recessed in walls of sufficient depth to suit style of trim indicated.
   1. Exposed Flat Trim: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).

D. Cabinet Door and Trim Material: Steel sheet.

E. Door Style: Full bubble with frame.

F. Door Glazing: Molded acrylic bubble.
   1. Acrylic Bubble Color: Clear, transparent.

G. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide manufacturer's standard hinge permitting door to open 180 degrees.

H. Accessories:
   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Door Lock: Cam lock that allows door to be opened during emergency by pulling sharply on door handle.
   3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated, or if not indicated, as directed by Architect
      b. Identify fire extinguisher in fire protection cabinet with the words "FIRE EXTINGUISHER."
         1) Location: Applied to cabinet.
         2) Application Process: Decals.
         3) Lettering Color: Red.
         4) Orientation: Horizontal.
I. Finishes: Manufacturer's standard baked-enamel paint for the following:
   1. Exterior of cabinet door and trim.
   2. Interior of cabinet and door.

2.03 FABRICATION

A. Fire Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.
   1. Weld joints and grind smooth.
   2. Provide factory-drilled mounting holes.
   3. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles selected.
   1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
   2. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.04 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish fire protection cabinets after assembly.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.05 STEEL FINISHES

A. Surface Preparation: Remove mill scale and rust, if present, from uncoated steel, complying with SSPC-SP 5/NACE No. 1, "White Metal Blast Cleaning" or SSPC-SP 8, "Pickling." After cleaning, apply a conversion coating suited to the organic coating to be applied over it.

B. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat. Comply with coating manufacturer's written instructions for applying and baking to achieve a minimum dry film thickness of 2 mils.
   1. Color and Gloss: Manufacturer's standard white.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

B. Proceed with installation only after unsatisfactory conditions have been corrected.
3.02 PREPARATION
A. Prepare recesses for semirecessed fire protection cabinets as required by type and size of cabinet and trim style.

3.03 INSTALLATION
A. General: Install fire protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights acceptable to authorities having jurisdiction.

B. Fire Protection Cabinets: Fasten cabinets to structure, square and plumb.
   1. Fasten mounting brackets to inside surface of fire protection cabinets, square and plumb.

3.04 ADJUSTING AND CLEANING
A. Remove temporary protective coverings and strippable films, if any, as fire protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire protection cabinet and mounting bracket manufacturers.

E. Replace fire protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION
SECTION 10523

FIRE EXTINGUISHERS

PART 1  GENERAL

1.01  RELATED DOCUMENTS

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

1.02  SUMMARY

A. Section Includes:
   1. Portable, hand-carried fire extinguishers.
   2. Mounting brackets for fire extinguishers.

B. Related Sections:
   1. Section 10522 "Fire Extinguisher Cabinet"

1.03  SUBMITTALS

A. Product Data: For each type of product indicated. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.

B. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.04  QUALITY ASSURANCE

A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."

B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

   1. Provide fire extinguishers approved, listed, and labeled by FMG.

1.05  COORDINATION

A. Coordinate type and capacity of fire extinguishers with fire protection cabinets to ensure fit and function.

PART 2  PRODUCTS

2.01  PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

A. Fire Extinguishers: Type, size, and capacity for each fire protection cabinet and mounting bracket indicated.

   1. Basis-of-Design Products: Subject to compliance with requirements, provide J. L. Industries, Inc.; models as follows for applications indicated:

      a.  2-1/2-lb Capacity Extinguisher: Model FG10.
      b.  5-lb Capacity Extinguisher: Model FG20.
2. Comparable Products: Subject to compliance with requirements, provide the basis-of-design products or comparable products by one of the following:
   a. Larsen's Manufacturing Company.
   b. Nystrom Building Products.


5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B.

B. Multipurpose Dry-Chemical Type in Steel Container: UL-rated, with monoammonium phosphate-based dry chemical in enameled-steel container, with rating and capacity as follows at locations indicated:
   1. 1-A:10-B:C, 2.5-lb nominal capacity.
   2. 2-A:10-B:C, 5-lb nominal capacity.

2.02 MOUNTING BRACKETS

A. Mounting Brackets: Manufacturer's standard galvanized steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or red baked-enamel finish.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine fire extinguishers for proper charging and tagging.
   1. Remove and replace damaged, defective, or undercharged fire extinguishers.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
   1. Mounting Brackets: 54 inches above finished floor to top of fire extinguisher.

B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.

END OF SECTION
SECTION 10670

STORAGE SHELVING

PART 1 GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:

1. Wire-type, four-post metal storage shelving.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, construction details, material descriptions, dimensions of individual components and profiles, and finishes for metal storage shelving.

B. Product Schedule: For metal storage shelving.

C. Maintenance Data: For metal storage shelving to include in maintenance manuals.

1.04 QUALITY ASSURANCE

A. Source Limitations: Obtain metal storage shelving from single source from single manufacturer.

1.05 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install metal storage shelving until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.06 COORDINATION

A. Coordinate sizes and locations of blocking and backing required for installation of metal storage shelving attached to wall assemblies.

PART 2 PRODUCTS

2.01 MATERIALS

A. Steel Tubing: ASTM A 513, Type 2.

B. Steel Wire: ASTM A 899.

C. Wall Anchors: Manufacturer's standard, galvanized-steel anchors designed to secure metal storage shelving to adjacent wall. Provide one per shelving unit for each shelving unit adjacent to a wall unless additional anchors are indicated in calculations.
2.02 METAL STORAGE SHELVING

A. Wire-Type, Four-Post Metal Storage Shelving: Factory-formed, field-assembled, freestanding system without back or end panels, designed for shelves to span between and be supported by corner posts, with shelves adjustable over the entire height of shelving unit. Fabricate initial shelving unit with a post at each corner. Fabricate additional shelving units similarly, so each unit is independent. Provide fixed top and bottom shelves, adjustable intermediate shelves, and accessories indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide InterMetro Industries Corporation; Super Adjustable Super Erecta Shelving, or comparable product by one of the following:
   a. Lyon Workspace Products, LLC.
   b. Safco Products; a division of LDI.

2. Load-Carrying Capacity per Shelf: 800 lb.
3. Posts: Fabricated from 1-inch-OD, round tubing of indicated material; with grooves or notches at 1 inch o.c. to receive shelf-to-post connectors. Label posts with numbers at not less than 2 inches o.c. for determining shelf height.
   a. Post Material: Steel.
   b. Post Base: Bolt leveler.
   c. Post Cap: Nylon or plastic.

4. Framed-Type Wire Shelves: Steel wire-over-wire construction, with shelf frame fabricated from same material and with same finish as posts; with manufacturer's standard post collar, designed to engage collet (wedge), welded at each corner.
5. Shelf Quantity: Four shelves per shelving unit in addition to top and bottom shelf.
6. Shelf-to-Post Connectors: Manufacturer's standard one-piece collet (wedge), designed to engage post collar attached to shelves.
7. Bracing: Manufacturer's standard diagonal cross bracing, as required for stability, load-carrying capacity of shelves, and number of shelves.
8. Overall Unit Width: 48 inches.
9. Overall Unit Depth: 24 inches.
10. Overall Unit Height: 86 inches.
11. Steel Finish: Manufacturer's standard chrome plated.

B. Wire-Type, Wall-Mounted Metal Storage Shelving: Factory-formed, field-assembled system without back or end panels, designed for shelves to span between and be supported by end supports. Provide fixed top and bottom shelves, and accessories indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, provide InterMetro Industries Corporation; Regular Erecta Shelving, Cat. No. 12WS12C Wall Kit, or comparable product by one of the following:
   a. Lyon Workspace Products, LLC.
   b. Safco Products; a division of LDI.

2. Supports: Steel, fabricated for wall mounting and to receive shelf-to-post connectors.
3. Framed-Type Wire Shelves: Steel wire-over-wire construction, with shelf frame fabricated from same material and with same finish as supports; designed to engage supports.
4. Shelves: Top and bottom shelf, 24-inch nominal length.
5. Overall Unit Length: 26-1/4 inches.
6. Overall Unit Depth: 13 inches.
7. Overall Unit Height: 21 inches.
8. Steel Finish: Manufacturer's standard chrome plated.
2.03 FABRICATION

A. Shop Fabrication: Prefabricate shelving components in shop to greatest extent possible to minimize field fabrication; temporarily preassemble shelving components where necessary to ensure that field-assembled components fit together properly. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Fabricate metal storage shelving square and rigid, with posts or supports plumb and true and shelves flat and free of dents or distortion. Fabricate connections to form a rigid structure, free of buckling and warping.

1. Form exposed work true to line and level with accurate angles and surfaces and straight sharp edges.
2. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Locate joints where least conspicuous.
3. Build in straps, plates, brackets, and other reinforcements as needed to support shelf loading.
4. Cut, reinforce, drill, and tap metal fabrications to receive hardware, fasteners, and similar items.

C. Form metal in maximum lengths to minimize joints. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing the Work.

2.04 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine floors for suitable conditions where metal storage shelving will be installed.

C. Examine walls to which metal storage shelving will be attached for properly located blocking, grounds, or other solid backing for attachment of support fasteners.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PREPARATION

A. Vacuum finished floor and wet mop resilient flooring over which metal storage shelving is to be installed.

3.03 INSTALLATION

A. Install metal storage shelving level, plumb, square, rigid, true, and with shelves flat and free of dents or distortion. Make connections to form a rigid structure, free of buckling and warping.
1. Install exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible.
2. Install braces, straps, plates, brackets, and other reinforcements as needed to support shelf loading and as required for stability.
3. Adjust post-base bolt leveler to achieve level and plumb installation.
4. Anchor shelving units to wall with wall anchors.
5. Connect side-to-side shelving units together.
6. Install shelves in each shelving unit at spacing indicated on Drawings or, if not indicated, at equal spacing.
   a. Four-Post Metal Storage Shelving: Install four clips, one at each post, for support of each shelf; with clips fully engaged in post perforations.

3.04 **ERECITION TOLERANCES**
   A. Erect four-post metal storage shelving to a maximum tolerance from vertical of 1/2 inch in up to 10 feet of height, not exceeding 1 inch for heights taller than 10 feet.

3.05 **ADJUSTING**
   A. Adjust metal storage shelving so that connectors and other components engage accurately and securely.
   B. Replace metal storage shelving that has been damaged or has deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**END OF SECTION**
SECTION 10800

TOILET ACCESSORIES

PART 1  GENERAL

1.01  RELATED DOCUMENTS

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

1.02  SUMMARY

A. Section Includes:
   1. Public-use washroom accessories.
   2. Private-use bathroom accessories.
   3. Custodial accessories.

1.03  SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:
   1. Construction details and dimensions.
   2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
   3. Material and finish descriptions.
   4. Features that will be included for Project.
   5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.
   1. Identify locations using room designations indicated on Drawings.
   2. Identify products using designations indicated on Drawings.

C. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.04  QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same articles in Part 2, provide products of same manufacturer unless otherwise approved by Architect.

1.05  COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.
1.06 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 PRODUCTS

2.01 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.0312-inch minimum nominal thickness, unless otherwise indicated.

B. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.0359-inch minimum nominal thickness.

C. Galvanized Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.


E. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

F. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).

G. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.


2.02 PUBLIC-USE WASHROOM ACCESSORIES

A. Basis-of-Design Products: The design for accessories is based on products indicated. Subject to compliance with requirements, provide the named product or a comparable product by one of the following:

1. American Specialties, Inc. (ASI).
2. Bobrick Washroom Equipment, Inc.

B. Toilet Tissue (Roll) Dispenser – TA-1:

2. Description: Surface mounted twin 9" jumbo roll toilet tissue dispenser.
5. Capacity: Designed for two (2) nine (9)-inch-diameter tissue rolls.

C. Paper Towel (Roll) Dispenser – TA-2:

2. Description: Surface mounted roll paper towel dispenser.
5. Material and Finish: Stainless steel, No. 4 finish (satin).

D. Liquid-Soap Dispenser – TA-3:
   2. Description: Designed for dispensing soap in liquid or lotion form.
   5. Lockset: Tumbler type.

E. Grab Bar, Horizontal – TA-4:
   1. Basis-of-Design Product: ASI; 3400 Type 57.
   3. Material: Stainless steel, 0.05 inch thick.
   a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
   5. Configuration and Length: "L" shape, leg 1 42", leg 2 54"

F. Grab Bar, Vertical – (TA-5):
   1. Basis-of-Design Product: ASI; 3400 Type 1.
   3. Material: Stainless steel, 0.05 inch thick.
   a. Finish: Smooth, No. 4, satin finish on ends and slip-resistant texture in grip area.
   5. Configuration and Length: Straight, 18 inches long.

G. Sanitary-Napkin Disposal Unit – TA-6:
   3. Door or Cover: Self-closing disposal-opening cover.
   5. Material and Finish: Stainless steel, No. 4 finish (satin).

H. Washroom Mirror Unit – TA-7:
   2. Framed, Stainless-Steel Mirror: Minimum nominal 0.0375-inch-thick (20 gage, Type 430 stainless steel with bright finish and 1/4-inch return at edges; bonded to 1/4-inch-thick, tempered hardboard backing and secured with tamper-resistant, stainless-steel fasteners.

I. Electric Hand Dryer – TA-8:
   1. Basis-of-Design Product: Xlerator; XL-SB

J. Waste Receptacle – TA-9:
1. Basis-of-Design Product: ASI; 20826
3. Material and finish: Stainless steel, No. 4 finish (satin).

K. Clothes Hook – TA-10:

2. Description: Single-prong unit.

L. Mop and Broom Holder – TA-11:

1. Basis-of-Design Product: Bobrick; B-224
2. Description: Unit with shelf, drying rod, hooks and holders.
3. Length: 36 inches.
5. Mop/Broom Holders: Four, spring-loaded, rubber hat, cam type.
   a. Shelf: Not less than nominal 0.05-inch-thick stainless steel.
   b. Drying Rod: 1/4-inch diameter stainless steel.

2.03 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to method in ASTM F 446.

3.02 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer's written recommendations.

END OF SECTION
SECTION 11011
FALL PROTECTION SYSTEMS

PART 1 - GENERAL

1.01 SYSTEM DESCRIPTION

A. Type of system required: Hands Free Fall Restraint
B. System location: Roof
C. Maximum number of workers on system at one time: 3 per span
D. Systems environmental exposure: Weather and Corrosion Resistant
E. Workers task while on the system: Traveling for Inspection and Maintenance

1.02 RELATED SECTIONS

1. Section 05120 “Structural Steel”
2. Section 05310 “Steel Deck”
3. Section 06100 “Rough Carpentry”
4. Section 07511 “Built-Up Hot asphalt Roofing”
5. Section 07724 “Roof Hatches”
6. Section 08600 “Skylights”
7. Section 09100 “Metal Support Assemblies”

1.03 REFERENCES

A. Occupational Safety & Health Administration (OSHA)
   1. 29 CFR 1910.23(c) (1) & 29 CFR 1926.501(b) (1) - Occupational Health and Safety Standards General Industry & Construction: Duty to have fall protection
   2. 29 CFR 1926.502(d) (15) (i-ii) - Safety and Health Regulations for Construction: Anchor Design Requirements
   3. 29 CFR 1910.66 I(c) (10), I (d) (iv), II (2) - General Industry: Anchor Design Requirements

B. American National Standards Institute (ANSI)
   3. Z359.2 [2007] – Minimum Requirements for a Comprehensive Managed Fall Protection Program


2. A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes

3. A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless


5. A193 - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications


D. American Welding Society (AWS) D1.1/D1 - Structural Welding Code – Steel

E. Design Standards


5. American Concrete Institute (ACI) 318-11 Building Code Requirements for Structural Concrete.

1.04 PERFORMANCE

A. System shall comply with 1.1 System Description
B. Performance Requirements

1. The system shall provide a secure attachment means to the supporting structure in conjunction with the manufacturer’s requirements. The anchor shall provide compatible connects with the applicable personal connection equipment. All components shall be designed by the fall protection system supplier and shall meet the applicable requirements of ANSI and applicable OSHA regulations.

2. Structural Performance:
   a. Structure supporting anchor point(s) must be capable of withstanding the design loads as required by governing regulations and codes. Where component design loads are specified herein, they represent design minimum requirements.
   b. All fall protection components shall be designed with a minimum 2:1 safety factor.

1.05 DESIGN

A. Design Requirements

1. The system shall comply with current applicable OSHA, ANSI, and state regulations and standards.

2. General Requirements:
   a. Connection to structure shall be designed and installed, under the supervision of a Qualified Person, as part of a complete personal Fall Protection system.
   b. Integrated energy absorbers shall not be used to limit the maximum arrest force of the worker. Energy absorbers shall be used only to control or reduce the maximum arrest load on the structure.
   c. The design engineer shall ensure the increased clearance requirements of a deployed system will not conflict with the required clearance of the system.
   d. Anchor point(s) shall satisfy the seismic conditions for nonstructural components as described by ASCE/SEI 7 and the most current edition of the IBC. No exceptions can be taken if the system is required to function for life-safety purposes after an earthquake.
   e. Brackets and supports shall be attached to the structure with appropriate anchors of proper size to adequately support the intended loaded.
   f. The designer shall take into account environmental factors (snow, ice, debris, etc...) when designing an anchor point such that the system functions properly.

3. Restraint anchors shall be designed per ANSI Z359.2 & ANSI Z359.6:
   a. The system shall prevent workers from reaching and falling into any open hole or off the edge of a working surface.
   b. The installed system, containing anchor points, shall comply with the requirements for fall arrest anchor(s) as indicated in this document.
   c. Anchor(s) may be used in restraint systems; provided that the design engineer has determined that the restraint forces will not cause the system to deploy and ensures that the anchor extension in combination with other deformations of the restraint system will not permit the worker(s) to reach the fall hazard.
   d. The use of fall restraint systems shall be limited to surfaces at or less than a slope of 1:3 from the horizontal. This is so a fall will not result in dynamic loading on the fall restraint system or where the authorized person could end up being suspended vertically from the system.
4. Fall Arrest anchor point(s) shall be designed per ANSI Z359.2 & ANSI Z359.6:
   a. The selection, design, and installation of fall arrest anchor(s) shall be performed under the supervision of a Qualified Person.
   b. Anchorages designed for fall arrest systems shall have the strength capable of sustaining static loads applied in the directions permitted by the system of at least two times the maximum arresting force.
   c. When more than one user is attached to a horizontal lifeline, the load on the lifeline can be determined using either lumped mass or sequential fall calculations as described in ANSI Z359.6 [6.3.6]
   d. The swing fall shall comply with ANSI Z359.6 [5.3]
   e. The clearance safety margin shall comply with ANSI Z359.6 [7.2.6.2]
   f. f. Where a worker is using a full body harness the force on the worker’s body shall not exceed 8kN / 1800lbs.

B. Sub-System Requirements
   1. Harnesses used with the system shall comply with ANSI Z359.1
   2. Connecting Components (carabiners and snap hooks) used with the system shall comply with ANSI Z359.12
   3. Energy Absorbing Lanyards (EALs) used with the system shall comply with ANSI Z359.13

C. The fall protection system shall be used exclusively for its designed use and shall be marked to prevent other uses.

D. The design shall take into consideration the potential uses of and loads on the fall protection system, in order to facilitate the prompt rescue of workers who may fall while attached to the system.

E. The anchors shall be capable of providing a consistent level of energy absorption in any direction in the plane of the roof structure.

1.06 SUBMITTALS

A. Product Data: Data sheets on each product to be used, including:
   1. Preparation instructions and recommendations.
   2. Storage and handling requirements and recommendations
   3. Installation methods

B. Drawings and Calculations:
   1. Drawings:
      a. Show the layout of the system including where the system is located and the complete assembly of all components.
      b. Include a specification of the number, location, and qualifications of workers using the system.
      c. Clearly specify the equipment dimensions, materials, fabrication details, hardware, and installation instructions.
2. Calculations:
   a. Calculations shall be prepared under the supervision of a registered Professional Engineer and Qualified Person.
   b. Include a statement defining the type of system and indicating that the anchor attachment design is in accordance with the requirements of ANSI Z359.6.

C. Operation and Maintenance Data shall be prepared per ANSI Z359.2 & ANSI Z359.6:
   1. Include complete list of equipment replacement parts; identify each entry with the equipment description and part numbers.
   2. Include technical information for servicing equipment.
   3. Include legible “as-constructed” drawings of the installed system.
   4. Include installation date and system owner’s name and address.
   5. Include detailed operating procedures:
      a. Written by a Qualified or Competent Person.
      b. Identifying the system(s) location
      c. Stating any safety precautions that shall be followed during access and egress.
      d. Describing the limitation on use of system: maximum load, designated equipment, required clearance and maximum number of persons permitted to be attached to the system at one time.
      e. Instructions for inspection, maintenance, and retirement of the system and all of its components, including how often inspection and maintenance are to be performed and a description of the qualifications required for persons performing these tasks.
      f. Procedure for inspection:
         I. Required or recommended inspection intervals.
         II. Detailed instruction for inspecting each component of the system.
         III. Description of acceptance or rejection criteria, including retirement criteria, of each component of the system.
         IV. Fall protection procedures shall include a requirement that any incidents, including accidents or near misses, be investigated to determine if procedures can be improved.
   6. Provide or direct the owner of the system or the employer of the workers using the system to develop and implement a rescue plan before the system is used.

1.07 QUALITY ASSURANCE

A. Single Source: Obtain all materials and equipment required under this section from a single supplier.

B. Designer/Installer Qualifications: Engage a single firm to assume undivided responsibility for the design and fabrication of all fall protection system components. Firm shall have a minimum of 5 years documented experience in the fabrication of such components similar to that required for this project. Additionally, the firm shall have a minimum of 5 years documented experience in
the installation of such components and who offers a regular inspection and maintenance service on such systems.

C. Design Engineer: Employ a firm with a minimum of 10 years of experience designing fall protection systems with a minimum of 5 systems installed in the previous 12 months. Who employs a registered Professional Engineer (PE), with evidence of being the principal PE on at least 3 fall arrest systems which have been in use for no less than 1 year prior to bid closing date.

D. Professional Engineer and Fall Protection Qualified Person: Shall oversee the fall protection systems’ design, such that all component items meet the “Structural Performance” requirements, including sizing and spacing of all attachments to the building structure and verify the design is compliant with all applicable OSHA and ANSI standards. Additionally, they must prepare, stamp and sign all required calculations; while also approving the system designer’s drawings.

E. Welding to be executed by certified welders in accordance with AWS requirements.

1.08 DELIVERY, STORAGE & HANDLING

A. Material delivery shall be coordinated with all effected entities.

B. Storage and Protection:
   1. Store originally packaged materials in a cool, dry, and protected location.
   2. Materials shall be in new condition and show no signs of damage.

1.09 SEQUENCING

A. Ensure that products of this section are supplied to affected trades in time to prevent interruption of construction progress.

1.10 WARRANTY

A. Manufacturer’s standard one year warranty for materials and workmanship.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers shall comply with the Quality Assurance section of this documentation.

2.02 PRODUCTS

A. XSPlatforms by American Anchor-USA

B. Capital

C. Safety

2.03 MATERIALS

A. Product
1. The system shall be a complete and turnkey solution complying with the performance and design criteria of this document.

2. Components: All system connectors, cables and bolts shall be stainless steel Type 316 or epoxy coated aluminum. Fabricated supports required for additional support may be carbon steel with a corrosion resistant coating. However a faying surface shall be used to prevent galvanic reactions.

3. Provided complete with required components for weatherproof mounting to the following surfaces:
   a. Green Roofing Type.
   b. Insulated Roof Deck Type.

4. The anchor(s) shall be attached to the supporting structure with appropriate fasteners. The fasteners shall be designed to support a load on the fall protection system of 2 times the maximum design load without failure.

5. Provide all designed sub-system items per Section 1.5 (B) of this document.

B. Supporting Structure

1. Structural Components shall comply with the applicable standards:
   a. Structural Steel: ASTM A36
   b. Structural Tubing: ASTM A500 Grade B
   c. Structural Bars, Plates, Shapes, and Sheet Piling: ASTM A6
   d. Piping: ASTM A53

2. Structural Components shall comply with the applicable design specification:
   a. Steel design shall comply with AISC 14th ed.
   b. Wood design shall comply with ANSI/NDS [2005]
   c. Concrete design shall comply with ACI [2008]

3. Fasteners shall comply with the applicable standards:
   a. Structural Bolts: ASTM A325
   b. Alloy-Steel and Stainless Steel Bolting: ASTM A193

4. Flashing and Sealing Material shall comply with the applicable standards:

5. Material substitutions shall be better than or equal to the requirements found in this section.

6. Fabrication
   a. Fabricate work true to dimension, square, plumb, level, and free from distortion or defects detrimental to performance.
   b. Coordinate the system with supporting structure.
   c. Welding:
      I. AWS D 1.1 as applicable.
      II. If Butt welds are used, then surplus welding material is to be ground off to ensure exposed surfaces are smooth. Fillet welds shall not be ground.
III. Slag is to be removed from the materials surface.

PART 3 - EXECUTION

3.01 INSTALLATION

A. Install in accordance with approved shop drawings and manufacturer’s instructions.

B. The Fall Protection System shall be installed under the direction of manufacturer’s authorized trained personnel and under the supervision of a Qualified Person.

C. Install anchorages and fasteners in accordance with their manufacturer’s recommendations to obtain the allowable working loads published in the product literature and in accordance with this specification.

D. Do not load or stress the Fall Protection System until all materials and fasteners are properly installed and ready for service.

E. Where bolting is used for fastening, no fewer than three threads are to be exposed and the nut is to be positively locked using a thread-locking fluid or the double nutting technique.

F. Dissimilar materials with greater than 0.15V shall be separated by a faying surface.

G. Anchor point(s) must be secured to roof surface with waterproof mechanical connectors as approved.

3.02 FIELD QUALITY CONTROL

A. After the Fall Protection System is installed, approved authorized Qualified or Competent Person shall inspect and operate the system and shall make all final adjustments for proper operation.

3.03 ADJUSTMENTS AND FINAL INSPECTION

A. Verify that all manufactured units have been installed in accordance with specifications and details, and will function as intended. Adjust any items where necessary to ensure proper operation.

B. Provide a complete drawing set with any revisions to the design or layout of the fall protection system during installation.

3.04 OPERATOR TRAINING

A. Provide a minimum of 4 hours of operator training after system has been installed. Training is to be for the users of the system conducted at the installation site.

3.05 MAINTENANCE, INSPECTION AND TESTING

A. Provide manufacturer maintenance, inspection and testing instructions.

B. Provide documentation that is consistent with applicable OSHA and ANSI standards.

END OF SECTION
SECTION 12240
ROLLER WINDOW SHADES

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Roller window shades.

B. Related Sections:
   1. Section 06100 "Rough Carpentry"

1.03 SUBMITTALS
A. Product Data: For each type of product indicated. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions.
   1. Shade Operators: Include operating instructions.

B. Shop Drawings: Show location and extent of roller shades. Include elevations, sections, details, and dimensions not shown in Product Data. Show installation details, mountings, attachments to other Work, operational clearances, and relationship to adjoining work.

C. Samples for Initial Selection: For each colored component of each type of roller shade indicated.
   1. Include similar Samples of accessories involving color selection.

D. Samples for Verification: Shade material; not less than 12-inch-square section of fabric, from dye lot used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of material.

E. Window Treatment Schedule: Include roller shades in schedule using same room designations indicated on Drawings.

F. Maintenance Data: For roller shades to include in maintenance manuals. Include the following:
   1. Methods for maintaining roller shades and finishes.
   2. Precautions about cleaning materials and methods that could be detrimental to fabrics, finishes, and performance.
   3. Operating hardware.

1.04 QUALITY ASSURANCE
A. Installer Qualifications: An experienced installer who has completed installation of roller shades 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.
B. Source Limitations: Obtain roller shades through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide roller shade band materials with the fire-test-response characteristics indicated, as determined by testing identical products per test method indicated below by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:


D. Corded Window Covering Product Standard: Provide roller shades complying with WCMA A 100.1.

1.05 PRODUCT HANDLING

A. Deliver shades in factory packages, marked with manufacturer and product name, fire-test-response characteristics, and location of installation using same room designations indicated on Drawings.

1.06 PROJECT CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and wet and dirty finish work in spaces, including painting, is complete and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operable glazed units’ operation hardware throughout the entire operating range. Notify Architect of discrepancies. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Products: The design for roller window shades is based on the following products of Draper Inc.:

2. Shade Band Material: Flocke.

B. Comparable Products: Subject to compliance with requirements, provide the named products, or comparable products by one of the following:

2. Lutron Shading Solutions by VIMCO.
3. MechoShade Systems, Inc.
4. Nysan Shading Systems Ltd.

2.02 ROLLER SHADES

A. Shade Band Material: Phifer SheerWeave, Draper

1. Openness Factor: 5 percent.
2. Weight: 19.2 oz./sq. yd.
3. Thickness: 0.036 inch.
4. UV Blockage: 95 percent
5. Color: PW3560, Alabaster, Linen
B. Rollers: Electrogalvanized or epoxy primed steel or extruded-aluminum tube of diameter and wall thickness required to support and fit internal components of operating system and the weight and width of shade band material without sagging; designed to be easily removable from support brackets; with manufacturer's standard method for attaching shade material.

C. Mounting Brackets: End caps, fabricated from steel finished to match headbox.

D. Pocket-Style Headbox: 0.060-inch thick extruded aluminum; long edges returned or rolled; with a bottom cover consisting of slot opening of minimum dimension to allow lowering and raising of shade and a removable or openable, continuous metal access panel concealing shade roller, brackets, and operating hardware and operators within.

1. Size: 4-1/8 inches high by 3-1/2 inches wide by length required to accommodate shade.
2. Components: L-shaped removable front face and bottom cover, and L-shaped back and top.

E. Bottom Bar: Steel or extruded aluminum, with plastic or metal capped ends. Provide concealed, by pocket of shade material, internal-type bottom bar with concealed weight bar as required for smooth, properly balanced shade operation.

F. Shade Operation: Manual; with continuous loop bead chain and clutch operator.

1. Clutch: Capacity to lift size and weight of shade; sized to fit roller or provide adaptor.
2. Lift Assist Mechanism: Manufacturer's standard spring assist for balancing roller shade weight and lifting heavy roller shades.
3. Loop Length: Length required to make operation convenient from floor level.
5. Cord Tensioner Mounting: As indicated on Drawings, or if not indicated, as directed by Architect.

2.03 ROLLER SHADE FABRICATION

A. Product Description: Roller shade consisting of a roller, a means of supporting the roller, a flexible sheet or band of material carried by the roller, a means of attaching the material to the roller, a bottom bar, and an operating mechanism that lifts and lowers the shade.

B. Concealed Components: Noncorrodible or corrosion-resistant-coated materials.

1. Lifting Mechanism: With permanently lubricated moving parts.

C. Unit Sizes: Obtain units fabricated in sizes to fill window and other openings as follows, extending from head to sill and jamb to jamb, measured at 74 deg F:

1. Shade Units Installed between (Inside) Jambs: Edge of shade not more than 1/4 inch from face of jamb. Length equal to head to sill dimension of opening in which each shade is installed.
2. Shade Units Installed Outside Jambs: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

D. Installation Brackets: Designed for easy removal and reinstallation of shade, for supporting headbox, roller, and operating hardware and for hardware position and shade mounting method indicated.

E. Installation Fasteners: Not fewer than two fasteners per bracket, fabricated from metal noncorrosive to shade hardware and adjoining construction; type designed for securing to supporting substrate; and supporting shades and accessories under conditions of normal use.
F. Color-Coated Finish: For metal components exposed to view, apply manufacturer's standard baked finish complying with manufacturer's written instructions for surface preparation including pretreatment, application, baking, and minimum dry film thickness.


G. Colors of Metal and Plastic Components Exposed to View: As selected by Architect from manufacturer's full range, unless otherwise indicated.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 ROLLER SHADE INSTALLATION

A. Install roller shades level, plumb, square, and true according to manufacturer's written instructions, and located so shade band is not closer than 2 inches to interior face of glass, unless otherwise indicated. Allow clearances for window operation hardware.

3.03 ADJUSTING AND PROTECTION

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

B. Clean roller shade surfaces after installation, according to manufacturer's written instructions.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

D. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

3.04 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain systems.

END OF SECTION
SECTION 12320

MANUFACTURED PLASTIC-LAMINATE-FACED CASEWORK

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Plastic-laminate-faced cabinets of stock design.
   2. Solid surface countertops.

B. Related Sections:
   1. Section 09650 "Resilient Base and Accessories".

1.03 DEFINITIONS

A. Exposed Portions of Cabinets: Surfaces visible when doors and drawers are closed, including bottoms of cabinets more than 48 inches above floor, and surfaces visible in open cabinets.

B. Semi-exposed Portions of Cabinets: Surfaces behind opaque doors, such as interiors of cabinets, shelves, dividers, interiors and sides of drawers, and interior faces of doors. Tops of cases 78 inches or more above floor are defined as semi-exposed.

C. Concealed Portions of Cabinets: Surfaces not usually visible after installation, including sleepers, web frames, dust panels, and ends and backs that are placed directly against walls or other cabinets.

D. Hardwood Plywood: A panel product composed of layers or plies of veneer, or of veneers in combination with lumber core, hardboard core, MDF core, or particleboard core, joined with adhesive, and faced both front and back with hardwood veneers.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work. Show fabrication details, including types and locations of hardware. Show installation details, including field joints and filler panels. Indicate manufacturer's catalog numbers for casework.

C. Samples for Initial Selection: For cabinet finishes and for each type of top material indicated.

D. Samples for Verification: 8-by-10-inch Samples for each type of finish, including top material and the following:
   1. Section of countertop showing top, front edge, and backsplash construction.

E. Qualification Data: For qualified Installer.

F. Warranty: Sample of special warranty.
1.05 QUALITY ASSURANCE

A. Source Limitations: Obtain manufactured casework from single source from single manufacturer.

B. Quality Standard: Unless otherwise indicated, comply with requirements for modular cabinets in AWI's "Architectural Woodwork Quality Standards."
   1. Provide AWI Quality Certification Program labels or certificate indicating that manufactured casework complies with requirements.

C. Product Designations: Drawings indicate sizes, configurations, and finish material of manufactured casework by referencing designated manufacturer's catalog numbers. Other manufacturers' casework of similar sizes and door and drawer configurations, of same finish material, and complying with the Specifications may be considered.

1.06 PRODUCT HANDLING

A. Deliver manufactured casework only after painting, utility roughing-in, and similar operations that could damage, soil, or deteriorate casework have been completed in installation areas. If casework must be stored in other than installation areas, store only in areas where environmental conditions meet requirements specified in "Project Conditions" Article.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.07 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install manufactured casework 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 occupancy levels during the remainder of the construction period.

B. Field Measurements: Verify actual dimensions of construction contiguous with manufactured casework by field measurements before fabrication.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of manufactured casework that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Delamination of components or other failures of glue bond.
      b. Warping of components.
      c. Failure of operating hardware.
      d. Deterioration of finishes.

   2. Warranty Period: 5 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide LSI Corporation of America; New Century Series L44, or comparable product by the following:
1. PolyVision Corporation.

2.02 MATERIALS, GENERAL

A. Low-Emitting Materials: Provide manufactured casework, including countertops, made with adhesives and composite wood products containing no urea formaldehyde.

B. Maximum Moisture Content for Lumber: 7 percent for hardwood and 12 percent for softwood.

C. Hardwood Plywood: HPVA HP-1, either veneer core or particleboard core unless otherwise indicated.

D. Softwood Plywood: DOC PS 1.

E. Particleboard: ANSI A208.1, Grade M-2.

F. Plastic Laminate: High-pressure decorative laminate complying with NEMA LD 3.

G. Thermoset Decorative Panels: Particleboard or MDF finished with thermally fused, melamine-impregnated decorative paper complying with LMA SAT-1.

H. Edge banding for Plastic Laminate: Rigid PVC extrusions, through color with satin finish, 3 mm thick at doors and drawer fronts, 1 mm thick elsewhere.

I. Edge banding for Thermoset Decorative Panels: PVC or polyester edge banding complying with LMA EDG-1 and matching thermoset decorative panels.

2.03 CABINET MATERIALS

A. Exposed Cabinet Materials:
   1. Plastic Laminate: Grade VGS; not less than 0.028-inch thick.
   2. Unless otherwise indicated, provide specified edge banding on all exposed edges.

B. Semi-exposed Cabinet Materials:
   1. Plastic Laminate: Grade VGS or CLS. Provide plastic laminate for interior faces of doors and drawer fronts and where indicated.
   2. Thermoset Decorative Panels: Provide thermoset decorative panels for semi-exposed surfaces unless otherwise indicated.
   3. Unless otherwise indicated, provide specified edge banding on all semi-exposed edges.

C. Concealed Cabinet Materials:
   1. Solid Wood: Any hardwood or softwood species, with no defects affecting strength or utility.
   3. Plastic Laminate: Grade BKL.

2.04 DESIGN, COLOR, AND FINISH

A. Design: Provide manufactured casework of the following design:
   1. Flush overlay with semi-recessed plastic pulls.
B. Plastic-Laminate Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range of colors and patterns.

C. Thermoset Decorative Panel Colors, Patterns, and Finishes: As selected by Architect from casework manufacturer's full range.

D. PVC Edge banding Color: As selected from casework manufacturer's full range.

2.05 CABINET FABRICATION

A. Plastic-Laminate-Faced Cabinet Construction: As required by referenced quality standard, but not less than the following:

1. Bottoms and Ends of Cabinets, and Tops of Wall Cabinets and Tall Cabinets: 3/4-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.
2. Shelves: 3/4-inch thermoset decorative panels.
3. Backs of Cabinets: 1/2-inch particleboard, plastic-laminate faced on exposed surfaces, thermoset decorative panels on semi-exposed surfaces.
5. Drawer Sides and Backs: 1/2-inch thermoset decorative panels, with glued dovetail.
6. Drawer Bottoms: 1/4-inch thermoset decorative panels glued and dadoed into front, back, and sides of drawers. Use 1/2-inch material for drawers more than 24 inches wide.
7. Doors: 3/4-inch particleboard or MDF with wood stiles and rails, plastic-laminate faced.

B. Filler Strips: Provide as needed to close spaces between cabinets and walls, ceilings, and indicated equipment. Fabricate from same material and with same finish as cabinets.

2.06 CASEWORK HARDWARE AND ACCESSORIES

A. Hardware, General: Unless otherwise indicated, provide manufacturer's standard mirror polished-finish, commercial-quality, heavy-duty hardware.

1. Use threaded metal or plastic inserts with machine screws for fastening to particleboard except where hardware is through-bolted from back side.

B. Butt Hinges: Chrome-plated, semi-concealed, 5-knuckle hinges complying with BHMA A156.9, Grade 1, with antifriction bearings and rounded tips. Provide 2 hinges for doors less than 48 inches high and 3 hinges for doors more than 48 inches high.

C. Pulls: Semi-recessed plastic pulls. Provide 2 pulls for drawers more than 24 inches wide.

1. Color: As selected by Architect from manufacturer's full range.

D. Door Catches: Powder-coated, nylon-roller spring catch or dual, self-aligning, permanent magnet catch. Provide 2 catches on doors more than 48 inches high.

E. Drawer Slides: BHMA A156.9, Type B05091. Self-closing design; with positive in-stop, out-stop, and out-keeper to maintain drawer at 80 percent open position; white epoxy powder-coated finish.

1. Heavy Duty (Grade 1HD-100 and Grade 1HD-200): Side mounted; full-over travel-extension type.
2. Box Drawer Slides: Grade 1HD-200, for file drawers and paper storage drawers; with full-extension, 3-part progressive opening slide.

F. Drawer and Hinged Door Locks: Cylindrical (cam) type, 5-pin tumbler, brass with chrome-plated finish, and complying with BHMA A156.11, Grade 1.
1. Provide a minimum of two keys per lock and six master keys.
2. Provide locks on all doors and drawers.

G. Adjustable Shelf Supports: Manufacturer's standard twin pin design with anti tip-up shelf restraints; with load rating not less than 300 lbs. for each support.

H. Grommets for Cable Passage through Countertops: 2-inch OD, molded-plastic grommets and matching plastic caps with slot for wire passage; color as selected by Architect.

2.07 COUNTERTOPS

A. Countertops, General: Provide smooth, clean exposed tops and edges in uniform plane free of defects. Provide front and end overhang of 1 inch over base cabinets.

B. Material:
   1. Tops: Plastic Laminate
   2. Substrate Thickness: 3/4 inches.
   3. Edge treatment: Match surface.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of manufactured casework.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 CASEWORK INSTALLATION

A. Install level, plumb, and true; shim as required, using concealed shims. Where manufactured casework abuts other finished work, apply filler strips and scribe for accurate fit, with fasteners concealed where practical.

B. Base Cabinets: Set cabinets straight, level, and plumb. Adjust subtops within 1/16 inch of a single plane. Fasten cabinets to masonry or framing, wood blocking, or reinforcements in walls and partitions with fasteners spaced 24 inches o.c. Bolt adjacent cabinets together with joints flush, tight, and uniform. Align similar adjoining doors and drawers to a tolerance of 1/16 inch.

1. Where base cabinets are not installed adjacent to walls, fasten to floor at toe space with fasteners spaced 16 inches o.c. Secure sides of cabinets to floor, where they do not adjoin other cabinets, with not less than two fasteners.

C. Transaction Countertop: Wall hang cabinets straight, level, and plumb. Adjust fronts and bottoms within 1/16 inch of a single plane. Fasten to hanging strips, masonry, or framing, blocking, or reinforcements in walls or partitions. Align similar adjoining doors to a tolerance of 1/16 inch.

1. Fasten through back, near top and bottom, at ends, and not more than 16 inches o.c.
2. Use toggle bolts at hollow masonry.
D. Install hardware uniformly and precisely. Set hinges snug and flat in mortises unless otherwise indicated. Adjust and align hardware so moving parts operate freely and contact points meet accurately. Allow for final adjustment after installation.

3.03 INSTALLATION OF TOPS
A. 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. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer's written instructions to exert a constant, heavy-clamping pressure at joints.

B. Secure tops to cabinets with Z- or L-type fasteners or equivalent, using two or more fasteners at each front, end, and back.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

D. Secure backsplashes and end splashes to tops with concealed metal brackets at 16 inches o.c. and walls with adhesive.

E. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.04 CLEANING AND PROTECTING
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. Protection: Provide 6-mil plastic or other suitable water-resistant covering over countertop surfaces. Tape to underside of countertop at a minimum of 48 inches o.c. Remove protection at Substantial Completion.

END OF SECTION
SECTION 12480
ENTRANCE MATS AND FRAMES

PART 1  GENERAL

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

1.02  SUMMARY
A. Section Includes: Roll-up mats in recessed frames.
B. Related Sections:
   1. Section 03300 "Cast-in-Place Concrete"

1.03  SUBMITTALS
A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
B. Shop Drawings: Show location and perimeter conditions of floor mats and frames.
C. Samples for Initial Selection: For each type of product indicated.
D. Sample for Verification: 12-inch-square, assembled section of floor mat.
E. Maintenance Data: For floor mats and frames to include in maintenance manuals.

1.04  QUALITY ASSURANCE
A. Source Limitations: Obtain floor mats and frames through one source from a single manufacturer.
B. Accessibility Requirements: Provide installed floor mats that comply with Section 4.5 in the U.S. Architectural & Transportation Barriers Compliance Board's "Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG)" and Sections 302 and 303 in ICC A117.1.

1.05  PROJECT CONDITIONS
A. Field Measurements: Indicate measurements on Shop Drawings.

1.06  COORDINATION
A. Coordinate size and location of recesses in concrete with installation of finish floors to receive floor mats and frames.

PART 2  PRODUCTS

2.01  ROLL-UP MATS
A. Basis-of-Design Product: Subject to compliance with requirements, provide Pawling Corporation; RG-300 Drain-Well, or a comparable product by one of the following:
1. Balco, Inc.
2. C/S Group.

B. Roll-up, Aluminum-Rail Hinged Mats: Extruded-aluminum tread rails 1-3/8 inches wide by 1-1/2 inches deep, sitting on continuous vinyl cushions.
   1. Tread Inserts: Rigid corrugated vinyl.
   2. Colors, Textures, and Patterns of Inserts: As selected by Architect from manufacturer's full range.

C. Recessed Frames:
   1. Extruded Aluminum: ASTM B 221, Alloy 6061-T6 or Alloy 6063-T5, T6, or T52.
   2. Color: Clear.

2.02 CONCRETE FILL AND GROUT MATERIALS

A. Provide concrete grout and fill equivalent in strength to cast-in-place concrete slabs for recessed mats and frames. Use aggregate no larger than one-third fill thickness.

2.03 FABRICATION

A. Floor Mats: Shop fabricate units to greatest extent possible in sizes indicated. Unless otherwise indicated, provide single unit for each mat installation; do not exceed manufacturer's recommended maximum sizes for units that are removed for maintenance and cleaning. Where joints in mats are necessary, space symmetrically and away from normal traffic lanes. Miter corner joints in framing elements with hairline joints or provide prefabricated corner units without joints.

B. Recessed Frames: As indicated, for permanent recessed installation, complete with corner pins or reinforcement and anchorage devices.
   1. Fabricate edge-frame members in single lengths or, where frame dimensions exceed maximum available lengths, provide minimum number of pieces possible, with hairline joints equally spaced and pieces spliced together by straight connecting pins.

C. Coat surfaces of aluminum frames that will contact cementitious material with manufacturer's standard protective coating.

2.04 ALUMINUM FINISHES

A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.

B. Finish designations prefixed by AA comply with the system established by the Aluminum Association for designating aluminum finishes.

C. Class I, Clear Anodic Finish: AA-M12C22A41 (Mechanical Finish: nonspecular as fabricated; Chemical Finish: etched, medium matte; Anodic Coating: Architectural Class I, clear coating 0.018 mm or thicker) complying with AAMA 611.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrates and floor conditions for compliance with requirements for location, sizes, minimum recess depth, and other conditions affecting installation of floor mats and frames.
1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Install recessed mat frames to comply with manufacturer’s written instructions. Set mat tops at height recommended by manufacturer for most effective cleaning action; coordinate top of mat surfaces with bottom of doors that swing across mats to provide clearance between door and mat.

1. Install necessary shims, spacers, and anchorages for proper location and secure attachment of frames.
2. Install grout and fill around frames and, if required to set mat tops at proper elevations, in recesses under mats. Finish grout and fill smooth and level.

3.03 PROTECTION

A. After completing frame installation and concrete work, provide temporary filler of plywood or fiberboard in recesses and cover frames with plywood protective flooring. Maintain protection until construction traffic has ended and Project is near Substantial Completion.

END OF SECTION
SECTION 13852
DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.01 DESCRIPTION

A. The Contractor shall furnish and install a completely functional fire alarm system. The system shall be in full compliance with all codes, regulations, SEPTA Standards and guidance as stated in this scope of work. The Contractor is responsible to apply for and obtain all required permits.

B. The Fire Alarm System shall include but not be limited to: control panel, power supply, remote power supplies, alarm initiating and notification devices, connections to supplementary systems, conduit, wire and accessories.

C. The Fire Alarm System shall monitor the wet sprinkler system including, but not limited to, flow switches and valve tamper switches.

D. The Fire Alarm System shall be non-proprietary. The alarm equipment must be readily available for purchase, installation and service by any reputable contractor regularly engaged in the fire alarm installation and service business. Additionally, the equipment must be capable of being readily monitored, without losing the type of alarm (fire, supervisory, and trouble) and specific zone or point, by any non-proprietary receiver. Further, replacement parts and system training must be readily available at a reasonable cost to whoever maintains the alarm equipment for SEPTA. This may include SEPTA personnel or a third party contractor.

E. The Fire Alarm System shall be an addressable system. The Silent Knight 5820XL or SEPTA approved equal shall be provided.

F. Each addressable point shall be programmed to transmit its individual address back to SEPTA's Central Monitoring Station, Tyco Integrated Services (TycoIS), as an individual zone number. Each zone number shall have only one address assigned to it. Zone 1 cannot be used for it is incompatible with TycoIS reporting protocols. If multiple SLC loops are utilized each zone number or address cannot be duplicated. (ie.: cannot have 33:004 & 4:004 device addresses)

G. The Fire Alarm contractor shall specify, for SEPTA approval, the specific Fire Alarm System components that will be used in the design. The contractor is expected to ensure high quality in all components of the system that is specified.

H. The Fire alarm system shall be "turnkey" to SEPTA. This includes complete operation and communication to SEPTA’s MMI (Monitoring, Maintenance, and Inspection) service contractor of record (currently TycoIS).

I. The Fire Alarm System shall meet all of the fire alarm code requirements at the facility.

1.02 CODES AND STANDARDS

A. The Fire Alarm System and installation shall comply with all relevant codes and government regulations.

B. The Fire Alarm System and installation shall comply with all relevant National Fire Protection Association (NFPA) Codes and FM Global Standards. In all cases, the Fire Alarm System and installation shall comply with NFPA 70, National Electrical Code; NFPA 72, National Fire Alarm Code; and NFPA 101 Life Safety Code.
C. The Fire Alarm System and installation shall comply with all relevant Local, State, and International Code Council Codes adopted by the local authority having jurisdiction (AHJ).

D. The Fire Alarm System and installation shall comply with all requirements of the local AHJ (City of Philadelphia, L&I). Within SEPTA, the AHJ is jointly shared between Engineering, Maintenance & Construction (EM&C) Contract Services and the SEPTA location Fire Marshal.

E. In all cases, the Fire Alarm system must be installed in accordance with the most stringent applicable codes, regulations and SEPTA standards.

F. The fire alarm system and all components shall be listed by Underwriters Laboratories, Inc. and FM Global for use in fire protection systems.

G. Any element of the fire alarm system that is not designed in accordance with the applicable codes and standards must be addressed through a request for variance with the local AHJ. A variance is the responsibility of the fire alarm designer and requires the written approval of SEPTA EM&C Contract Services and the SEPTA Fire Marshal. A copy of the variance, approved by the local AHJ (City of Philadelphia, L&I) must be submitted to SEPTA EM&C Contract Services upon acceptance.

1.03 FIRE DETECTION AND ALARM SYSTEM PERFORMANCE

A. Signaling Line Circuits (SLC)

1. SLC’s shall be wired to meet the Class B, Style 4 performance.
2. T-Tapping is permitted. (T-Tapping shall occur at a final device and not in mid-stream of any circuit.
3. Splicing of the cable is not permitted.
4. The zoning of the Fire Detection and Alarm System shall be configured as described in the specification in later sections and as shown on drawings.

B. Notification Appliance Circuits

1. Notification Appliance shall be wired to meet the Class B performance.
2. T-Tapping is not permitted.
3. Splicing of the cable is not permitted.
4. End of line resistor compatible with the FACP is required for supervision.

C. Sprinkler systems, including limited area sprinkler systems, shall be monitored by the main FACP for water flow, valve tamper and low air pressure if applicable and as shown on drawings.

D. Control interface devices such as elevator recall and equipment shut downs, etc. shall be included.

1.04 RELATED SECTIONS

A. Any/All of the systems that will connect to the Fire Alarm System shall be graphically depicted on the Fire Alarm drawings and wiring diagrams.

1.05 SUBMITTALS

A. Submit detailed shop drawings based on contract drawings and specifications. Drawings shall include detailed wiring diagrams and interconnection of all fire alarm devices, panels and associated remote monitored and controlled equipment.
B. Submit manufacturers' catalog cut sheets, compatibility listings, and other descriptive information (prior to purchasing equipment) to provide SEPTA sufficient detail in determining compliance with this Drawings and Specifications for every installed component, for example:

1. Fire Alarm design drawings are to be submitted to SEPTA concurrently when the drawings are submitted to City L&I for permitting.
3. Notification Appliances (i.e. Horn/Strobes)
4. All Initiating Devices, including supplementary system device monitor modules.
5. Output Relays
6. Fire Alarm Control Panel
7. Remote Power Module
8. Remote Annunciator Panel
9. Rechargeable Batteries
10. Wire & Cables
11. Wire, Device and Back box Labels
12. Conduit and Hangers
13. Conduit & Device Back box Attachment Methods

C. Fire Alarm System Manual

1. The Fire Alarm System Manual shall be compiled and developed for use by SEPTA location personnel and technicians (SEPTA or 3rd Party Contractor) during operation and maintenance activities over the useful life of the system.
2. The Fire Alarm System Manual shall be a three-ring binder that is labeled with the SEPTA property name and the make and model of the Fire Alarm System. It shall be indexed and include the following:
   a. A detailed narrative description of the system inputs, evacuation signaling, ancillary functions, annunciation, sequence of operations, expansion capability, application considerations, and limitations.
   b. Operator instructions for basic system operations, including alarm acknowledgement, silence alarm, silence trouble signals, silence a supervisory signal, system reset, interpretation of applicable system output (LED’s, CRT display, and printout, operation of controls and functions, and change of printer paper (if applicable).
   d. Catalog cut sheets for every installed component.
   e. A detailed description of routine maintenance and testing as required and recommended to include testing and maintenance instructions for each type of device installed. This information should include the following:
      1) Listing of the individual system components that require periodic testing and maintenance.
      2) Step-by-step instructions detailing the requisite testing and maintenance procedures and the intervals at which these procedures shall be performed, for each type of device installed.
   f. Detailed troubleshooting instructions for each trouble condition generated from the monitored field wiring, including opens, grounds, and loop failures. These instructions should include a list of all trouble signals annihilated by the system, a description of the condition(s) that cause such trouble signals, and step-by-step instructions describing how to isolate such problems and correct them. The instructions should focus on guiding technicians in identifying the sources of problems in specific subsystems and in locating, replacing, and testing specific modular components.
   g. Record of Completion
h. Detailed zone or point listing that list and describes every device type and location. (Zone descriptions shall be reviewed and approved by the Project Manager and EMC Administration Contract Services only).

i. Record of alarm inspection, testing, and certification.

j. As-Built Drawings of the entire fire alarm system in ACAD and PDF formats (on a CD).

k. As-Built Point-to-Point wiring diagram of the entire installation both input and output device circuiting

l. As-Built Drawings in ACAD format (on a CD).


4. Individual sheets of the Fire Alarm System Manual must be typed (unless the manufacturer prints them) and should be protected by top-loading, heavyweight, clear sheet protectors.

D. Submit detail circuit schematic drawings for any supplemental and/or auxiliary shutdown circuits.

E. Submit ampere-hour calculations for system operation by battery.

F. Submit notification appliance circuit voltage drop calculations.

1.06 QUALITY ASSURANCE

A. Qualifications

1. The Contractor shall provide a qualified and experienced person in the installation, inspection, and testing of fire alarm systems who shall supervise installation personnel. Examples of qualified personnel shall include, but not be limited to, the following:

a. Factory trained and certified personnel.

b. National Institute of Certification in Engineering Technologies (NICET) fire alarm level II certified personnel.

c. Personnel licensed or certified by a state or local authority.

2. The Contractor shall examine the design specifications and drawings in detail and take responsibility to complete the installation and ensure that all system performance requirements are met.

B. Quality of Materials

1. All of the Fire Alarm System materials shall meet the following requirements:

a) All materials and equipment supplied by the Contractor shall be new and meet or exceed the latest published specifications of the equipment manufacturer.

b) All products must be listed for the specific fire alarm system application for which they are used.

c) Underwriter’s Laboratories, Inc. and FM Global shall approve all equipment for its intended purpose and compatibility.

d) The Contractor shall certify that the proposed Fire Alarm equipment shall comply completely with all the Fire Alarm Code requirements of this Contract.

e) All Fire Alarm equipment suppliers shall be authorized dealer/distributors of the major equipment components supplied and
certification of such shall be provided to the SEPTA Project Manager.

1.07 WARRANTY

A. All major Fire Alarm equipment shall be installed, adjusted and serviced by authorized representatives of the equipment manufacturers.

B. The Contractor shall warrant the entire system and each of the individual components of the system. All system components warranty must be for a minimum of one (1) year. The warranty shall require the Contractor to provide all equipment, material, and labor at no charge to SEPTA during the warranty period.

C. All manufacturers’ warranties shall be in SEPTA’s name. If the Contractor modifies any equipment to void any manufacturer’s warranty, the Contractor shall provide a warranty equivalent to that of the original manufacturer’s warranty.

D. The Contractor shall provide a, maximum, two-hour response time for service calls during the warranty period.

E. The Warranty period starts the day when the SEPTA 3rd Party Fire Alarm Maintenance, Monitoring and Inspection Co. has accepted the fire alarm system installation to their central monitoring station for monitoring.

1.08 TRAINING

A. The Fire Alarm contractor shall provide formal training to SEPTA employees and contractor personnel on the operations and points of the system. The contractor shall coordinate with the SEPTA Project Manager for a list of the specific groups that shall attend the training. The training shall be completed prior to acceptance.

B. The training must consist of two sessions of four hours each to allow attendance by different groups. The sessions shall begin in a classroom setting and be followed by an on site walk through and demonstration of the system and its restore from alarm activation. A roster of intended attendees shall be provided by the Project Manager.

C. The training must include identification of activated initiating devices and corrective action to restore the system. These actions include the clearing of smoke detectors, reset of manual pull stations, and activation of supplementary systems. The training must also include proper response to all of the control panel and annunciator indicators.

1.09 WORKMANSHIP

A. The contractor shall supply all necessary tools, equipment, and material required for the accomplishment of this contract.

B. Competent personnel under the supervision and employment of the contractor shall perform all work. The contractor, and all parties employed on the work, shall perform their work in a good and workmanlike manner. The contractor must furnish labor, which can work in harmony with all other elements of labor employed or to be employed by the Authority.

C. The contractor must remove and dispose of all trash from the installation.

D. Contractor shall clean up any construction related debris on the job site upon completion of the individual task that generated the debris.

E. Work area must be cleaned of all work debris at the end of each work day.

PART 2 - PRODUCTS
2.01 FIRE ALARM CONTROL PANEL

A. The Fire Alarm System shall be an addressable system. The Silent Knight 5820XL or SEPTA approved equal is preferred.

B. The main control panel shall be installed where indicated on drawings.

C. The control panel shall include a communication device for monitoring that is programmable by any reputable contractor regularly engaged in the Fire Alarm installation, maintenance, and monitoring business. The use of a second panel that requires attendant action is not permitted.

D. FACP shall be supplemented by Silent Knight Model 5815XL Loop Expanders or SEPTA approved equal for a maximum of four (4) Style 4 SLCs or SEPTA approved equivalent.

E. The fire alarm panel shall utilize a substantially large panel to control the system. Spare points, equal to 25% of the total points, must be provided.

F. The control must be a 24-volt system.

G. The control panel must allow for a minimum of (2) sets of outputs (separate from the connection to the monitoring center) that will allow secondary monitoring (for general signal and trouble only) by SEPTA’s Control Center.

H. The control panel shall have a distinct tone for alarm, trouble, and supervisory conditions.

I. Control panel shall be field programmable.

J. All Programmed device point/zone descriptions must be approved by the Project Manger.

K. Database (site specific software) is the property of SEPTA.

L. Contractor shall provide 120Volt power to the new fire alarm system main panel and any other panel or devices as required to complete the system. (NOTE: The 120Volt power connected to the existing fire alarm system may be re-used to power the new fire alarm panel.)

M. The fire alarm system will require 2 dedicated telephone lines to communicate with the Central Monitoring Station. Contractor shall provide conduit and wiring back to the designated communications room or cabinet as required to allow the new fire alarm system the capability to communicate with the central monitoring station using 2 dedicated telephone lines.

2.02 REMOTE POWER MODULE

A. Remote power module shall be a Silent Knight 5895XL or SEPTA approved equal of the same manufacturer as the Main FACP as specified in section 2.01.

B. The power module must have 6.0 amps of output power, Flexput I/O circuits rated 3.0 amps each, and two Form C relay contacts rated at 2.5 amps at 24 VDC. The power module shall connect to the main FACP via an RS-485 system bus (SBUS). The power module shall contain an additional RS-485 bus that is completely compatible with all add-on modules, including SLC’s expander’s, remote annunciators, and serial/parallel printer interface modules.

C. The power module RS-485 bus shall be optically isolated providing ground loop isolation and transient protection. The unit shall be an SBUS repeater that conditions the signal driving up to 6,000 feet of additional wiring.

2.03 INITIATING CIRCUIT EXPANDER
A. The Contractor shall supply SLC Expander Card(s) (Silent Knight 5815XL or Septa approved equal) to meet the required FACP 4 SLC loop as mentioned in Section 2.01 Part D. the SLC Expander Card(s) must be of the same manufacturer as the main FACP as specified in Section 2.01 Part A.

B. It must allow the addition of 127 addressable devices to the main FACP

C. The signaling circuit card must have the same functionality as the SLC that is built into the main FACP and support the same addressable devices as the main panel.

D. The SLC Expander Card must connect to the panel via the RS 485 bus and is housed in the remote power supply cabinet.

E. The SLC Expander Card cannot reside in its own separate cabinet.

2.04 REMOTE FIRE ALARM ANNUNCIATOR PANEL (FAAP)

A. Remote annunciator shall be installed for the fire alarm system at the location shown on drawings. Additionally, a second remote annunciator shall be provided. Location of this second annunciator is not shown on the drawings. The exact locations of all remote annunciators shall be determined after award of the contract.

B. FAAP shall be a Silent Knight Model SK-5860 or SEPTA approved equivalent.

C. FAAP shall be UL Listed and FM Approved with the main FACP.

D. FAAP shall indicate FACP Fire, Trouble and Supervisory alarm status.

E. FAAP shall control the FACP Acknowledge, Silence and Reset functions.

F. FAAP shall be mounted on a 4-inch square weatherproof backbox.

2.05 BATTERY BACKUP AND PANEL

A. The system must have a backup battery system. The battery back-up power supply shall be capable of operating the system under normal load for a period of at least twenty-four (24) hours followed immediately by a period of five minutes in alarm condition. Battery charger shall be capable of recharging the batteries in a 48-hour period as required by NFPA 72.

B. Notification appliance circuits shall be sized to ensure full functioning of appliances under all permissible voltage conditions for the fire alarm control panel. In other words, appliances have to function at 27 VDC, 24VDC, and even as low as 20.4 VDC (control panel low battery condition as defined by UL).

C. Backup batteries must be of the type that only requires annual charger and discharge tests as required by NFPA 72.

D. The backup batteries must be located in a cabinet separate from the alarm control panel. The panel should be located below or to the side of the alarm control panel. The panel shall be painted red and locked with a cabinet type lock keyed to the SEPTA CAT 30 system.

E. The backup batteries shall be marked with the month and year of manufacture.

2.06 MANUAL PULL STATIONS

A. Fire alarm pull stations shall be Silent Knight Model SK-500PSDA or SEPTA approved equivalent.

B. Fire alarm pull stations shall be dual-action and ADA Compliant.
E. Fire alarm pull stations shall be equipped with a CAT 30 system lock and key prior to installation. NOTE: Contractor shall provide and install the CAT 30 lock cylinders.

F. Fire alarm pull stations that require glass breakage or that have crushable tubes to activate are not acceptable.

J. Manual pull stations shall be mounted at ADA compliant height of 48” to center of handle.

K. Pull station final mounting locations shall be determined in the field with SEPTA Project Management personnel. Unless a pull station final location has been agreed to with SEPTA Project Management it can be subject to relocation at no cost to SEPTA.

2.07 DETECTORS

A. Detector locations shown on drawings are approximate and shall be installed so that they can be safely and easily accessible by ladder or lift. They shall not be installed in locations that make it difficult or impossible to comply with periodic inspection and cleaning requirements. This requires careful consideration of space for ladder or lift movement, positioning, and installation. Use of an extension ladder requires a safe anchor point for the ladder. Further, pipes, air vents, ducts, etc. should be considered for their impact on Fire Alarm Device accessibility.

B. In all cases, the selection and mounting location of smoke detectors shall be influenced by the ease of maintenance to include sensitivity testing.

C. The selection and exact placement of smoke detectors shall take into account both the performance characteristics of the detector and the areas into which the detectors are to be installed to prevent nuisance alarms or improper operation after installation.

D. The smoke detectors shall be provided with dust covers, which could be used as temporary covers when workmen are working in an area. These covers must be turned over to SEPTA EM&C Administration Department upon turnover of the system.

E. Smoke detectors shall have a visual indicator to indicate the status of the detector.

F. Smoke detectors shall be Silent Knight Model SD505-APS or SEPTA approved equivalent.

G. Heat detectors shall be Silent Knight Model SD505-AHS or SEPTA approved equivalent.

2.08 DUCT SMOKE DETECTORS

A. Duct smoke detectors shall be provided and installed where shown on contract drawings by the Fire Alarm contractor on any HVAC air handler and/or make up air handler. Duct smoke detector shall be mounted within five feet of the fire/smoke damper provided and installed by the mechanical contractor.

B. Duct detector shall be Silent Knight Model SD505-ADHR or SEPTA approved equivalent.

C. Duct detector housings shall be UL listed with the respective smoke detector.

D. Contractor is responsible for designing, installing and submitting for approval all components and methods of accomplishing HVAC and/or make-up air handler shut downs.

E. Contractor shall provide and install all parts and material required to perform the shutdown of the air handler unit(s) and/or actuation of any smoke evacuation fans.

2.09 ADDRESSABLE MONITORING MODULES
A. Provide Silent Knight SD500-AIM or SEPTA approved equal addressable monitor module for monitoring a single two-wire point device.

2.10 OUTPUT RELAY MODULE

A. Fire Alarm System Output relay modules shall be used to control the shutdown and/or operational inputs to supplemental equipment (i.e. HVAC systems or fire/smoke dampers).

B. Relay Module shall be Silent Knight Model SD500-ARM or SEPTA approved equivalent.

C. Relay Module shall be UL Listed and FM approved with the main FACP.

D. Relay Module shall be mounted in a 4-inch square box within three (3) feet of the connected equipment.

E. Fire alarm contractor shall provide and install all conduit and wiring from the output relay module to the connected equipment.

F. Fire Alarm contractor shall make final termination to the connected equipment.

2.11 NOTIFICATION APPLIANCES

A. Notification Appliances shall be manufactured by Wheelock, or approved equal as specified below:
   1. All notification appliances are to be of tamper proof design. Any tool required to remove these devices are to be turned over to SEPTA upon completion of the project.
   2. All Horn/strobe units (wall mounted) shall be a Wheelock Model ASWP-2475W-FR with a Model WPBB-R and WP-KIT weatherproof back box or SEPTA approved equivalent.
   3. All Horn/strobe units (ceiling mounted) shall be a Wheelock Model ASWP-2475C-FR and WFPA or SEPTA approved equivalent. Round type shall be permitted but must be approved by the Project Manager.
   4. All Strobe units (wall mounted) shall be a Wheelock Model RSSWP-2475W-FR with a Model WP SBB-R and WP-KIT weatherproof back box or SEPTA approved equivalent.
   5. All Strobe units (ceiling mounted) shall be Wheelock Model RSSWP model types. Round type shall be permitted but must be approved by the Project Manager.

B. All horn/strobes are to be synced to comply with ADA requirements.

C. Upon fire alarm system silencing the horns shall go silent BUT the strobes will continue to flash until the fire alarm system has been reset.

2.12 SURGE PROTECTION MODULES

A. Contractor shall provide and install surge protection for the incoming power to the fire alarm main panel and all remote power supply panels. Protection device shall be mounted either in or adjacent to each fire alarm panel and not at the electrical distribution panel serving the fire alarm panel(s).

B. Provide surge protection for panel communication, SLC and NAC circuits where they extend beyond any building enclosure.

C. The surge protection shall be a Ditek Model DTK-120SR Module or SEPTA approved equivalent for incoming fire alarm panel power circuits.
D. The surge protection shall be a Ditek Model 2MHLP36B-WB module and base or SEPTA approved equivalent for communication, SLC and notification circuits.
E. Surge protector ground wires shall be run as straight as possible and have a minimum separation distance of 3 feet from FACP and FSSCP.
F. Surge protection shall be UL 497B Listed and be compatible with the FACP.
G. Surge protection shall be installed in accordance with Manufacturer’s installation instructions.
H. Wire connections shall utilize screw terminal connections.

2.13 SUPPLEMENTARY AND OTHER FIRE ALARM SYSTEM DEVICES
A. Remote power supply modules shall be of the same manufacturer of the fire alarm system main panel.
B. Sprinkler System fire alarm monitoring modules shall be installed in one enclosure adjacent to each riser for easier troubleshooting of these devices. Enclosure must be Stainless Steel and NEMA 4x construction. Monitoring Modules must be mounted on DIN rails within this enclosure.
C. In addition to the control panel and the cabinet for the back up batteries, an additional cabinet shall be provided to hold the Fire Alarm System Manual. The cabinet should be located below or to the side of the alarm control panel. The cabinet shall be painted red, labeled with "Fire Alarm System Manual" and locked with a cabinet type lock keyed to the SEPTA CAT 30 system.

2.14 FIRE ALARM SYSTEM POWER, RACEWAY AND WIRING
A. The contractor shall label all raceway used for the fire alarm system as “FIRE ALARM SYSTEM". Labels shall be waterproof (peal-off type). The words labels should be placed on every connection box. Connection box labels should be octagon shaped and measure 3” across. Conduit should be labeled at a minimum of every 20 feet; shorter lengths of conduit between connection boxes should be labeled at the midway point. Conduit labels should be rectangular shaped and measure ¾” wide by 5 ½” long. Labels are available through SEPTA EM&C Contract Services.
B. The raceway shall be installed in a manner that considers the effects of electrical and Radio Frequency noise to prevent or minimize induced or electromagnetic interference.
C. Conduits and/or wiring shall not be installed less than 12 inches from any conduit or exposed electrical bus work and/or distribution panel containing 480Volt or higher voltage electrical conductors.
D. Cast metal or plastic molded boxes (not sheet metal) shall be used for surface mounting any device(s) to any exposed wall surface or support beam (i.e. in the ceiling, electrical substations, mechanical rooms, etc.) Silent Knight Model SB-I/0 Surface mount box or SEPTA approved equivalent.
E. Standard sheet metal (1900 Style) back boxes shall be permitted for use on non-surface mounted devices for office areas.
F. Existing conduits and/or suspended ceiling support systems cannot be used to mount new conduits or device back boxes.
G. The distance between connection (junction) boxes for the Fire Alarm system should not exceed 100 feet.
H. The Fire Alarm conduit shall be a minimum of ¾” (EMT) with compression fittings (set screw type connectors are not permitted) and appropriately sized for the cable it will carry and allow for 25% expansion. Non-fire alarm cable shall not be installed in any fire alarm conduit.

I. FMC (Flexible Metal Conduit) conduit shall be permitted to be used only above suspended ceiling and/or within walls and shall be 100% concealed from eyesight during normal operating conditions and shall be a minimum of ¾” and shall not exceed 10 feet. (NOTE: Must be metal lined type).

J. Conduits connecting wet or dry sprinkler system water flow, tamper and/or low air switches shall be Flexible Liquid Tight (ie.: Seal-Tite) style from the wall to each fire alarm device(s).

K. Any/all penetration into the buildings shall be properly and professionally sealed to prevent water/weather infiltration into the buildings.

L. The Fire Alarm system notification circuit shall be a minimum of 14 gauge; the initiating circuit shall be a minimum of 18 gauge.

M. Conductors and Wiring material and methods shall meet all NFPA, NEC and local code requirements.

N. Wires shall be color-coded and labeled to allow zone identification at terminal and junction locations. Zone identification labels must be of high quality and equal to the 3M ScotchCode Wire Marking Tape.

O. If the installation is located where it has an increased potential risk of damage from vehicle damage or vandalism this portion of the conduit shall be required to be rigid steel (EMT will not be permitted in these situations). Review these locations with the project manager prior to procuring and installing conduits. Project Manager has the right to have any section of EMT changed to Rigid Steel even if EMT has already been installed and at no additional cost to SEPTA.

P. If the installation is located in an area that requires an explosion proof system, the installation should be in accordance with NFPA 69.

2.15 FIRE ALARM ACTIVATION SEQUENCE

A. The fire alarm system shall go into full fire alarm (all notification devices in the building will activate and all output relays will activate) upon activation of any fire alarm initiating device water flow, pull station, heat detector and/or smoke detector in either building.

B. Exception to Part A above; For HVAC shutdown, the HVAC system shall shutdown upon activation of any heat, smoke or duct smoke detector only. Manual pull stations will not activate HVAC shutdown.

C. Contractor shall provide a fire alarm activation matrix in the as-built documentation describing the activation of any/all input devices with respect to all the fire alarm output devices.

2.16 FIRE ALARM SYSTEM IDENTIFICATION

A. All of the below required system identification techniques shall be incorporated into the shop drawings.

B. Design must provide for the complete labeling (with waterproof labels) of all Fire Alarm system devices (detectors, pull stations, relays, etc.) with an address.

C. Field devices shall be labeled with their address both on the device and on the back box and/or mounting plate. Address labels must be easily seen without the use of a ladder.
D. Device address labels are to be typed letters not hand written.

2.17 FIRE ALARM SYSTEM FUNCTIONAL TESTS
A. General Testing Requirements – Ensure notification to the SEPTA Project Manager in writing of the date, time, and location of the scheduled date and time of all fire alarm system testing. This notification must be at least four (4) weeks prior to each test, such that the SEPTA Project Manager or his authorized representative may witness the test, at the option of the SEPTA Project Manager.

B. The Fire Alarm system must be functionally tested in accordance with NFPA 72 and FM Global standards.

PART 3 - EXECUTION

3.01 ACCEPTANCE
A. The contractor will be responsible for maintenance and response to alarms until the newly installed Fire Alarm system responsibility is turned over to SEPTA E, M,&C. Acceptance will not take place until the Fire Alarm system is completely and satisfactorily installed, the facility work is completed, all training has been provided, and documentation as contained in this specification is provided to the SEPTA Project Manager.

B. Once acceptance takes place, the contractor is not permitted to perform any Fire Alarm system punch list work, installation, service, connection, etc. without the specified approval of SEPTA EM&C Contract Services.

C. The equipment transferred from the Contractor to SEPTA must be free of dust, dirt, metal shavings, etc.

D. When ready for acceptance, the alarm contractor is to provide a separate overview briefing to SEPTA management (to include but not limited to: Fire Marshal, and representatives from EM&C Contract Services and Facilities) at a mutually agreed time. This briefing will be followed by a “walk-through” of the system to physically view the system devices and an activation of the Fire Alarm.

E. At the above overview briefing, the contractor must supply SEPTA the below items and documentation. All of the items must be formally and professionally presented to SEPTA. Further, all items requiring signature must contain the printed or typed signature block of the signatory.

1. Provide installing contractor’s written statement stating that the system has been installed in accordance with approved plans and tested in accordance with the manufacturer’s specifications and the appropriate NFPA requirements.

2. Provide a hardcopy and MSExcel versions of the zone list with its descriptions as installed in the fire alarm system. (NOTE: Final Zone list descriptions must be approved by the Project Manager prior to being installed in the fire alarm system.)

3. Provide a “Record of Completion” as defined in NFPA 72.

4. Provide a “Record of Alarm Inspection, Testing, and Certification.” This record must include all applicable items contained in Chapter 10 of NFPA 72 plus include an audibility record that provides a record of ambient and alarm level dBA. This audibility record must be identified for each section, room, etc. of the facility.

5. Provide a copy of the Fire Alarm permit submittal and approval by the City of Philadelphia.
6. Provide a copy of the final electrical inspection performed on this installation.
7. Provide a copy of UL certificates or FM placards.
8. Provide four sets of all keys to the Fire Alarm system.
9. Provide dust covers for smoke detectors in a quantity equal to the number of smoke detectors.
11. Provide a record of the installed Operating System Software (sometimes referred to as firmware, BIOS, or Executive Program) and site-specific software (runs at a level below the operating system software and is specific to the Fire Alarm System installation) version numbers.
12. Provide two copies of the site-specific software.
13. Provide four sets of the field marked up contractor’s “shop drawings” and final project As-Built Drawings. These drawings must contain the following minimum information as indicated below.
   a. At a minimum, Shop and As-Built Drawings must include floor plan drawings, riser diagrams, control panel wiring diagrams, point-to-point wiring diagrams, and typical wiring diagrams as described herein.
   b. Floor plan drawings shall be drawn to an indicated scale and should include the following information:
      1) Property name and address
      2) Device Legend (NOTE: Heat Detectors shall be separately identified as to “Rate-of-Rise” or “Fixed.”)
      3) Date
      4) Floor identification.
      5) Point of Compass.
      6) Graphic Scale.
      7) All walls and doors.
      8) All partitions extending to within 18 inches of the ceiling.
      9) Room (and Bay if applicable) descriptions (and use) and numbers.
     10) Closets (that allow walk-in) shall be included in the drawings.
     11) Fire Alarm controls, annunciators, initiating and notification device/component locations (must include connections to suppression systems, elevators, HVAC, etc.). The Fire Alarm Identification System described in this document shall be utilized to record the address of devices on the drawings.
     12) Location of fire alarm primary and remote power connection(s).
     13) Location of expansion controls.
     14) Locations of monitor/control interfaces to other and/or supplementary systems.
     15) All Riser locations
   c. Fire alarm system riser diagrams shall include the following information:
      1) General arrangement of the system, in building cross-section.
      2) Number of risers.
      3) Point-to-Point Wiring Diagram
      4) Type and number of circuits in each riser.
      5) Type and number of fire alarm system components/devices on each circuit.
   d. Control panel wiring diagrams shall be provided for all control equipment (i.e. equipment listed as either a control unit or control unit accessory), power supplies, battery chargers, and annunciators and shall include the following minimum information:
      1) Identification of the control equipment depicted.
      2) Physical Location(s) of all equipment.
3) All field wiring terminals and terminal identification.
4) Details of all circuits connected to field wiring terminals and circuit identifications and color coding schemes.
5) All indicators and manual controls, including the full text of all labels.
6) All field connections to supervising station signaling equipment, releasing equipment, and fire safety control interfaces.
7) Location of wiring and junction boxes.
8) Type of Cable or wiring method used on each circuit (to include manufacturer).
9) Cable routing.
  e. Typical wiring diagrams shall be provided for all initiating devices, notification appliances, remote alarm light emitting diodes (LED'S), remote test stations, and end-of-line and power supervisory devices.

14. Provide As-Built Drawings in ACAD format (on a CD).

F. Upon satisfactory completion of the acceptance requirements, the contractor shall coordinate with SEPTA EM&C Contract Services, the exact date of cut over of system monitoring to the current fire alarm monitoring contractor. Successful programming of the system to the fire alarm monitoring contractor will complete the acceptance process.

G. Contractor shall provide qualified personnel to support the fire alarm system cut over to the monitoring service.

3.02 SITE AND EQUIPMENT CLEAN UP

A. Contractor shall clean up any debris left at the site due to their construction efforts (i.e. packing materials from products used, concrete dust from core drilling holes and/or anchors, metal shavings from drilling into metallic material, etc.)

3.03 FIRE ALARM MONITORING CUTOVER

A. Contractor shall be responsible for all payments to the current fire alarm monitoring company (TycoIS) for the final installation (cut over) of this fire alarm system to their database.

B. The Contractor shall be solely responsible for coordinating with TycoIS and confirming that their monitoring practices and protocols are compliant with the fire alarm system design and final installation.

C. SEPTA Project Manager shall be responsible for coordinating the installation with the current fire alarm monitoring company (TycoIS).

END OF SPECIFICATION
SECTION 13930
WET-PIPE FIRE-SUPPRESSION SPRINKLERS

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Pipes, fittings, and specialties.
   2. Fire-protection valves.
   3. Fire-department connections.
   4. Sprinklers.
   5. Alarm devices.

1.03 DEFINITIONS
A. Standard-Pressure Sprinkler Piping: Wet-pipe sprinkler system piping designed to operate at working pressure of 175 psig maximum.

1.04 SYSTEM DESCRIPTIONS
A. Wet-Pipe Sprinkler System: Automatic sprinklers are attached to piping containing water which is connected to a water supply through an alarm valve. Water discharges immediately from sprinklers when they are opened. Sprinklers open when heat melts a fusible link or destroys a frangible device.

1.05 PERFORMANCE REQUIREMENTS
A. Standard-Pressure Piping System Component: Listed for 175-psig minimum working pressure.

B. Delegated Design: Design sprinkler system(s), including comprehensive engineering analysis by a qualified professional engineer licensed in the Commonwealth of Pennsylvania, using performance requirements and design criteria indicated.

1. Available fire-hydrant flow test records indicate the following conditions:
   a. Date: December 23, 2014.
   b. Time: 9:45 AM
   c. Performed by: City of Philadelphia Water Department.
d. Location of Residual Fire Hydrant R: North side of Dyre Street, 14 ft. east of Griscom Street.
e. Location of Flow Fire Hydrant F: East side of Griscom Street, 109 ft. south of Dyre Street.
f. Static Pressure at Residual Fire Hydrant R: 68 psi.
h. Residual Pressure at Residual Fire Hydrant R: 56 psi.

C. Sprinkler system design shall be approved by authorities having jurisdiction.

1. Margin of Safety for Available Water Flow and Pressure: 10 percent or 10 psi (whichever is greater), 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 2.
   d. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
   e. Office and Public Areas: Light Hazard.
3. Minimum Density for Automatic-Sprinkler Piping Design:
   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.
   c. Ordinary-Hazard, Group 2 Occupancy: 0.20 gpm over 1500-sq. ft. area.
4. 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 FM Global Data Sheet 2-0 recommendations unless otherwise indicated.
5. Total Combined Hose-Stream Demand Requirement: According to NFPA 13 unless otherwise indicated:
   a. Light-Hazard Occupancies: 100 gpm for 30 minutes.
   b. Ordinary-Hazard Occupancies: 250 gpm for 60 to 90 minutes.

1.06 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.

C. Delegated-Design Submittal: For sprinkler systems indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by a qualified professional engineer licensed in the Commonwealth of Pennsylvania responsible for their preparation.

D. Coordination Drawings: Sprinkler systems, 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.
2. Compressed air piping.
3. HVAC hydronic piping.
4. Items penetrating finished ceiling include the following:
   a. Lighting fixtures.
   b. Air outlets and inlets.
   c. Fire alarm notification and detection devices

E. Qualification Data: For qualified Installer and professional engineer.

F. Approved Sprinkler Piping Drawings: Working plans, prepared according to FM Global Data Sheet 2-0, that have been approved by authorities having jurisdiction, including hydraulic calculations.

G. Welding certificates.

H. Fire-hydrant flow test report.

I. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in FM Global Data Sheet 2-0. Include "Contractor's Material and Test Certificate for Aboveground Piping."

J. Field quality-control reports.

K. Operation and Maintenance Data: For sprinkler specialties to include in emergency, operation, and maintenance manuals.

1.07 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.


B. Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

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.

D. Sprinkler system equipment, specialties, accessories, installation, and testing shall comply with the following:

   1. FM Global Data Sheet 2.0 – Installation Guidelines for Automatic Sprinklers.

   2. NFPA 13, "Installation of Sprinkler Systems."
1.08 COORDINATION

A. Coordinate layout and installation of sprinklers with other construction that penetrates ceilings, including light fixtures, HVAC equipment, and partition assemblies.

1.09 EXTRA MATERIALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Sprinkler Cabinets: Finished, wall-mounted, steel cabinet with hinged cover, and with space for minimum of six spare sprinklers plus sprinkler wrench. Include number of sprinklers required by NFPA 13 and sprinkler wrench. Include separate cabinet with sprinklers and wrench for each type of sprinkler used on Project.

PART 2 - PRODUCTS

2.01 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.

2.02 STEEL PIPE AND FITTINGS

A. Schedule 40, Black 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, Black-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, plain end.


D. Uncoated, Steel Couplings: ASTM A 865, threaded.


F. Malleable- or Ductile-Iron Unions: UL 860.


H. Steel Flanges and Flanged Fittings: ASME B16.5, Class 150.


J. Grooved-Joint, Steel-Pipe Appurtenances:

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:
2. Pressure Rating: 300 psig minimum.
3. Uncoated, 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.

**2.03 PIPING JOINING MATERIALS**

A. Pipe-Flange Gasket Materials: AWWA C110, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free.

1. Class 125, Cast-Iron Flanges and Class 150, Bronze Flat-Face Flanges: Full-face gaskets.
2. Class 250, Cast-Iron Flanges and Class 300, Steel Raised-Face Flanges: Ring-type gaskets.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Welding Filler Metals: Comply with AWS D10.12M/D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

**2.04 LISTED FIRE-PROTECTION VALVES**

A. General Requirements:

1. Valves shall be UL listed and FM approved.

B. Ball Valves:

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. Anvil International, Inc.
   b. Victaulic Company.

2. Standard: UL 1091 except with ball instead of disc.
3. Valves NPS 1-1/2 and Smaller: Bronze body with threaded ends.
4. Valves NPS 2 and NPS 2-1/2: Bronze body with threaded ends or ductile-iron body with grooved ends.
5. Valves NPS 3: Ductile-iron body with grooved ends.

C. Iron Butterfly Valves:
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. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Pratt, Henry Company.
   h. Shurjoint Piping Products.
   i. Tyco Fire & Building Products LP.
   j. Victaulic Company.

2. Standard: UL 1091.
4. Body Material: Cast or ductile iron.
5. Style: Lug or wafer.

D. Check Valves:

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. AFAC Inc.
   b. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   c. Anvil International, Inc.
   d. Clow Valve Company; a division of McWane, Inc.
   e. Crane Co.; Crane Valve Group; Crane Valves.
   f. Crane Co.; Crane Valve Group; Jenkins Valves.
   g. Crane Co.; Crane Valve Group; Stockham Division.
   h. Fire-End & Croker Corporation.
   i. Fire Protection Products, Inc.
   j. Fivalco Inc.
   k. Globe Fire Sprinkler Corporation.
   l. Groeniger & Company.
   m. Kennedy Valve; a division of McWane, Inc.
   n. Matco-Norca.
   o. Metraflex, Inc.
   p. Milwaukee Valve Company.
   q. Mueller Co.; Water Products Division.
   r. NIBCO INC.
   s. Potter Roemer.
   t. Reliable Automatic Sprinkler Co., Inc.
   u. Shurjoint Piping Products.
   v. Tyco Fire & Building Products LP.
   w. United Brass Works, Inc.
   x. Venus Fire Protection Ltd.
   y. Victaulic Company.
   z. Viking Corporation.
   aa. Watts Water Technologies, Inc.

4. Type: Swing check.
5. Body Material: Cast iron.
6. End Connections: Flanged or grooved.

E. 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. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Crane Valves.
   e. Crane Co.; Crane Valve Group; Jenkins Valves.
   f. Crane Co.; Crane Valve Group; Stockham Division.
   g. Hammond Valve.
   h. Milwaukee Valve Company.
   i. Mueller Co.; Water Products Division.
   j. NIBCO INC.
   k. Shurjoint Piping Products.
   l. Tyco Fire & Building Products LP.
   m. United Brass Works, Inc.
   n. Watts Water Technologies, Inc.

4. Body Material: Cast or ductile iron.
5. End Connections: Flanged or grooved.

F. Indicating-Type Butterfly Valves:

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. Anvil International, Inc.
   b. Fivalco Inc.
   c. Global Safety Products, Inc.
   d. Kennedy Valve; a division of McWane, Inc.
   e. Milwaukee Valve Company.
   f. NIBCO INC.
   g. Shurjoint Piping Products.
   h. Tyco Fire & Building Products LP.
   i. Victaulic Company.

2. Standard: UL 1091.
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.


G. NRS Gate Valves:

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. American Cast Iron Pipe Company; Waterous Company Subsidiary.
   b. American Valve, Inc.
   c. Clow Valve Company; a division of McWane, Inc.
   d. Crane Co.; Crane Valve Group; Stockham Division.
   e. Kennedy Valve; a division of McWane, Inc.
   f. Mueller Co.; Water Products Division.
   g. NIBCO INC.
   h. Tyco Fire & Building Products LP.

5. Stem: Nonrising.
6. End Connections: Flanged or grooved.

2.05 TRIM AND DRAIN VALVES

A. General Requirements:

2. Pressure Rating: 175 psig minimum.

B. Angle Valves:

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. Fire Protection Products, Inc.
   b. United Brass Works, Inc.

C. Ball Valves:

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. Affiliated Distributors.
   b. Anvil International, Inc.
   c. Barnett.
d. Conbraco Industries, Inc.; Apollo Valves.
e. Fire-End & Croker Corporation.
f. Fire Protection Products, Inc.
g. Flowserve.
h. FNW.
i. Jomar International, Ltd.
j. Kennedy Valve; a division of McWane, Inc.
k. Kitz Corporation.
l. Legend Valve.
m. Metso Automation USA Inc.
n. Milwaukee Valve Company.
o. NIBCO INC.
p. Potter Roemer.
q. Red-White Valve Corporation.
r. Southern Manufacturing Group.
s. Stewart, M. A. and Sons Ltd.
t. Tyco Fire & Building Products LP.
u. Victaulic Company.
v. Watts Water Technologies, Inc.

D. Globe Valves:

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:

2.06 SPECIALTY VALVES

A. General Requirements:

2. Pressure Rating:
   a. Standard-Pressure Piping Specialty Valves: 175 psig minimum.
3. Body Material: Cast or ductile iron.
4. Size: Same as connected piping.
5. End Connections: Flanged or grooved.

B. Riser Check Valves:

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. AFAC Inc.
   c. Reliable Automatic Sprinkler Co., Inc.
   d. Tyco Fire & Building Products LP.
   e. Venus Fire Protection Ltd.
   f. Victaulic Company.
   g. Viking Corporation.
3. Design: For vertical installation.
4. Include trim sets for bypass, drain, pressure gages.

C. Automatic (Ball Drip) Drain Valves:

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. AFAC Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.

4. Type: Automatic draining, ball check.

2.07 FIRE-DEPARTMENT CONNECTIONS

A. Flush-Type, Fire-Department Connection:

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. AFAC Inc.
   c. GMR International Equipment Corporation.
   d. Guardian Fire Equipment, Inc.
   e. Potter Roemer.

3. Type: Flush, for wall mounting.
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.
11. Number of Inlets: Two.
12. Outlet Location: Back.
13. Escutcheon Plate Marking: Similar to "AUTO SPKR."
2.08 SPRINKLER SPECIALTY PIPE FITTINGS

A. Branch Outlet Fittings:

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. Anvil International, Inc.
   b. National Fittings, Inc.
   c. Shurjoint Piping Products.
   d. Tyco Fire & Building Products LP.
   e. Victaulic Company.

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. Flow Detection and Test Assemblies:

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. AGF Manufacturing Inc.
   b. Reliable Automatic Sprinkler Co., Inc.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.

4. Body Material: Cast- or ductile-iron housing with orifice, sight glass, and integral test valve.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

C. Sprinkler Inspector's Test Fittings:

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. AGF Manufacturing Inc.
   b. Triple R Specialty.
   c. Tyco Fire & Building Products LP.
   d. Victaulic Company.
   e. Viking Corporation.
4. Body Material: Cast- or ductile-iron housing with sight glass.
5. Size: Same as connected piping.
6. Inlet and Outlet: Threaded.

2.09 SPRINKLERS

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. AFAC Inc.
3. Reliable Automatic Sprinkler Co., Inc.
4. Tyco Fire & Building Products LP.
5. Venus Fire Protection Ltd.

B. General Requirements:


C. Automatic Sprinklers with Heat-Responsive Element:

1. Nonresidential Applications: UL 199.
2. Characteristics: Nominal 1/2-inch orifice with Discharge Coefficient K of 5.6, and for "Ordinary" temperature classification rating unless otherwise indicated or required by application.

D. Sprinkler Finishes:

1. Chrome plated.
2. Bronze.

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.

F. Sprinkler Guards:

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. 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.

### 2.10 ALARM DEVICES

A. Alarm-device types shall match piping and equipment connections.

B. Water-Flow Indicators:

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:
   - ADT Security Services, Inc.
   - McDonnell & Miller; ITT Industries.
   - Potter Electric Signal Company.
   - System Sensor; a Honeywell company.
   - Viking Corporation.
   - Watts Industries (Canada) Inc.

4. Components: Two single-pole, double-throw circuit switches for 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 if removed.
5. Type: Paddle operated.
7. Design Installation: Horizontal or vertical.

C. Valve Supervisory Switches:

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:
   - Fire-Lite Alarms, Inc.; a Honeywell company.
   - Kennedy Valve; a division of McWane, Inc.
   - Potter Electric Signal Company.
   - System Sensor; a Honeywell company.

3. Type: Electrically supervised.
5. Design: Signals that controlled valve is in other than fully open position.

### 2.11 PRESSURE GAGES

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. AMETEK; U.S. Gauge Division.
2. Ashcroft, Inc.
3. **Brecco Corporation.**
4. **WIKA Instrument Corporation.**

B. **Standard:** UL 393.

C. **Dial Size:** 3-1/2- to 4-1/2-inch diameter.

D. **Pressure Gage Range:** 0 to 250 psig minimum.

E. **Water System Piping Gage:** Include "WATER" label on dial face.

**PART 3 - EXECUTION**

**3.01 PREPARATION**

A. Perform fire-hydrant flow test according to NFPA 13 and NFPA 291. Use results for system design calculations required in "Quality Assurance" Article.

B. Report test results promptly and in writing.

**3.02 WATER-SUPPLY CONNECTIONS**

A. Install shutoff valve, backflow preventer, pressure gage, drain, and other accessories indicated at connection to water-distribution piping.

B. Install shutoff valve, check valve, pressure gage, and drain at connection to water supply.

**3.03 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 FM Global Data Sheet 2-0: Installation Guidelines for Automatic Sprinklers.

C. Use listed fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

D. Install unions adjacent to each valve in pipes NPS 2 and smaller.

E. Install flanges, flange adapters, or couplings for grooved-end piping on valves, apparatus, and equipment having NPS 2-1/2 and larger end connections.

F. Install "Inspector's Test Connections" in sprinkler system piping, complete with shutoff valve, and sized and located according to FM Global Data Sheet 2-0.

G. Install sprinkler piping with drains for complete system drainage.
H. Install sprinkler control valves, test assemblies, and drain risers adjacent to standpipes when sprinkler piping is connected to standpipes.

I. Install automatic (ball drip) drain valve at each check valve for fire-department connection, to drain piping between fire-department connection and check valve. Install drain piping to and spill over floor drain or to outside building.

J. Install alarm devices in piping systems.

K. Install hangers and supports for sprinkler system piping according to FM Global Data Sheet 2-0. Comply with requirements for hanger materials in FM Global Data Sheet 2-0.

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.

O. Install sleeve seals for piping penetrations of concrete walls and slabs.

P. Install escutcheons for piping penetrations of walls, ceilings, and floors.

3.04 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. Welded Joints: Construct joints according to AWS D10.12M/D10.12, using qualified processes and welding operators according to “Quality Assurance” Article.
1. Shop weld pipe joints where welded piping is indicated. Do not use welded joints for galvanized-steel pipe.

I. 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.

J. 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.

K. Steel-Piping, Pressure-Sealed Joints: Join Schedule 5 steel pipe and steel pressure-seal fittings with tools recommended by fitting manufacturer.

3.05 VALVE AND SPECIALTIES INSTALLATION

A. Install listed fire-protection valves, trim and drain valves, specialty valves and trim, controls, and specialties according to FM Global Data Sheet 2-0 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. Install check valve in each water-supply connection. Install backflow preventers instead of check valves in potable-water-supply sources.

D. Specialty Valves:
   1. General Requirements: Install in vertical position for proper direction of flow, in main supply to system.

3.06 SPRINKLER INSTALLATION

A. Install sprinklers in suspended ceilings in center of acoustical ceiling panels.

3.07 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.

3.08 IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in FM Global Data Sheet 2-0.

B. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 16075 “Electrical Identification.”
3.09 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 FM Global Data Sheet 2-0.
   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.

3.10 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers with paint other than factory finish.

3.11 DEMONSTRATION

A. Train Owner's maintenance personnel to adjust, operate, and maintain specialty valves.

3.12 PIPING SCHEDULE

A. Piping between Fire-Department Connections and Check Valves: Galvanized, Schedule 40 pipe with threaded ends and threaded joints.

B. Standard-pressure, wet-pipe sprinkler system, NPS 2 and smaller, shall be the following:
   1. 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 and larger, may be one of the following:
   1. Schedule 10, black-steel pipe with roll-grooved ends; uncoated, grooved-end fittings for steel piping; grooved-end-pipe couplings for steel piping; and grooved joints.
   2. Schedule 10, black-steel pipe with plain ends; welding fittings; and welded joints.

3.13 SPRINKLER SCHEDULE

A. Use sprinkler types in subparagraphs below for the following applications:
1. Rooms without Ceilings: Upright pendent or sprinklers.
2. Rooms with Suspended Ceilings: Concealed sprinklers.

B. Provide sprinkler types in subparagraphs below with finishes indicated.

1. Concealed Sprinklers: Rough brass, with factory-painted white cover plate.
2. Upright or Pendent 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 15010

BASIC MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.01 DESCRIPTION

A. Provide all labor and material, equipment and appliances and perform all operations for the work as outlined in the specifications and delineated on the Contract Drawings. All work shall be performed in strict accordance with these specifications and the Contract Drawings.

1.02 RELATED SECTIONS

A. Section 01300 – Submittals
B. Division 15: Mechanical, specifically:
   1. Section 15050 – Basic Mechanical Materials and Methods

1.03 REFERENCES

A. ANSI: American National Standards Institute
   1. ANSI B31.1 – Power Piping
B. SSPC: Steel Structures Painting Council, Surface Preparation Specifications
   1. SSPC-SP 2, Hand Tool Cleaning.
   2. SSPC-SP 6, Commercial Blast Cleaning.
   3. SSPC-SP 8, Pickling.
   4. SSPC-PA 1, Paint Application Specifications: Shop, Field and Maintenance Painting.
C. NFPA: National Fire Protection Association
D. UL: Underwriters Laboratories Inc.

1.04 SUBMITTALS

A. Submit under the provisions of Section 01300
B. Product Data: Submit Product Data applicable to items listed under Submittals in each Section of Division 15; and such items as may be scheduled on the Drawings
C. Shop Drawings: Submit shop drawings applicable to items listed under Submittals in each Section of Division 15; and such items as may be scheduled on the Drawings.

D. Operation and Maintenance Manuals: Submit operation and maintenance manuals (prepared by product manufacturers or Contractor) for each Section of Division 15; and such items as may be scheduled on the Drawings.

1.05 QUALITY CONTROL

A. Requirements of Regulatory Agencies: Comply with construction requirements of State, County, and such other local political subdivision specifications as may exceed the requirements of the codes, standards, and approving bodies referenced herein.

B. Comply with requirements of FM Global Data Sheets referenced in the various specification sections and as directly appropriate to the work and workmanship of this contract.
   1. Comply with requirements of the National Fire Protection Association (NFPA) Standards referenced in the various Specifications Sections, and as directly appropriate to the work and workmanship of this contract.
   2. Comply with requirements for both the Underwriters' Laboratories, Inc. (UL) Listings, Labels, and Approvals and the National Electrical Manufacturers' Associations (NEMA) Stamps or Seals as applicable to electrical equipment or apparatus forming parts of the Mechanical Equipment.

C. Certificates and permits: Upon completion of work, and prior to final payment, furnish to the Project Manager formal certification of final inspections from authorities having jurisdiction and secure required permits, if any, from such authorities. Additionally, prepare detailed diagrams and drawings, which may be required by those authorities having jurisdiction.

D. Certificates and Permits: Upon completion of work, and prior to final payment, furnish to the Project Manager formal certification of final inspections from authorities having jurisdiction and secure required permits, if any, from such authorities. Additionally, prepare detailed diagrams and drawings, which may be required by those authorities having jurisdiction.

E. Source Quality Control: Products used throughout these specifications, are those of companies having established reputations in the manufacture of the particular materials, equipment, or apparatus specified. Such products may be of their own make, or products of others for which they assume full responsibility when used in said outfits (which are not manufactured completely by them), and with replacement parts available.

F. Workmen's Qualifications: In acceptance or rejection of completed work, no allowance will be made for lack of skill on the part of the Contractor's forces performing such work.

G. Provide certified pipe welder(s) capable of welding in accordance with ANSI B31.1, Power Piping (Pressure Piping). Show proof of certification when requested by the Project Manager.

H. Reference Standards:

1. Steel Structures Painting Council (SSPC) Surface Preparation Specifications:
   a. SSPC-SP 2, Hand Tool Cleaning.
   b. SSPC-SP 6, Commercial Blast Cleaning.
1.06 JOB CONDITIONS

A. Install or mount as work of Division 15 – Mechanical, such electrical components or apparatus as provided by Product Manufacturer’s specified under the various Sections of this Division 15.

PART 2 - PRODUCTS

2.01 MATERIALS

A. Products: Material particulars and requirements are as specified in the various Sections included under Division 15 – Mechanical.

B. Piping System Specifications as applicable to several Mechanical Specifications Sections are specified in Section 15050. Products applicable to specific Mechanical Specifications Sections, or for special applications, are specified in those Sections.

C. Provide products of new and recent manufacturer.

D. For each category of materials and equipment (Products), provide Products of the same manufacturer and type.

PART 3 - EXECUTION

3.01 INSTALLATIONS

A. General Requirements: Installation particulars and requirements are as specified in the various Sections included under Division 15 - Mechanical.
   1. Perform required interconnection of the differing mechanical systems to the various mechanical equipment, devices, or apparatus, regardless of where such Products are specified throughout Division 15 - Mechanical, in order to ensure the completeness of such mechanical systems.
   2. Install mechanical equipment level, unless indicated or directed otherwise.

B. Factory finishes and field painting:
   1. General Requirements: Painting of the materials, equipment, apparatus, and items installed as work of this Contract will be painted as specified under Section 09900.
      a. The above requirement does not apply to fully factory-finished items, that is, items having factory-applied primer and final finish coatings, except as specified in the following paragraphs.
      b. Painting factory finished items will be required in the cases where the factory finish is damaged. Such painting will be performed by this Contract, and as specified herein.
2. Surface Preparation: This Contractor is responsible for the quality of the repaint work insofar as proper surface preparation will affect the finished appearance. The quality of the repaint work will be subject to the Project Manager's approval.

   a. Perform surface preparation of damaged areas in conformance with the latest edition of the Steel Structures Painting Council Standard SSPC-SP2, Hand Tool Cleaning.

   b. Where a damaged area occurs on one surface of an item having several surfaces, that entire surface where the damage occurs shall require repainting. The surface preparation for outside the damaged area shall consist of a light sanding to profile the existing paint.

3. Paint Application: Apply paint in such a manner so that the finished appearance will match as nearly as possible the factory finish

   a. Use paint material matching the composition of the factory-applied products.

   b. Comply with the paint manufacturer's label instruction for mixing, thinning, proper spreading rate, drying time, and environmental limitations concerning application.

3.02 FIELD QUALITY CONTROL

A. General: Perform cleaning, testing, adjusting and balancing operations as specified in the various Sections included under Division 15 - Mechanical.

   1. Provide instruments, testing equipment, and such other required materials to perform the Field Quality Control Work.

END OF SECTION
SECTION 15050
BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY
A. 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.
   7. Grout.
   8. Mechanical demolition.
   9. Equipment installation requirements common to equipment sections.
   10. Painting and finishing.
   11. Concrete bases.
   12. Supports and anchorages.

1.03 DEFINITIONS
A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspace, 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 duct shafts.
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:
2. CPVC: Chlorinated polyvinyl chloride plastic.
3. PE: Polyethylene plastic.
4. 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.

1.04 SUBMITTALS
A. Product Data: For the following:
   1. Transition fittings.
   2. Dielectric fittings.
   3. Mechanical sleeve seals.
   4. Escutcheons.
B. Welding certificates.

1.05 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 Mechanical 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.

1.06 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.

1.07 COORDINATION
A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical 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 mechanical items requiring access that are concealed behind finished surfaces. Access panels and doors are specified in Division 8 Section "Access Doors and Frames."

PART 2 - PRODUCTS

2.01 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.

2.02 PIPE, TUBE, AND FITTINGS

A. Refer to individual Division 15 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.

2.03 JOINING MATERIALS

A. Refer to individual Division 15 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. 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.

F. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
2.04 **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:**
   - b. Central Plastics Company.
   - c. Eclipse, Inc.
   - d. Epco Sales, Inc.
   - g. 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:**
   - b. Central Plastics Company.
   - c. Epco Sales, Inc.

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:**
   - 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 Couplings:** Galvanized-steel coupling with inert and noncorrosive, thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

1. **Manufacturers:**
   - a. Calpico, Inc.
   - b. Lochinvar Corp.

G. **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.

2.05 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: 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.

2.06 SLEEVES

A. Galvanized-Steel Sheet: 0.0239-inch 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.

E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.


G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.07 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 and rough brass.

D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
   1. Finish: Polished chrome-plated and rough brass.

E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.

F. Split-Plate, Stamped-Steel Type: With exposed-rivet 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.

2.08 GROUT

A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 PIPING SYSTEMS - COMMON REQUIREMENTS

A. Install piping according to the following requirements and Division 15 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: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge and set screw.
      h. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type.
      i. Bare Piping in Unfinished Service Spaces: One-piece, stamped-steel type with concealed or exposed-rivet 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.

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. PVC 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 7 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 7 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 7 Section "Through-Penetration Firestop Systems" 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.

3.02 PIPING JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 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.


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.

3.03 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.

3.04 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 mechanical 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.
3.05 PAINTING

A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.06 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.

3.07 ERECTION OF METAL SUPPORTS AND ANCHORAGES

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1.

3.08 GROUTING

A. Mix and install grout for mechanical 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 15055

MOTORS

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 includes basic requirements for factory- and field-installed motors.

1.3 DEFINITIONS

A. Factory-Installed Motor: A motor installed by motorized-equipment manufacturer as a component of equipment.

B. Field-Installed Motor: A motor installed at Project site and not factory installed as an integral component of motorized equipment.

1.4 SUBMITTALS

A. Product Data for Field-Installed Motors: For each type and size of motor, provide nameplate data and ratings; shipping, installed, and operating weights; enclosure type and mounting arrangements; size, type, and location of winding terminations; conduit entry and ground lug locations; and information on coatings or finishes.

B. Shop Drawings for Field-Installed Motors: Dimensioned plans, elevations, sections, and details, including required clearances and service space around equipment. Include the following:

   1. Each installed unit’s type and details.
   2. Nameplate legends.
   3. Diagrams of power, signal, and control wiring. Provide schematic wiring diagram for each type of motor and for each control scheme.

C. Coordination Drawings: Floor plans showing dimensioned layout, required working clearances, and required area above and around field-installed motors. Show motor layout, mechanical power transfer link, driven load, and relationship between electrical components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate field measurements.

D. Manufacturer Seismic Qualification Certification: Submit certification that motors, accessories, and components will withstand seismic forces defined in Division 15 Section "Mechanical Vibration and Seismic Controls. Include the following:
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   a. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."
   b. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified and the unit will be fully operational after the seismic event."

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

E. Qualification Data: For testing agency.

F. Source quality-control test reports.

G. Field quality-control test reports.

H. Operation and Maintenance Data: For field-installed motors to include in emergency, operation, and maintenance manuals.

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. Source Limitations: Obtain field-installed motors through one source from a single manufacturer.

C. Product Options for Field-Installed Motors: Drawings indicate size, profiles, and dimensional requirements of motors and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."

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 NFPA 70.

1.6 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices and features that comply with the following:

1. Compatible with the following:
a. Magnetic controllers.
b. Multispeed controllers.
c. Reduced-voltage controllers.

2. Designed and labeled for use with variable frequency controllers, and suitable for use throughout speed range without overheating.
3. Matched to torque and horsepower requirements of the load.
4. Matched to ratings and characteristics of supply circuit and required control sequence.

B. Coordinate motor support with requirements for driven load; access for maintenance and motor replacement; installation of accessories, belts, belt guards; and adjustment of sliding rails for belt tensioning.

C. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

PART 2 - PRODUCTS

2.1 MOTOR REQUIREMENTS

A. Motor requirements apply to factory- and field-installed motors except as follows:

1. Different ratings, performance, or characteristics for motor are specified in another Section.
2. Motorized-equipment manufacturer requires ratings, performance, or characteristics, other than those specified in this Section, to meet performance specified.

2.2 MOTOR CHARACTERISTICS

A. Motors 3/4 HP and Larger: Three phase.
B. Motors Smaller Than 3/4 HP: Single phase.
C. Frequency Rating: 60 Hz.
D. Voltage Rating: NEMA standard voltage selected to operate on nominal circuit voltage to which motor is connected.
E. Service Factor: 1.15 for open dripproof motors; 1.0 for totally enclosed motors.
F. Duty: Continuous duty at ambient temperature of 105 deg F and at altitude of 3300 feet above sea level.
G. 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.
H. Enclosure: Open dripproof.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.
B. Efficiency: Premium, as defined in NEMA MG 1.

C. Stator: Copper windings, unless otherwise indicated.
   1. Multispeed motors shall have separate winding for each speed.

D. Rotor: Squirrel cage, unless otherwise indicated.

E. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.

F. Temperature Rise: Match insulation rating, unless otherwise indicated.

G. Insulation: Class F, unless otherwise indicated.

H. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller Than 15 HP: Manufacturer’s standard starting characteristic.

I. Enclosure: Cast iron for motors 7.5 hp and larger; rolled steel for motors smaller than 7.5 hp.
   1. Finish: Gray enamel.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variable Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Designed with critical vibration frequencies outside operating range of controller output.
   2. Temperature Rise: Matched to rating for Class B insulation.
   3. Insulation: Class H.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Rugged-Duty Motors: Totally enclosed, with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings insulated with non-hygroscopic material.
   1. Finish: Chemical-resistant paint over corrosion-resistant primer.

D. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:
   1. Measure winding resistance.
   2. Read no-load current and speed at rated voltage and frequency.
   3. Measure locked rotor current at rated frequency.
   4. Perform high-potential test.
2.5 SINGLE-PHASE MOTORS

A. Type: One of the following, to suit starting torque and requirements of specific motor application:

1. Permanent-split capacitor.
2. Split-phase start, capacitor run.
3. Capacitor start, capacitor run.

B. Shaded-Pole Motors: For motors 1/20 hp and smaller only.

C. 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.

D. Bearings: Ball type for belt-connected motors and other motors with high radial forces on motor shaft; sealed, prelubricated-sleeve type for other single-phase motors.

E. Source Quality Control for Field-Installed Motors: Perform the following tests on each motor according to NEMA MG 1:

1. Measure winding resistance.
2. Read no-load current and speed at rated voltage and frequency.
3. Measure locked rotor current at rated frequency.
4. Perform high-potential test.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive field-installed motors for compliance with requirements, installation tolerances, and other conditions affecting performance.

B. Examine roughing-in for conduit systems to verify actual locations of conduit connections before motor installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FIELD-INSTALLED MOTOR INSTALLATION

A. Anchor each motor assembly to base, adjustable rails, or other support, arranged and sized according to manufacturer's written instructions. Attach by bolting. Level and align with load transfer link.

3.3 FIELD QUALITY CONTROL FOR FIELD-INSTALLED MOTORS

A. Prepare for acceptance tests.

1. Align motors, bases, shafts, pulleys, and belts. Tension belts according to manufacturer's written instructions.
2. Verify bearing lubrication.
3. Run each motor with its controller. Demonstrate correct rotation, alignment, and speed at motor design load.
4. Test interlocks and control and safety features for proper operation.
5. Verify that current and voltage for each phase comply with nameplate rating and NEMA MG 1 tolerances.

B. 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.

C. Testing Agency: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.

D. Testing Agency: Engage a qualified testing and inspecting agency to perform the following field tests and inspections and prepare test reports:

E. Perform the following field tests and inspections and prepare test reports:

1. Perform electrical tests and visual and mechanical inspections except optional tests and inspections stated in NETA ATS on factory- and field-installed motors. 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.

3.4 FIELD-INSTALLED MOTOR DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain field-installed motors. Refer to Division 1 Section "Closeout Procedures."

END OF SECTION
SECTION 15060
HANGERS AND SUPPORTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following hangers and supports for mechanical 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 positioning systems.
7. Equipment supports.

B. Related Sections include the following:
1. Division 15 Section(s) "Metal Ducts" for duct hangers and supports.

1.03 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."

1.04 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.

1.05 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: Signed and sealed by a qualified professional engineer. 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.

1.06 QUALITY ASSURANCE


B. Welding: Qualify procedures and personnel according to the following:
   1. AWS D1.1, "Structural Welding Code--Steel."
   4. AWS D1.4, "Structural Welding Code--Reinforcing Steel."
   5. ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. 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.

2.02 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.
   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.
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.

2.03 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.

2.04 METAL FRAMING SYSTEMS

A. Description: MFMA-3, shop- or field-fabricated pipe-support assembly made of steel channels and other components.

B. Manufacturers:

2. ERICO/Michigan Hanger Co.; ERISTRUT Div.
3. GS Metals Corp.
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.

2.05 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.
6. Value Engineered Products, 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 beyond sheet metal shield for piping operating below ambient air temperature.

2.06 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.

B. Mechanical-Expansion Anchors: Insert-wedge-type zinc coated stainless 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. Manufacturers:
   b. Empire Industries, Inc.
   c. Hilti, Inc.
   d. ITW Ramset/Red Head.
   e. MKT Fastening, LLC.
   f. Powers Fasteners.

2.07 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, system of metal brackets, clips, and straps for positioning piping in pipe spaces for plumbing fixtures for commercial applications.

B. Manufacturers:

2. HOLDRITE Corp.; Hubbard Enterprises.
3. Samco Stamping, Inc.

2.08 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural-steel shapes.

2.09 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.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 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. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450 deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
3. 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.
4. 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.
5. 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.
6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated stationary pipes, NPS 3/4 to NPS 8.
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<th>Hangers and Supports 15060 - 6</th>
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<td>7.</td>
<td>Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.</td>
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<td>8.</td>
<td>Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 8.</td>
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<tr>
<td>9.</td>
<td>Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated stationary pipes, NPS 1/2 to NPS 2.</td>
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<tr>
<td>10.</td>
<td>Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 8.</td>
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<td>11.</td>
<td>Extension Hinged or 2-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated stationary pipes, NPS 3/8 to NPS 3.</td>
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<td>12.</td>
<td>U-Bolts (MSS Type 24): For support of heavy pipes, NPS 1/2 to NPS 30.</td>
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<td>13.</td>
<td>Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.</td>
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<td>14.</td>
<td>Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.</td>
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<td>15.</td>
<td>Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.</td>
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<tr>
<td>16.</td>
<td>Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.</td>
</tr>
<tr>
<td>17.</td>
<td>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.</td>
</tr>
<tr>
<td>18.</td>
<td>Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.</td>
</tr>
<tr>
<td>19.</td>
<td>Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.</td>
</tr>
<tr>
<td>20.</td>
<td>Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.</td>
</tr>
<tr>
<td>21.</td>
<td>Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.</td>
</tr>
</tbody>
</table>

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.

N. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.
3.02  **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.
   2.  **Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported.** Weld steel according to AWS D1.1.

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 drawings 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 B31.1 (for power piping) and ASME B31.9 (for building services piping) are not exceeded.

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**Hangers and Supports 15060 - 8**
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 B31.1 for power piping and 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. Pipes NPS 8 and Larger: Include wood inserts.
6. Insert Material: Length at least as long as protective shield.
7. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.03 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.

3.04 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.

3.05 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.

3.06 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. Touch Up: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal shall match existing paint.

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 15061
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

B. Refer to Architectural Documents for information and direction relating to “under slab grid system” that is provided for hanging of plumbing, mechanical, electrical piping, conduits, ducts, etc.

1.02 SUMMARY

A. Section Includes:

1. Metal pipe hangers and supports.
2. Trapeze pipe hangers.
3. Fastener systems.

B. Related Sections:

1. Division 05 Section "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.

1.03 DEFINITIONS

A. MSS: Manufacturers Standardization Society of the Valve and Fittings Industry Inc.

1.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
1.05 SUBMITTALS

A. Product Data: For each type of product indicated.

B. Shop Drawings: fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers.

1.06 QUALITY ASSURANCE

A. Structural Steel Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel

2.02 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.03 FASTENER SYSTEMS

A. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.04 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-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.

2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Metal 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 the building structure.

B. Metal 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 for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Fastener System Installation:
1. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer’s written instructions.

D. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

E. 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.

F. Install lateral bracing with pipe hangers and supports to prevent swaying.

G. 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.

H. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

I. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

J. Insulated Piping:
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 allowed by 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.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

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.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.02 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/D1.1M 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 so contours of welded surfaces match adjacent contours.

3.03 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

3.04 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 a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 09.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.05 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are 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 carbon-steel pipe hangers and supports and attachments for general service applications.

F. Use copper-plated pipe hangers and copper attachments for copper piping and tubing.

G. Use padded hangers for piping that is subject to scratching.

H. 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 36, requiring clamp flexibility and up to 4 inches of insulation.
3. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
4. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
5. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
6. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
7. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
8. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
9. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.

I. 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 24.

J. 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.

K. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
2. C-Clamps (MSS Type 23): For structural shapes.
3. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
4. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
5. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

L. 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.

M. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

N. Use mechanical-expansion anchors instead of building attachments where required in concrete construction.

END OF SECTION 15061
SECTION 15073

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following:
   1. Elastomeric hangers.
   2. Spring hangers.
   4. Pipe riser resilient supports.
   5. Resilient pipe guides.
   7. Restraining braces and cables.

1.03 DEFINITIONS


1.04 PERFORMANCE REQUIREMENTS

A. Seismic-Restraint Loading:
   1. Site Class as Defined in the IBC: D.
   2. Assigned Seismic Use Group or Building Category as Defined in the IBC: II.
      a. Component Importance Factor: 1.0.
      b. Component Response Modification Factor: 4.0.
      c. Component Amplification Factor: 4.0.
   3. Design Spectral Response Acceleration at Short Periods (0.2 Second): 28.6%.
   4. Design Spectral Response Acceleration at 1-Second Period: 9.6%.

1.05 ACTION SUBMITTALS

A. Product Data: For the following:
1. Include rated load, rated deflection, and overload capacity for each vibration isolation device.
2. Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of seismic-restraint component used.
   a. Tabulate types and sizes of seismic restraints, complete with report numbers and rated strength in tension and shear as evaluated by an agency acceptable to authorities having jurisdiction.
   b. Annotate to indicate application of each product submitted and compliance with requirements.
3. Interlocking Snubbers: Include ratings for horizontal, vertical, and combined loads.

B. Delegated-Design Submittal: For seismic-restraint details 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. Riser Supports: Include riser diagrams and calculations showing anticipated expansion and contraction at each support point, initial and final loads on building structure, spring deflection changes, and seismic loads. Include certification that riser system has been examined for excessive stress and that none will exist.
2. Vibration Isolation Base Details: Detail overall dimensions, including anchorages and attachments to structure.
3. Seismic-Restraint Details:
   a. Design Analysis: To support selection and arrangement of seismic restraints. Include calculations of combined tensile and shear loads.
   b. Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.
   c. Preapproval and Evaluation Documentation: By an agency acceptable to authorities having jurisdiction, showing maximum ratings of restraint items and the basis for approval (tests or calculations).

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Show coordination of seismic bracing for plumbing piping and equipment with other systems and equipment in the vicinity, including other supports and seismic restraints.

B. Qualification Data: For professional engineer and testing agency.

C. Welding certificates.

D. Field quality-control test reports.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air-mounting systems to include in operation and maintenance manuals.
1.08 QUALITY ASSURANCE

A. Testing Agency Qualifications: An independent agency, with the experience and capability to conduct the testing indicated, that is a nationally recognized testing laboratory (NRTL) as defined by OSHA in 29 CFR 1910.7, and that is acceptable to authorities having jurisdiction.

B. Comply with seismic-restraint requirements in the IBC unless requirements in this Section are more stringent.

C. Welding: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

D. Seismic-restraint devices shall have horizontal and vertical load testing and analysis and shall bear anchorage preapproval OPA number from OSHPD, preapproved by ICC-ES, or preapproved by another agency acceptable to authorities having jurisdiction, showing maximum seismic-restraint ratings. Ratings based on independent testing are preferred to ratings based on calculations. If preapproved ratings are not available, submittals based on independent testing are preferred. Calculations (including combining shear and tensile loads) to support seismic-restraint designs must be signed and sealed by a qualified professional engineer.

PART 2 - PRODUCTS

2.01 VIBRATION ISOLATORS

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. Amber/Booth Company, Inc.
2. Isolation Technology, Inc.
3. Mason Industries.
4. Vibration Eliminator Co., Inc.

C. Pipe Riser Resilient Support: All-directional, acoustical pipe anchor consisting of 2 steel tubes separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Include steel and neoprene vertical-limit stops arranged to prevent vertical travel in both directions. Design support for a maximum load on the isolation material of 500 psig (3.45 MPa) and for equal resistance in all directions.

D. Resilient Pipe Guides: Telescopic arrangement of 2 steel tubes or post and sleeve arrangement separated by a minimum of 1/2-inch- (13-mm-) thick neoprene. Where clearances are not readily visible, a factory-set guide height with a shear pin to allow vertical motion due to pipe expansion and contraction shall be fitted. Shear pin shall be removable and reinsertable to allow for selection of pipe movement. Guides shall be capable of motion to meet location requirements.
2.02 SEISMIC-RESTRAINT DEVICES

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. Cooper B-Line, Inc.; a division of Cooper Industries.
2. Hilti, Inc.
3. TOLCO Incorporated; a brand of NIBCO INC.
4. Unistrut; Tyco International, Ltd.

C. General Requirements for Restraint Components: Rated strengths, features, and applications shall be as defined in reports by an agency acceptable to authorities having jurisdiction.

1. Structural Safety Factor: Allowable strength in tension, shear, and pullout force of components shall be at least four times the maximum seismic forces to which they will be subjected.

D. Snubbers: Factory fabricated using welded structural-steel shapes and plates, anchor bolts, and replaceable resilient isolation washers and bushings.

1. Anchor bolts for attaching to concrete shall be seismic-rated, drill-in, and stud-wedge or female-wedge type.
2. Resilient Isolation Washers and Bushings: Oil- and water-resistant neoprene.
3. Maximum 1/4-inch (6-mm) air gap, and minimum 1/4-inch- (6-mm-) thick resilient cushion.

E. Channel Support System: MFMA-3, shop- or field-fabricated support assembly made of slotted steel channels with accessories for attachment to braced component at one end and to building structure at the other end and other matching components and with corrosion-resistant coating; and rated in tension, compression, and torsion forces.

F. Restraint Cables: ASTM A 603 galvanized-steel cables with end connections made of steel assemblies with thimbles, brackets, swivel, and bolts designed for restraining cable service; and with a minimum of two clamping bolts for cable engagement.

G. Hanger Rod Stiffener: Steel tube or steel slotted-support-system sleeve with internally bolted connections and or reinforcing steel angle clamped to hanger rod.

H. Resilient Isolation Washers and Bushings: One-piece, molded, oil- and water-resistant neoprene, with a flat washer face.

I. Mechanical Anchor Bolts: Drilled-in and stud-wedge or female-wedge type in zinc-coated steel for interior applications and stainless steel for exterior applications. Select anchor bolts with strength required for anchor and as tested according to ASTM E 488. Minimum length of eight times diameter.

2.03 FACTORY FINISHES

A. Finish: Manufacturer's standard prime-coat finish ready for field painting.
B. Finish: Manufacturer’s standard paint applied to factory-assembled and -tested equipment before shipping.
   1. Powder coating on springs and housings.
   2. All hardware shall be galvanized. Hot-dip galvanize metal components for exterior use.
   3. Color-code or otherwise mark vibration isolation and seismic-control devices to indicate capacity range.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas and equipment to receive vibration isolation and seismic-control devices for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in of reinforcement and cast-in-place anchors to verify actual locations before installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 APPLICATIONS

A. Multiple Pipe Supports: Secure pipes to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction.

B. Hanger Rod Stiffeners: Install hanger rod stiffeners where indicated or scheduled on Drawings to receive them and where required to prevent buckling of hanger rods due to seismic forces.

C. Strength of Support and Seismic-RestRAINT Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static and seismic loads within specified loading limits.

3.03 VIBRATION-CONTROL AND SEISMIC-RESTRAINT DEVICE INSTALLATION

A. Equipment Restraints:
   1. Install seismic snubbers on plumbing equipment mounted on vibration isolators. Locate snubbers as close as possible to vibration isolators and bolt to equipment base and supporting structure.
   2. Install resilient bolt isolation washers on equipment anchor bolts where clearance between anchor and adjacent surface exceeds 0.125 inches (3.2 mm).
   3. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

B. Piping Restraints:
   1. Comply with requirements in MSS SP-127.
   2. Space lateral supports a maximum of 40 feet (12 m) o.c., and longitudinal supports a maximum of 80 feet (24 m) o.c.
   3. Brace a change of direction longer than 12 feet (3.7 m).
C. Install cables so they do not bend across edges of adjacent equipment or building structure.

D. Install seismic-restraint devices using methods approved by an agency acceptable to authorities having jurisdiction providing required submittals for component.

E. Install bushing assemblies for anchor bolts for floor-mounted equipment, arranged to provide resilient media between anchor bolt and mounting hole in concrete base.

F. Install bushing assemblies for mounting bolts for wall-mounted equipment, arranged to provide resilient media where equipment or equipment-mounting channels are attached to wall.

G. Attachment to Structure: If specific attachment is not indicated, anchor bracing to structure at flanges of beams, at upper truss chords of bar joists, or at concrete members.

H. Drilled-in Anchors:

1. Identify position of reinforcing steel and other embedded items prior to drilling holes for anchors. Do not damage existing reinforcing or embedded items during coring or drilling. Notify the structural engineer if reinforcing steel or other embedded items are encountered during drilling. Locate and avoid prestressed tendons, electrical and telecommunications conduit, and gas lines.

2. Do not drill holes in concrete or masonry until concrete, mortar, or grout has achieved full design strength.

3. Wedge Anchors: Protect threads from damage during anchor installation. Heavy-duty sleeve anchors shall be installed with sleeve fully engaged in the structural element to which anchor is to be fastened.

4. Adhesive Anchors: Clean holes to remove loose material and drilling dust prior to installation of adhesive. Place adhesive in holes proceeding from the bottom of the hole and progressing toward the surface in such a manner as to avoid introduction of air pockets in the adhesive.

5. Set anchors to manufacturer's recommended torque, using a torque wrench.

6. Install zinc-coated steel anchors for interior and stainless steel anchors for exterior applications.

3.04 ACCOMMODATION OF DIFFERENTIAL SEISMIC MOTION

A. Install flexible connections in piping where they cross seismic joints, where adjacent sections or branches are supported by different structural elements, and where the connections terminate with connection to equipment that is anchored to a different structural element from the one supporting the connections as they approach equipment.

3.05 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
2. Schedule test with Owner, through Architect, before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days’ advance notice.


4. Test at least four of each type and size of installed anchors and fasteners selected by Architect.

5. Test to 90 percent of rated proof load of device.


7. Measure isolator deflection.

8. Verify snubber minimum clearances.


10. Air-Mounting System Operational Test: Test the compressed-air leveling system.

11. Test and adjust air-mounting system controls and safeties.

12. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.06 ADJUSTING

A. Adjust isolators after piping system is at operating weight.

B. Adjust limit stops on restrained spring isolators to mount equipment at normal operating height. After equipment installation is complete, adjust limit stops so they are out of contact during normal operation.

C. Adjust active height of sprint isolators.

D. Adjust restraints to permit free movement of equipment within normal mode of operation.

END OF SECTION
SECTION 15075
MECHANICAL IDENTIFICATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY
A. This Section includes the following mechanical identification materials and their installation:
   1. Equipment nameplates.
   2. Equipment markers.
   3. Equipment signs.
   4. Access panel and door markers.
   5. Pipe markers.
   6. Duct markers.
   7. Stencils.
   8. Valve tags.
  10. Warning tags.

1.03 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. Valve numbering scheme.
D. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.04 QUALITY ASSURANCE

1.05 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 location of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 EQUIPMENT IDENTIFICATION DEVICES

A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
   a. Manufacturer, product name, model number, and serial number.
   b. Capacity, operating and power characteristics, and essential data.
   c. Labels of tested compliances.

2. Location: Accessible and visible.

3. Fasteners: As required to mount on equipment.

B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.

1. Terminology: Match schedules as closely as possible.

2. Data:
   a. Name and plan number.
   b. Equipment service.
   c. Design capacity.
   d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.

3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

C. Equipment Signs: ASTM D 709, Type I, cellulose, paper-base, phenolic-resin-laminate engraving stock; Grade ES-2, black surface, black phenolic core, with white melamine subcore, unless otherwise indicated. Fabricate in sizes required for message. Provide holes for mechanical fastening.

1. Data: Instructions for operation of equipment and for safety procedures.

2. Engraving: Manufacturer's standard letter style, of sizes and with terms to match equipment identification.

3. Thickness: 1/16 inch, unless otherwise indicated.

4. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.

D. Access Panel and Door Markers: 1/16-inch thick, engraved laminated plastic, with abbreviated terms and numbers corresponding to identification. Provide 1/8-inch center hole for attachment.

1. Fasteners: Self-tapping, stainless-steel screws or contact-type, permanent adhesive.
2.02 PIPING IDENTIFICATION DEVICES

A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.

1. Colors: Comply with ASME A13.1, unless otherwise indicated.
2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.

B. Pretensioned Pipe Markers: Precoiled semirigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.

C. Shaped Pipe Markers: Preformed semirigid plastic formed to partially cover circumference of pipe and to attach to pipe with mechanical fasteners that do not penetrate insulation vapor barrier.


E. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.

2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

2.03 DUCT IDENTIFICATION DEVICES

A. Duct Markers: Engraved, color-coded laminated plastic. Include direction and quantity of airflow and duct service (such as supply, return, and exhaust). Include contact-type, permanent adhesive.

2.04 STENCILS

A. Stencils: Prepared with letter sizes according to ASME A13.1 for piping; minimum letter height of 1-1/4 inches for ducts; and minimum letter height of 3/4 inch for access panel and door markers, equipment markers, equipment signs, and similar operational instructions.

1. Stencil Material: Metal or fiberboard.
2. Stencil Paint: Exterior, gloss, acrylic enamel black, unless otherwise indicated. Paint may be in pressurized spray-can form.
3. Identification Paint: Exterior, acrylic enamel in colors according to ASME A13.1, unless otherwise indicated.
2.05 **VALVE TAGS**

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.

1. Material: 0.032-inch thick brass.
2. Material: 0.0375-inch thick stainless steel.
4. Valve-Tag Fasteners: Brass wire-link or beaded chain; or S-hook.

2.06 **VALVE SCHEDULES**

A. Valve Schedules: For each piping system, on standard-size 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. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
2. Frame: Extruded aluminum.
3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.07 **WARNING TAGS**

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags; of plasticized card stock with matte finish suitable for writing.

1. Size: Approximately 4 by 7 inches.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as DANGER, CAUTION, or DO NOT OPERATE.

**PART 3 - EXECUTION**

3.01 **APPLICATIONS, GENERAL**

A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 **EQUIPMENT IDENTIFICATION**

A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:

1. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
2. Pumps, compressors, chillers, condensers, and similar motor-driven units.
3. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
4. Fans, blowers, primary balancing dampers, and mixing boxes.
5. Packaged HVAC central-station and zone-type units.

B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.

1. Letter Size: Minimum 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.
2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
   a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
   b. Fire department hose valves and hose stations.
   c. Meters, gages, thermometers, and similar units.
   d. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
   e. Pumps, compressors, chillers, condensers, and similar motor-driven units.
   f. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
   g. Fans, blowers, primary balancing dampers, and mixing boxes.
   h. Packaged HVAC central-station and zone-type units.
   i. Tanks and pressure vessels.
   j. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

C. Stenciled Equipment Marker Option: Stenciled markers may be provided instead of laminated-plastic equipment markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

D. Install equipment signs with screws or permanent adhesive on or near each major item of mechanical equipment. Locate signs where accessible and visible.

1. Identify mechanical equipment with equipment markers in the following color codes:
   a. Green: For cooling equipment and components.
   b. Yellow: For heating equipment and components.
   c. Green and Yellow: For combination cooling and heating equipment and components.
   d. Brown: For energy-reclamation equipment and components.

2. Letter Size: Minimum 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.

3. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.

4. Include signs for the following general categories of equipment:
a. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
b. Fuel-burning units, including boilers, furnaces, heaters, stills, and absorption units.
c. Pumps, compressors, chillers, condensers, and similar motor-driven units.
d. Heat exchangers, coils, evaporators, cooling towers, heat recovery units, and similar equipment.
e. Fans, blowers, primary balancing dampers, and mixing boxes.
f. Packaged HVAC central-station and zone-type units.
g. Tanks and pressure vessels.
h. Strainers, filters, humidifiers, water-treatment systems, and similar equipment.

E. Stenciled Equipment Sign Option: Stenciled signs may be provided instead of laminated-plastic equipment signs, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

F. Install access panel markers with screws on equipment access panels.

3.03 PIPING IDENTIFICATION

A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.

1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pretensioned pipe markers. Use size to ensure a tight fit.
2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 3/4 inch wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

B. Stenciled Pipe Marker Option: Stenciled markers may be provided instead of manufactured pipe markers, at Installer's option. Install stenciled pipe markers with painted, color-coded bands or rectangles complying with ASME A13.1 on each piping system.

1. Identification Paint: Use for contrasting background.

C. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed 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 nonaccessible 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.
3.04 DUCT IDENTIFICATION

A. Install duct markers with permanent adhesive on air ducts in the following color codes:

1. Green: For cold-air supply ducts.
2. Yellow: For hot-air supply ducts.
3. Blue: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
4. ASME A13.1 Colors and Designs: For hazardous material exhaust.
5. Letter Size: Minimum 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.

B. Stenciled Duct Marker Option: Stenciled markers, showing service and direction of flow, may be provided instead of laminated-plastic duct markers, at Installer's option, if lettering larger than 1 inch high is needed for proper identification because of distance from normal location of required identification.

C. Locate markers 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.

3.05 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices 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:

1. Valve-Tag Size and Shape:

2. Valve-Tag Color:
   a. Cold Water: Green.
   b. Hot Water: Yellow.
   c. Fire Protection: Black.

3. Letter Color:
   b. Hot Water: Black.
   c. Fire Protection: Black.

3.06 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

3.07 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.
3.08 ADJUSTING

A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.09 CLEANING

A. Clean faces of mechanical identification devices and glass frames of valve schedules.

END OF SECTION
SECTION 15076
IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Pipe labels.
   2. Valve tags.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Valve numbering scheme.
C. Valve Schedules: For each piping system to include in maintenance manuals.

1.04 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

2.01 PIPE IDENTIFICATION
A. Provide vinyl cloth identification bands, as manufactured by the William K. Brady Company, or "SNAP-A-ROUND" identification bands as manufactured by Seton Name Plate Corporation, or other acceptable manufacturers on all piping. Bands shall not be installed on exposed piping until final painting of the piping has been completed. Band shall indicate the piping service and the direction of flow in each pipe.
B. Install bands on each side of each partition, at each valve, at each change in direction, but in no case shall the bands be more than 25 feet apart on horizontal piping.
C. On vertical piping, the bands shall be located at each floor, at a height of approximately 5'-0" above the floor.

D. Markers or bands shall have background colors similar to ANSI A-13.1 color code and OSHA safety color regulation. In lieu of bands on concealed piping, the piping may, except where contrary to local laws, be painted with 6" bands around the pipe.

2.02 CHARTS AND TAGS

A. Install on each valve a brass tag giving the number of that particular valve and the words “Hot,” “Circ,” “Cold,” or “Gas” thereon. Tags shall be stamped to indicate piping system and shall be 2" diameter with white number 1/2" high and the letters 1/4" high. They shall be attached with a heavy brass “S” hook and a piece of brass window sash chain.

B. Install where directed by the Architect a chart and diagram giving the location and function of each numbered main and riser valve. The chart shall be glass covered in a proper size frame. Valve charts shall be submitted for review prior to framing.

C. Furnish three copies of valve schedule in loose leaf form with acetate covers. Schedule shall be divided into systems and each valve numbered within the systems shall be listed therein and the specific use shall be described. Furnish a key plan for each floor showing the valve locations.

PART 3 - EXECUTION

3.01 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.

END OF SECTION
SECTION 15080
MECHANICAL INSULATION

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary
   Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes mechanical insulation for boiler breeching, duct, equipment, and pipe,
   including the following:

1. Insulation Materials:
   a. Flexible elastomeric.
   b. Mineral fiber.
2. Insulating cements.
3. Adhesives.
5. Sealants.
6. Factory-applied jackets.
7. Tapes.
8. Securements.
9. Corner angles.

B. Related Sections include the following:

   1. Not applicable

1.03 DEFINITIONS

A. ASJ: All-service jacket.

B. FSK: Foil, scrim, kraft paper.

C. FSP: Foil, scrim, polyethylene.

D. PVDC: Polyvinylidene chloride.

E. SSL: Self-sealing lap.

1.04 SUBMITTALS

A. Product Data: For each type of product indicated, identify thermal conductivity, thickness, and
   jackets (both factory and field applied, if any).

Mechanical Insulation 15080 - 1
B. Shop Drawings: Show details for the following:

1. Application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Attachment and covering of heat tracing inside insulation.
3. Insulation application at pipe expansion joints for each type of insulation.
4. Insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Removable insulation at piping specialties, equipment connections, and access panels.
6. Application of field-applied jackets.
7. Application at linkages of control devices.
8. Field application for each equipment type.

C. Samples: For each type of insulation and jacket indicated. Identify each Sample, describing product and intended use. Sample sizes are as follows:

1. Preformed Pipe Insulation Materials: 12 inches long by NPS 2.
2. Sheet Form Insulation Materials: 12 inches square.
5. Manufacturer's Color Charts: For products where color is specified, show the full range of colors available for each type of finish material.

D. Installer Certificates: Signed by Contractor certifying that installers comply with requirements.

E. 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.

F. Field quality-control inspection reports.

1.05 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, 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.

1.06 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.
1.07 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports."

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.

C. Coordinate installation and testing of heat tracing.

1.08 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

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, products specified.
2. Products: Subject to compliance with requirements, provide one of the products specified.
3. 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.
4. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 INSULATION MATERIALS

A. Refer to Part 3 schedule articles for requirements about 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. 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:
      a. Aeroflex USA Inc.; Aerocel.
      b. Armacell LLC; AP Armaflex.
      c. RBX Corporation; Insul-Sheet 1800 and Insul-Tube 180.

G. 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 FSK jacket. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.
   1. Products:
      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.

H. Mineral-Fiber, Preformed Pipe Insulation:
   1. Available Products:
      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-SSL. Factory-applied jacket requirements are specified in Part 2 "Factory-Applied Jackets" Article.

2.03 INSULATING CEMENTS
   1. Products:
      a. Insulco, Division of MFS, Inc.; Triple I.

2.04 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 and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.
1. Products:
   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:
      a. Childers Products, Division of ITW; CP-82.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.


   1. Products:
      a. Childers Products, Division of ITW; CP-82.
      c. ITW TACC, Division of Illinois Tool Works; S-90/80.
      d. Marathon Industries, Inc.; 225.
      e. Mon-Eco Industries, Inc.; 22-25.

E. PVC Jacket Adhesive: Compatible with PVC jacket.

   1. Products:
      a. Dow Chemical Company (The); 739, Dow Silicone.
      e. Speedline Corporation; Speedline Vinyl Adhesive.

2.05 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:
      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.

C. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below ambient services.
   1. Products:
      a. Childers Products, Division of ITW; CP-30.
      b. Foster Products Corporation, H. B. Fuller Company; 30-35.
      c. ITW TACC, Division of Illinois Tool Works; CB-25.
      e. Mon-Eco Industries, Inc.; 55-10.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
   3. Service Temperature Range: 0 to 180 deg F.

D. Vapor-Barrier Mastic: Solvent based; suitable for outdoor use on below ambient services.
   1. Products:
      a. Childers Products, Division of ITW; Encacel.
      b. Foster Products Corporation, H. B. Fuller Company; 60-95/60-96.
      c. Marathon Industries, Inc.; 570.
      d. Mon-Eco Industries, Inc.; 55-70.
   2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 30-mil dry film thickness.
   3. Service Temperature Range: Minus 50 to plus 220 deg F.
   4. Solids Content: ASTM D 1644, 33 percent by volume and 46 percent by weight.

2.06 SEALANTS

A. FSK and Metal Jacket Flashing Sealants:
   1. Products:
      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:
   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.


### 2.07 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. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.
4. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
5. PVDC Jacket for Indoor Applications: 4-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.
6. PVDC Jacket for Outdoor Applications: 6-mil-thick, white PVDC biaxially oriented barrier film with a permeance at 0.01 perms when tested according to ASTM E 96 and with a flame-spread index of 5 and a smoke-developed index of 25 when tested according to ASTM E 84.

   a. Products:

      1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.

8. Vinyl Jacket: UL-rated white vinyl with a permeance of 1.3 perms when tested according to ASTM E 96, Procedure A, and complying with NFPA 90A and NFPA 90B.

### 2.08 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136 and UL listed.

1. Products:

   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.
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 and UL listed.

1. Products:
   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.
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:
   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.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.09 SECUREMENTS

A. Bands:

1. Products:
   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, 1/2 inch wide with wing or closed seal.

3. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide with wing or closed seal.

B. Insulation Pins and Hangers:

1. 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.
   a. Products:
      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, 0.106-inch-diameter shank, length to suit depth of insulation indicated with integral 1-1/2-inch galvanized carbon-steel washer.
   a. Products:
      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:
      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:
      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:
   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:
   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.

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:
   a. ACS Industries, Inc.
   b. C & F Wire.
   c. Childers Products.
   d. PABCO Metals Corporation.
   e. RPR Products, Inc.

2.10 CORNER ANGLES

A. PVC Corner Angles: 30 mils thick, minimum 1 by 1 inch, PVC according to ASTM D 1784, Class 16354-C. White or color-coded to match adjacent surface.
B. Aluminum Corner Angles: 0.040 inch thick, minimum 1 by 1 inch, aluminum according to ASTM B 209, Alloy 3003, 3005, 3105 or 5005; Temper H-14.

C. Stainless-Steel Corner Angles: 0.024 inch thick, minimum 1 by 1 inch, stainless steel according to ASTM A 167 or ASTM A 240/A 240M, Type 304 or 316.

PART 3 - EXECUTION

3.01 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.

3.02 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.

D. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.03 COMMON 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.

   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.
5. Handholes.
6. Cleanouts.

3.04 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 Below-Grade Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. 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.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. 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.

F. Insulation Installation at Floor Penetrations:
1. Duct: Install insulation continuously through floor penetrations that are not fire rated. For penetrations through fire-rated assemblies, terminate insulation at fire damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

2. Pipe: Install insulation continuously through floor penetrations.

3. Seal penetrations through fire-rated assemblies according to Division 7 Section "Through-Penetration Firestop Systems."

3.05 DUCT AND PLENUM INSULATION INSTALLATION

A. 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.

3.06 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. 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, 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.

3.07 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.

3.08 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 (50 mm) from 1 edge and 1 end of insulation segment. Secure laps to adjacent insulation section with 1/2-inch (13-mm) outward-clinching staples, 1 inch (25 mm) 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 (10 deg C) at 18-foot (5.5-m) 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 (75 mm).

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.

3.09 FINISHES

A. Duct, Equipment, and Pipe Insulation with ASJ, Glass-Cloth, or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Division 9 painting Sections.

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.


B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.
C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified independent inspecting agency to perform field inspections and prepare inspection reports.

B. Perform the following field tests and inspections and prepare test reports:
   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(s) 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 three location(s) for each type of equipment defined in the "Equipment Insulation Schedule" Article. For large equipment, remove only a portion adequate to determine compliance.

C. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements. Remove defective Work.

D. Install new insulation and jackets to replace insulation and jackets removed for inspection. Repeat inspection procedures after new materials are installed.

3.11 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:
   1. Indoor, exposed supply and outdoor air.
   2. Indoor, exposed return located in nonconditioned space.
   3. Indoor, exposed exhaust between isolation damper and penetration of building exterior.

B. Items Not Insulated:
   1. Factory-insulated flexible ducts.
   2. Flexible connectors.
   4. Factory-insulated access panels and doors.

3.12 INDOOR DUCT AND PLENUM INSULATION SCHEDULE

A. Exposed, rectangular, supply-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

B. Exposed, rectangular, return-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

C. Exposed, rectangular, outdoor-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.
D. Exposed, rectangular, exhaust-air duct insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

E. Exposed, supply-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

F. Exposed, return-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

G. Exposed, outdoor-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

H. Exposed, exhaust-air plenum insulation shall be the following:
   1. Mineral-Fiber Blanket: 1-1/2 inches thick and 0.75-lb/cu. ft. nominal density.

3.13 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. Fire-suppression piping.
   2. Drainage piping located in crawl spaces.
   4. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.14 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:
   1. 3 inch and Smaller: Insulation shall be [the following:
      a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

B. Domestic Hot and Recirculated Hot Water:
   1. 3 inch and Smaller: Insulation shall be the following:
      a. Mineral-Fiber Pipe Insulation, Type I: 1 inch thick.

C. Condensate and Equipment Drain Water below 60 Deg F:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Flexible Elastomeric: 1 inch thick.

D. Heating-Hot-Water Supply and Return, 200 Deg F and below:
   1. 3 inch and Smaller: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe, Type I: 1 ½ inches thick.

E. Refrigerant Suction and Hot-Gas Piping:
1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

F. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

3.15 OUTDOOR, ABOVEGROUND PIPING INSULATION SCHEDULE

A. Refrigerant Suction and Hot-Gas Piping:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

B. Refrigerant Suction and Hot-Gas Flexible Tubing:

1. All Pipe Sizes: Insulation shall be the following:
   a. Flexible Elastomeric: 1 inch thick.

END OF SECTION
SECTION 15082
PLUMBING PIPING INSULATION

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section includes insulating the following plumbing piping services:
   1. Domestic cold-water piping.
   2. Domestic hot-water piping.
   3. Supplies and drains for handicap-accessible lavatories and sinks.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied, if any).
B. LEED Submittals:
   1. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content and chemical components.
   2. Laboratory Test Reports for Credit IEQ 4: For adhesives and sealants, documentation indicating that product complies 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."
C. 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 pipe expansion joints for each type of insulation.
   3. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
   4. Detail removable insulation at piping specialties, equipment connections, and access panels.
   5. Detail application of field-applied jackets.

1.04 INFORMATIONAL SUBMITTALS
A. Qualification Data: For qualified Installer.
B. 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.

C. Field quality-control reports.

1.05 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. 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.

C. Comply with the following applicable standards and other requirements specified for miscellaneous components:


1.06 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.

1.07 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment."
B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.08 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

2.01 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," articles for where insulating materials shall be applied.

B. All referenced manufactures on the construction drawings are to establish a minimum acceptable level of quality and is not intended to prevent submission of equivalent equipment or other materials. Refer to Plumbing Schedules on drawing P1.01

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.


   1. All referenced manufactures on the construction drawings are to establish a minimum acceptable level of quality and is not intended to prevent submission of equivalent equipment or other materials.

      a. Johns Manville; Micro-Lok HP
      b. Approved Equal

E. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials. Flexible Elastomeric Insulation to be used on all “under slab” trap priming soft K copper tubing.

   1. All referenced manufactures on the construction drawings are to establish a minimum acceptable level of quality and is not intended to prevent submission of equivalent equipment or other materials.

      a. Armacell LLC; AP Armaflex.
      b. Approved Equal.
2.02 PVC INSULATED FITTING COVERS

A. PVC Insulated Fitting Covers: High-impact, gloss white, UV-resistant, polyvinyl chloride.

1. All referenced manufactures on the construction drawings are to establish a minimum acceptable level of quality and is not intended to prevent submission of equivalent equipment or other materials.

   a. Johns Manville; Zeston 2000 PVC
   b. Approved Equal.

2.03 ADHESIVES

A. Flexible Elastomeric and Polyolefin Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. Products: Subject to compliance with requirements, provide one of the following available products that may be incorporated into the Work include, but are not limited to, the following:

   a. Armacell LLC; Armaflex 520 Adhesive.
   b. Approved Equal.

2. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

3. Adhesive 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.”

2.04 TAPES

A. PVC Tape: Flexible polyvinyl chloride film adhesive tape

1. All referenced manufactures on the construction drawings are to establish a minimum acceptable level of quality and is not intended to prevent submission of equivalent equipment or other materials.

   b. Approved Equal.

2. Width: 2 inches (51 mm).

3. Thickness: 10 mils (0.25 mm).

4. Adhesion: 30 ounces force/inch (0.033 N/mm) in width.

5. Elongation: 200 percent.

6. Tensile Strength: 27 lbf/inch (4.7 N/mm) in width.

2.05 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers
1. Manufacturers: Subject to compliance with requirements, provide products available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Truebro; a brand of IPS Corporation
   b. McGuire Manufacturing.
   c. Plumberex.

2. Description: Manufactured plastic wraps for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures

1. Manufacturers: Subject to compliance with requirements, provide products available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Truebro; a brand of IPS Corporation.
   b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 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.

3.03 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- (75-mm-) wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches (100 mm) o.c.
   3. Overlap jacket longitudinal seams at least 1-1/2 inches (38 mm). 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
      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 (100 mm) 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.

3.04 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 (50 mm) below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. 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 (50 mm).
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. 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 Division 07 Section "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:
1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Division 07 Section "Penetration Firestopping."

### 3.05 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. 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 (50 mm) 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.

3.06 INSTALLATION OF FIBER GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of 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 services, secure laps with outward clinched staples at 6 inches (150 mm) o.c.
4. For insulation with factory-applied jackets on below-ambient services, 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 cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch (25 mm), 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. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.
D. Insulation Installation on Valves and Pipe Specialties:
   1. Install preformed sections of cellular-glass insulation to valve body.
   2. 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.

3.07 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

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.

3.08 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. 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 two (2) locations of straight pipe, two (2) locations of threaded fittings, and two (2) locations of flanged valves for each pipe service defined in the “Piping Insulation Schedule, General” Article.

D. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.09 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.

A. Domestic Cold Water:
   1. Cellular Glass: 1 inch thick.

B. Domestic Hot Water:
   1. Cellular Glass: 1 inch thick

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:
   1. All Pipe Sizes: Insulation shall be the following:
      a. Mineral-Fiber, Preformed Pipe Insulation, Type I: 1 inch thick.

END OF SECTION
SECTION 15092
SLEEVES AND SLEEVE SEALS FOR PLUMBING PIPING

PART 1 - GENERAL
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.02 SUMMARY
A. Section Includes:
   1. Sleeves.
   2. Sleeve-seal systems.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 SLEEVES
A. Cast-Iron Wall Pipes: Cast or fabricated of cast or ductile iron and equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Galvanized-Steel-Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, with plain ends.

2.02 SLEEVE-SEAL SYSTEMS
A. Basis-of-Design Product: Subject to compliance with requirements, provide comparable product by one of the following:
   1. Advance Products & Systems, Inc.
   2. CALPICO, Inc.
   3. Metraflex Company

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 Connecting Bolts and Nuts: Carbon steel, with corrosion-resistant coating, of length required to secure pressure plates to sealing elements.
### 2.03 SLEEVE-SEAL FITTINGS

A. **Basis-of-Design Product:** Subject to compliance with requirements, provide comparable product by one of the following:

1. Presealed Systems.

B. **Description:** Manufactured plastic, sleeve-type, waterstop assembly made for imbedding in concrete slab or wall. Unit has plastic or rubber waterstop collar with center opening to match piping OD.

### 2.04 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.

Packaging: Premixed and factory packaged.

### PART 3 - EXECUTION

#### 3.01 SLEEVE INSTALLATION

A. Install sleeves for piping passing through penetrations in floors, partitions, roofs, 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. Comply with requirements for firestopping specified in Division 07 Section "Penetration Firestopping."

#### 3.02 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.

3.03 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

3.04 SLEEVE-SEAL-FITTING SCHEDULE

A. Use sleeves and sleeve seals for the following piping-penetration applications:

1. Concrete Slabs-on-Grade:
   a. Piping Smaller Than NPS 6 Cast-iron wall sleeves with sleeve-seal system. Retain first subparagraph below if using sleeve-seal systems; delete if using sleeve-seal fittings.
      1) Select sleeve size to allow for 1-inch annular clear space between piping and sleeve for installing sleeve-seal system.

2. Concrete Slabs above Grade:
   a. Piping Smaller Than NPS 6 Galvanized-steel-pipe sleeves

3. Interior Partitions:

END OF SECTION
SECTION 15097
ESCUTCHEONS FOR PLUMBING PIPING

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Escutcheons.
   2. Floor Plates

1.03 SUBMITTALS
A. Product Data: For each type of product indicated.

PART 2 - PRODUCTS

2.01 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.
D. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.
E. Split-Plate, Stamped-Steel Type: With chrome-plated finish, concealed hinge, and spring-clip fasteners.
PART 3 - EXECUTION

3.01 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 insulated 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. Chrome-Plated finish: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
   b. Insulated Piping: One-piece, stamped-steel type or split-plate, stamped-steel type with concealed hinge or split-plate, stamped-steel type with exposed-rivet hinge.

C. Install floor plates for piping penetrations of kitchen floor.

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.

3.02 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION
SECTION 15100
SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.

1.03 PERFORMANCE REQUIREMENTS
A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:
   Soil, Waste, and Vent Piping: 10-foot head of water

1.04 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. LEED Submittals:
   1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
   2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."

1.05 INFORMATIONAL SUBMITTALS
A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.07 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste 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 according to requirements indicated:

1. Notify Architect Construction Manager no fewer than two days in advance of proposed interruption of sanitary waste service.
2. Do not proceed with interruption of sanitary waste service without Architect's Construction Manager's written permission.

PART 2 - PRODUCTS

2.01 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.

2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class
B. Gaskets: ASTM C 564, rubber.
C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

a. ANACO-Husky.
b. Mission Rubber Company; a division of MCP Industries, Inc.
c. Tyler Pipe.
3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and
   ASTM C 564, rubber sleeve with integral, center pipe stop.

2.04 COPPER TUBE AND FITTINGS

A. Copper 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. Hard Copper Tube: ASTM B 88, Type L, water tube, drawn temper.
D. Soft Copper Tube: ASTM B 88, Type L water tube, annealed temper.
E. Copper Pressure Fittings:
   1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper,
      solder-joint fittings. Furnish wrought-copper fittings if indicated.
   2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket,
      metal-to-metal seating surfaces, and solder-joint or threaded ends.
F. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.
   1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-
      inch (3.2-mm) maximum thickness unless thickness or specific material is indicated.
   2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.
G. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

PART 3 - EXECUTION

3.01 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 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. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

K. 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 two 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.

L. Lay buried building 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.

M. 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 for piping NPS 3 and smaller; 1 percent downward in direction of flow for piping NPS 4 and larger.
3. Vent Piping: 1 percent down toward vertical fixture vent or toward vent stack.

N. 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."

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

P. Plumbing Specialties:
1. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Division 15 Section "Sanitary Waste Piping Specialties."
2. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Division 15 Section "Sanitary Waste Piping Specialties."

Q. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

R. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 15 Section "Sleeves and Sleeve Seals for Plumbing Piping."
S. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 15 Section "Sleeves and Sleeve Seals for Plumbing Piping."

T. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 15 Section "Escutcheons for Plumbing Piping."

3.02 JOINT CONSTRUCTION


C. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

D. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.03 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Division 15 Section "Vibration and Seismic Controls for Plumbing Piping and Equipment."

B. Comply with requirements for pipe hanger and support devices and installation specified in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install 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.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting and coupling.

D. Support vertical piping and tubing at base and at each floor.

E. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.
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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 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

G. Install supports for vertical cast-iron soil piping every 15 feet.

H. Install supports for vertical copper tubing every 10 feet.

I. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.04 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. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

3.05 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Division 15 Section "Identification for Plumbing Piping and Equipment."

3.06 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.

3.07 CLEANING AND PROTECTION

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.

3.08 PIPING SCHEDULE

A. Aboveground, soil, waste and vent piping:

1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings heavy-duty hubless-piping couplings; and coupled joints.
3. Copper DWV tube, copper drainage fittings, and soldered joints.
4. Retain "any of" option in first paragraph below to allow Contractor to retain piping materials from those retained.

B. Underground, soil, waste, and vent piping:

1. Service class, cast-iron soil piping; gaskets; and gasketed joints.
2. Hubless, cast-iron soil pipe and fittings; heavy-duty, cast-iron hubless-piping couplings; and coupled joints.
3. Stainless-steel pipe and fittings, gaskets, and gasketed joints.

END OF SECTION
SECTION 15110

GENERAL-DUTY VALVES FOR PLUMBING PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. This Section includes the following general-duty valves:
   1. Copper-alloy ball valves.
   2. Ferrous-alloy ball valves.

B. Related Sections include the following:
   1. Division 15 Section "Identification for Plumbing Piping and Equipment" for valve tags and charts.

1.03 SUBMITTALS

A. Product Data: For each type of valve indicated. Include body, seating, and trim materials; valve design; pressure and temperature classifications; end connections; arrangement; dimensions; and required clearances. Include list indicating valve and its application. Include rated capacities; shipping, installed, and operating weights; furnished specialties; and accessories.

1.04 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.

1.05 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 gate valves closed to prevent rattling.
4. Set ball and plug valves open to minimize exposure of functional surfaces.
5. Block check valves in either closed or open position.

B. Use the following precautions during storage:
   1. Maintain valve end protection.
   2. Store valves indoors and maintain at higher than ambient dew-point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

1.06 DEFINITIONS
A. CWP: Cold working pressure.
B. EPDM: Ethylene propylene copolymer rubber.
C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.
D. NRS: Nonrising stem.
E. OS&Y: Outside screw and yoke.
F. RS: Rising stem.
G. SWP: Steam working pressure.

PART 2 - PRODUCTS

2.01 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.

2.02 BALL VALVES
A. Manufacturers:
   a. NIBCO INC.
   b. Appolo
   c. Milwaukee

B. Ball valves 3" and smaller: On "L" copper tubing used for water systems, valves shall be regular port two piece ball valves modified with stainless steel ball Milwaukee Valve Co. #BA-
150S bronze body, stainless steel ball, teflon seats and stuffing box ring, lever handle, solder ends. Ball valves for natural gas service shall be Apollo 80-100 series UL approved.

2.03 GATE VALVES

A. Manufacturers
   a. Milwaukee Valve Company.
   b. NIBCO INC.
   c. Watts Industries, Inc.

B. Gate valves 4" size and larger: On "L" copper tubing used for water systems, 125 lb. SWP, flanged, iron body, bronze mounted, solid wedge, O.S.&Y. gate with rising stem, Crane #465-1/2, Jenkins #651-A or Milwaukee Valve Co. #F-2885.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine piping system for compliance with requirements for installation tolerances and other conditions affecting performance.
   1. Proceed with installation only after unsatisfactory conditions have been corrected.

B. 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.

C. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

D. Examine threads on valve and mating pipe for form and cleanliness.

E. 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.

F. Do not attempt to repair defective valves; replace with new valves.

3.02 VALVE INSTALLATION

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

C. Locate valves for easy access and provide separate support where necessary.
D. Install valves in horizontal piping with stem at or above center of pipe.

E. Install valves in position to allow full stem movement.

F. Install check valves for proper direction of flow and as follows:
   1. Swing Check Valves: In horizontal position with hinge pin level.

3.03 JOINT CONSTRUCTION

A. Grooved Joints: Assemble joints with keyed coupling housing, gasket, lubricant, and bolts according to coupling and fitting manufacturer's written instructions.

B. Soldered Joints: Use ASTM B 813, water-flushable, lead-free flux; ASTM B 32, lead-free-alloy solder; and ASTM B 828 procedure, unless otherwise indicated.

3.04 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.

B. If valve applications are not indicated, use the following:
   1. Shutoff Service: Ball, or gate valves.

C. 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.

END OF SECTION
SECTION 15120
DOMESTIC WATER PIPING SPECIALTIES

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Vacuum breakers.
   2. Backflow preventers.
   4. Temperature-actuated, water mixing valves.
   5. Strainers.
   6. Hose bibbs.
   7. Wall hydrants.
   8. Drain valves.
   10. Water Pressure Reducing valves
   11. Trap-seal primer valves.
   12. Flexible connectors.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For domestic water piping specialties.
   1. Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS
Operation and Maintenance Data: For domestic water piping specialties to include in emergency, operation, and maintenance manuals.
PART 2 - PRODUCTS

2.01 GENERAL REQUIREMENTS FOR PIPING SPECIALTIES

A. Potable-water piping and components shall comply with NSF 61 and NSF 14

2.02 PERFORMANCE REQUIREMENTS

A. Minimum Working Pressure for Domestic Water Piping Specialties: 125 psig

2.03 VACUUM BREAKERS

A. Pipe-Applied, Atmospheric-Type Vacuum Breakers <Insert drawing designation if any:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Cash Acme.
      c. Zurn Plumbing Products Group; Wilkins Div.
      d. Approved equal.
   3. Size: NPS 1/4 to NPS 3, as required to match connected piping.
   5. Inlet and Outlet Connections: Threaded.

2.04 BACKFLOW PREVENTERS

A. Reduced-Pressure-Principle Backflow Preventers

   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following but are not limited to, the following:
      b. Conbraco Industries, Inc.
      c. FEBCO; a division of Watts Water Technologies, Inc.
      d. Approved equal.
   2. E Standard: ASSE 1013.
   3. Operation: Continuous-pressure applications.
   4. Pressure Loss: 12 psig maximum, through middle third of flow range.
   5. Size: 4” and smaller
   6. End Connections: Threaded for NPS 2 and smaller; flanged for NPS 2-1/2 and larger.
      a. Valves NPS 2 and Smaller: Ball type with threaded ends on inlet and outlet, similar to Febco 860 series
      b. Valves NPS 2-1/2 and Larger: Outside-screw and yoke-gate type with flanged ends on inlet and outlet, similar to Febco 860 series

2.05 BALANCING VALVES

A. Accessories: Meter hoses, fittings, valves, differential pressure meter, and carrying case.

B. Memory-Stop Balancing Valves

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Danfoss.
   b. Milwaukee Valve Company.
   c. NIBCO INC.
   d. Red-White Valve Corp.
   e. Approved equal.

2. Standard: MSS SP-110 for two-piece, copper-alloy ball valves.
3. Pressure Rating: 400-psig minimum CWP.
4. Size: NPS 2 or smaller.
5. Body: Copper alloy.
6. Port: Standard or full port.
7. Ball: Chrome-plated brass.
8. Seats and Seals: Replaceable.
9. End Connections: Solder joint or threaded.

2.06 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Individual-Fixture, Water Tempering Valves:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Sloan Valve Company.
   b. Powers; a Watts Industries Co.

3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.
8. Tempered-Water Setting: 120 degree
9. Tempered-Water Design Flow Rate: 0.5 GPM

B. Primary, Thermostatic, Water Mixing Valves:

1. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:
   a. Symmons Industries, Inc.
   b. Powers; a Watts Industries Co.
   c. Leonard Valve Company.
5. Connections: Threaded inlets and outlet.
6. Accessories: Manual temperature control, check stops on hot- and cold-water supplies, and adjustable, temperature-control handle, thermometer.
7. Valve Pressure Rating: 125 psig minimum, unless otherwise indicated.
8. Valve Finish: Chrome plated.
10. Cabinet: Factory-fabricated, stainless steel

2.07 HOSE BIBBS

A. Hose Bibbs

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. Woodford Manufacturing Company.
   c. Watts Drainage Products Inc.
   d. Approved equal.

2. Standard: ASME A112.18.1 for sediment faucets.
5. Supply Connections: NPS 1/2 or NPS 3/4 threaded or solder-joint inlet.
7. Pressure Rating: 125 psig
9. Finish for Finished Rooms: Chrome or nickel plated.
10. Operation for Finished Rooms: Operating key.
11. Include operating key with each operating-key hose bibb.
12. Include wall flange with each chrome- or nickel-plated hose bibb.
   Size: NPS 3/4

B. Hose Bibb shall be similar to Chicago 387-E27CP

2.08 WALL HYDRANTS

A. Nonfreeze Wall Hydrants:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   b. Watts Drainage Products Inc.
   c. Woodford Manufacturing Company.
   d. Approved equal.

4. Operation: Loose key.
5. Casing and Operating Rod: Of length required to match wall thickness. Include wall clamp.
6. Inlet: NPS 3/4 or NPS 1 (DN 20 or DN 25).
7. Outlet: Concealed, with integral vacuum breaker and garden-hose thread complying with ASME B1.20.7.
8. Box: Deep, flush mounting with cover.
12. Operating Keys(s): One with each wall hydrant.

2.09 DRAIN VALVES

A. Ball-Valve-Type, Hose-End Drain Valves
   2. Pressure Rating: 400-psig minimum CWP.
   3. Size: NPS 3/4
   4. Body: Copper alloy.
   5. Ball: Chrome-plated brass.
   8. Inlet: Threaded or solder joint.

B. Gate-Valve-Type, Hose-End Drain Valves:
   2. Pressure Rating: Class 125.
   5. Inlet: NPS 3/4 (DN 20) threaded or solder joint.
   6. Outlet: Garden-hose thread complying with ASME B1.20.7 and cap with brass chain.

2.10 OUTLET BOXES

A. Icemaker Outlet Boxes:
   1. Mounting: Recessed.
   3. Faucet: Valved fitting complying with ASME A112.18.1. Include NPS 1/2 (DN 15) or smaller copper tube outlet.
   4. Supply Shutoff Fitting: NPS 1/2 (DN 15) ball valve and NPS 1/2 (DN 15) copper, water tubing.
   5. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Sioux Chief
      b. Guy Gray Manufacturing Co., Inc.
      c. IPS Corporation.
      d. Oatey.
      e. Approved equal.
8. Faucet: Combination valved fitting complying with ASME A112.18.1. Include garden-hose thread complying with ASME B1.20.7 on outlets.
9. Supply Shutoff Fittings: NPS 1/2 gate, globe, or ball valves and NPS 1/2 (DN 15) copper, water tubing.
10. Drain: 2" standpipe and P-trap for direct waste connection to drainage piping.
11. Inlet Hoses: Two 60-inch-long, rubber household clothes washer inlet hoses with female, garden-hose-thread couplings. Include rubber washers.
12. Drain Hose: One 48-inch-long, rubber household clothes washer drain hose with hooked end.

2.11 WATER HAMMER ARRESTERS

A. Water Hammer Arresters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Josam Company
   b. MIFAB, Inc.
   d. Approved equal.

3. Type: Metal bellows.
4. Size: ASSE 1010, Sizes AA and A through F or PDI-WH 201, Sizes A through F.

2.12 WATER PRESSURE-REDUCING VALVES

A. Water Regulators

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]
   a. Cash Acme; a division of Reliance Worldwide Corporation.
   b. Watts; a division of Watts Water Technologies, Inc.; Watts Regulator Company.
   c. Zurn Industries, LLC; Plumbing Products Group; Wilkins Water Control Products.
   d. Approved equal.

3. Pressure Rating: Initial working pressure of 150 psig (1035 kPa).
4. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron for NPS 2-1/2 and NPS 3
5. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 and NPS 3 (DN 65 and DN 80).

2.13 STRainers FOR DOMESTIC WATER PIPING

A. Y-Pattern Strainers:

1. Pressure Rating: 125 psig (860 kPa) minimum, unless otherwise indicated.
2. Body: Bronze for NPS 2 (DN 50) and smaller; cast iron for NPS 2-1/2 (DN 65) and larger.
3. End Connections: Threaded for NPS 2 (DN 50) and smaller; flanged for NPS 2-1/2 (DN 65) and larger.
4. Screen: Stainless steel with round perforations, unless otherwise indicated.
5. Perforation Size:
   a. Strainers NPS 2 (DN 50) and Smaller: 0.020 inch (0.51 mm).

2.14 TRAP-SEAL PRIMER VALVES

A. Supply-Type, Trap-Seal Primer Valves:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. PPP Inc.
      b. Sioux Chief Manufacturing Company, Inc.
   3. Pressure Rating: 125 psig (860 kPa) minimum.
   5. Inlet and Outlet Connections: NPS 1/2 (DN 15) threaded, union, or solder joint.
   6. Gravity Drain Outlet Connection: NPS 1/2 (DN 15) threaded or solder joint.
   7. Finish: Chrome plated, or rough bronze for units used with pipe or tube that is not chrome finished.

PART 3 - EXECUTION

3.01 INSTALLATION

A. 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.
B. Install water control valves with inlet and outlet shutoff valves and bypass with globe valve. Install pressure gages on inlet and outlet.
C. Install balancing valves in locations where they can easily be adjusted.
D. 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.
E. Install water hammer arresters in water piping according to PDI-WH 201.
3.02 CONNECTIONS

A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping and specialties.

3.03 LABELING AND IDENTIFYING

A. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplate or sign on or near each of the following:

1. Pressure vacuum breakers.
2. Intermediate atmospheric-vent backflow preventers.
3. Reduced-pressure-principle backflow preventers.
5. Primary, thermostatic, water mixing valves.
7. Primary water tempering valves.
8. Hose stations.
10. Trap-seal primer systems.

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 Section 220553 "Identification for Plumbing Piping and Equipment."

3.04 FIELD QUALITY CONTROL

A. Perform the following tests and prepare test reports:

1. Test each reduced-pressure-principle backflow preventer according to authorities having jurisdiction and the device’s reference standard.

B. Remove and replace malfunctioning domestic water piping specialties and retest as specified above.

3.05 ADJUSTING

A. Set field-adjustable flow set points of balancing valves.

B. Set field-adjustable temperature set points of temperature-actuated water mixing valves.

END OF SECTION
SECTION 15121

PIPE EXPANSION FITTINGS AND LOOPS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
   A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY
   A. This Section includes the following pipe expansion joints and expansion compensation devices for mechanical piping systems:
      1. Pipe bends and loops.
      2. Alignment guides and anchors.

1.03 DEFINITIONS
   A. BR: Butyl rubber.
   B. Buna-N: Nitrile rubber.
   C. CR: Chlorosulfonated polyethylene synthetic rubber.
   D. CSM: Chlorosulfonyl-polyethylene rubber.
   E. EPDM: Ethylene-propylene-diene terpolymer rubber.
   F. NR: Natural rubber.
   G. PTFE: Polytetrafluoroethylene plastic.

1.04 PERFORMANCE REQUIREMENTS
   A. Compatibility: Products shall be suitable for piping system fluids, materials, working pressures, and temperatures.
   B. Capability: Products shall absorb 200 percent of maximum axial movement between anchors.

1.05 SUBMITTALS
   A. Product Data: For each type of pipe expansion joint and alignment guide indicated.
   B. Shop Drawings: Signed and sealed by a qualified professional engineer.
1. Design Calculations: Calculate requirements for thermal expansion of piping systems and for selecting and designing expansion joints, loops, and bends.
2. Anchor Details: Detail fabrication of each anchor indicated. Show dimensions and methods of assembly and attachment to building structure.
3. Alignment Guide Details: Detail field assembly and attachment to building structure.
4. Schedule: Indicate type, manufacturer's number, size, material, pressure rating, end connections, and location for each expansion joint.

C. Product Certificates: For each type of pipe expansion joint, signed by product manufacturer.

D. Welding certificates.

E. Operation and Maintenance Data: For pipe expansion joints to include in emergency, operation, and maintenance manuals.

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to the following:

2. Welding to Piping: ASME Boiler and Pressure Vessel Code: Section IX.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. 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.

2.02 ALIGNMENT GUIDES

A. Description: Steel, factory fabricated, with bolted two-section outer cylinder and base for alignment of piping and two-section guiding spider for bolting to pipe.

1. Manufacturers:

   a. Adsco Manufacturing, LLC.
   b. Advanced Thermal Systems, Inc.
   c. Flex-Hose Co., Inc.
   d. Flexicraft Industries.
   e. Flex-Weld, Inc.
   f. Hyspan Precision Products, Inc.
   g. Metraflex, Inc.
   h. Piping Technology & Products, Inc.
   i. Senior Flexonics, Inc.; Pathway Division.
2.03 MATERIALS FOR ANCHORS

A. Steel Shapes and Plates: ASTM A 36/A 36M.

B. Bolts and Nuts: ASME B18.10 or ASTM A 183, steel, hex head.

C. Washers: ASTM F 844, steel, plain, flat washers.

D. Mechanical Fasteners: Insert-wedge-type stud with expansion plug anchor for use in hardened portland cement concrete, and tension and shear capacities appropriate for application.
   2. Expansion Plug: Zinc-coated steel.

E. Chemical Fasteners: Insert-type-stud bonding system anchor for use with hardened portland cement concrete, and tension and shear capacities appropriate for application.
   1. Bonding Material: ASTM C 881, Type IV, Grade 3, 2-component epoxy resin suitable for surface temperature of hardened concrete where fastener is to be installed.

F. Concrete: Portland cement mix, 3000 psi minimum. Refer to Division 3 Section "Cast-in-Place Concrete" for formwork, reinforcement, and concrete.

G. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink, nonmetallic grout; suitable for interior and exterior applications.
   2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.01 PIPE BEND AND LOOP INSTALLATION

A. Install pipe bends and loops cold-sprung in tension or compression as required to partly absorb tension or compression produced during anticipated change in temperature.

B. Attach pipe bends and loops to anchors.
   2. Concrete Anchors: Attach by fasteners. Follow fastener manufacturer's written instructions.

3.02 SWING CONNECTIONS

A. Connect risers and branch connections to mains with at least five pipe fittings, including tee in main.
B. Connect risers and branch connections to terminal units with at least four pipe fittings, including tee in riser.

C. Connect mains and branch connections to terminal units with at least four pipe fittings, including tee in main.

3.03 ALIGNMENT-GUIDE INSTALLATION

A. Install guides on piping adjoining pipe expansion joints and bends and loops.

B. Attach guides to pipe and secure to building structure.

3.04 ANCHOR INSTALLATION

A. Install anchors at locations to prevent stresses from exceeding those permitted by ASME B31.9 and to prevent transfer of loading and stresses to connected equipment.

B. Fabricate and install steel anchors by welding steel shapes, plates, and bars to piping and to structure. Comply with ASME B31.9 and AWS D1.1.

C. Construct concrete anchors of poured-in-place concrete of dimensions indicated and include embedded fasteners.

D. Install pipe anchors according to expansion-joint manufacturer’s written instructions if expansion joints or compensators are indicated.

E. Use grout to form flat bearing surfaces for expansion fittings, guides, and anchors installed on or in concrete.

END OF SECTION
SECTION 15140
DOMESTIC WATER PIPING

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Aboveground domestic water pipes, tubes, fittings, and specialties inside the building.

1.03 PERFORMANCE REQUIREMENTS
A. Seismic Performance: Domestic water piping and support and installation shall withstand effects of earthquake motions determined according to ASCE/SEI 7

1.04 SUBMITTALS
A. Product Data: For the following products:
   1. Specialty valves.
   2. Transition fittings.
   3. Dielectric fittings.
   4. Flexible connectors.

B. Coordination Drawings: For piping in 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.
   2. Gas piping.

C. LEED Submittals:
   1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
   2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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.”
1.05 INFORMATIONAL SUBMITTALS

A. System purging and disinfecting activities report.
B. Field quality-control reports.

1.06 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.

PART 2 - PRODUCTS

2.01 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.

2.02 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L (ASTM B 88M, Type B) water tube, drawn temper.
B. Soft Copper Tube: ASTM B 88, Type K (ASTM B 88M, Type A) water tube, annealed temper.
D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.
E. Copper Unions:
   1. MSS SP-123.
   3. Solder-joint or threaded ends.
F. Copper Pressure-Seal-Joint Fittings: (Alternative)
   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. Viega.
      b. NIBCO Inc.
      c. Approved Equal
   2. Fittings for NPS 2 (DN 50) and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
   3. Fittings for NPS 2-1/2 to NPS 4 (DN 65 to DN 100): Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
2.03 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:
   1. AWWA C110/A21.10, rubber, flat face, 1/8 inch (3.2 mm) thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
   2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

PART 3 - EXECUTION

3.01 EARTHWORK

A. Comply with requirements in Division 31 Section "Earth Moving" for excavating, trenching, and backfilling.

3.02 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 domestic water piping level without pitch and plumb.

C. Install piping concealed from view and protected from physical contact by building occupants 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, and coordinate with other services occupying that space.

F. Install piping adjacent to equipment and specialties to allow service and maintenance.

G. Install piping to permit valve servicing.

H. 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.

I. Install piping free of sags and bends.

J. Install fittings for changes in direction and branch connections.
K. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

L. Install a hot-water heating cable system on all hot water piping.

M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 15 Section "Sleeves and Sleeve Seals for Plumbing Piping."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Division 15 Section "Sleeves and Sleeve Seals for Plumbing Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 15 Section "Escutcheons for Plumbing Piping."

P. 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 for "General-Duty Valves" and with requirements for drain valves and strainers in Section 15120 "Domestic Water Piping Specialties."

Q. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

3.03 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.

3.04 VALVE INSTALLATION

A. General-Duty Valves: Comply with requirements in Division 15 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 or gate valves for piping NPS 3 and smaller. gate valves for piping NPS 4 and larger.

C. Install drain valves at low points in horizontal piping, and where required to drain water piping. Drain valves are specified in Division 15 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. Set calibrated balancing valves partly open to restrict but not stop flow. Comply with requirements in Division 15 Section "Domestic Water Piping Specialties" for calibrated balancing valves.

### 3.05 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.

### 3.06 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. **Dielectric Fittings for NPS 2 and Smaller**: Use dielectric couplings or nipples.

C. **Dielectric Fittings for NPS 2-1/2 to NPS 4**: Use dielectric flanges.

### 3.07 FLEXIBLE CONNECTOR INSTALLATION

A. Install bronze-hose flexible connectors in copper domestic water tubing.

### 3.08 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.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.09 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:

1. Plumbing Fixtures: Cold- and hot-water supply piping in sizes indicated, but not smaller than required by plumbing code. Comply with requirements in Division 15 plumbing fixture Sections for connection sizes.
2. 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.

3.10 IDENTIFICATION

A. Identify system components. Comply with requirements in Division 15 Section "Identification for Plumbing Piping and Equipment" for identification materials and installation.

B. Label pressure piping with system operating pressure.

3.11 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.

3.12 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, 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.


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.

3.13 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.

3.14 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, shall be:
   Hard copper tube, ASTM B 88, Type L; wrought- copper solder-joint fittings; and soldered joints.

3.15 VALVE SCHEDULE

1. Shutoff Duty: Use ball or gate valves for piping NPS 3 and smaller. Use, gate valves with flanged ends for piping NPS 4 and larger.
2. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

END OF SECTION
SECTION 15155
SANITARY WASTE PIPING SPECIALTIES

PART 1 - GENERAL

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

1.02 SUMMARY
A. This Section includes the following sanitary drainage piping specialties:
1. Cleanouts.
2. Floor drains
B. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 CLEAN OUTS
A. Exposed Metal Cleanouts (CO):
1. ASME A112.36.2M, Cast-Iron Cleanouts:
   b. Tyler Pipe Industries.
   c. Approved Equal.
2. Standard: ASME A112.36.2M for cast iron for cleanout test tee.
3. Size: Same as connected drainage piping
5. Closure: Countersunk, brass plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
B. Metal Floor Cleanouts (FCO-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. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc: Model # 4020
   b. Josam Company; Josam Div.
c. Zurn Plumbing Products Group; Light Commercial Operation.
d. Approved Equal.

2. Standard: ASME A112.36.2M for cast-iron soil pipe with cast-iron, adjustable housing cleanout.
3. Size: Same as connected branch.
4. Type: Adjustable nickel bronze top.
5. Body or Ferrule: Cast iron.
7. Closure: Brass plug with straight threads and gasket.
8. Adjustable Housing Material: Cast iron.
10. Frame and Cover Shape: Round.
11. Top Loading Classification: Medium Duty.
12. Riser: ASTM A 74, Service class, cast-iron drainage pipe fitting and riser to clean out.
14. Size: Same as connected branch.

C. Cast-Iron Wall Cleanouts (WCO-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. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc: Model # 4710
   b. Josam Company; Josam Div.
   c. Zurn Plumbing Products Group; Light Commercial Operation.
   d. Approved Equal.

2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: As required to match connected piping.
5. Closure Plug Size: Same as or not more than one size smaller than cleanout size.

2.02 FLOOR DRAINS

A. Cast-Iron Floor Drains (FD-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:
   b. Josam Company; Josam Div.
   c. Zurn Plumbing Products Group; Light Commercial Operation.

2. Standard: ASME A112.6.3.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Outlet: Bottom.
8. Coating in first subparagraph below is usually used only on sanitary floor drains.
10. Sediment Bucket: Required.
11. Top or Strainer Material: Bronze.
13. Top Shape: Round.
14. Dimensions of Top or Strainer: 8” inches
15. Top Loading Classification: Medium Duty.

B. Cast Iron Indirect Waste Floor Drain (FD-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:
   b. Josam Company; Josam Div.
   c. Zurn Plumbing Products Group; Light Commercial Operation.
   d. Approved equal
2. Standard: ASME A112.6.3.
5. Seepage Flange: Required.
6. Anchor Flange: Required.
7. Outlet: Bottom.
10. Top or Strainer Material: Bronze or nickel bronze.
12. Top Shape: Round.
13. Dimensions of Top or Strainer: 12” inches
15. Trap Material: Cast iron.

2.03 INSTALLATION

A. 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.

B. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

C. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

1. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
2. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.

D. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.

E. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.

F. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.

2.04 TESTS

A. 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 the sanitary piping. 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 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.

2.05 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 15160

FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

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

1.02 SUMMARY
   A. Section Includes:
      1. Pipe, tube, and fittings.
      2. Specialty pipe fittings.

1.03 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

1.04 ACTION SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. LEED Submittals:
      1. Product Data for Credit IEQ 4.1: For solvent cements and adhesive primers, documentation including printed statement of VOC content.
      2. Laboratory Test Reports for Credit IEQ 4: For solvent cements and adhesive primers, documentation indicating that products 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."

1.05 INFORMATIONAL SUBMITTALS
   A. Seismic Qualification Certificates: For storm drainage piping, accessories, and components, from manufacturer.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Field quality-control reports.

1.06 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 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.

2.02 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service classes.
B. Gaskets: ASTM C 564, rubber.
C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.03 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. Heavy-Duty, Hubless-Piping Couplings:

1. Manufacturers: Subject to compliance with requirements, [provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following]:
   a. ANACO-Husky.
   b. MIFAB, Inc.

3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
PART 3 - EXECUTION

3.01 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 02210 "Earth Moving."

3.02 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 from 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. 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.

K. 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.

L. Install storm drainage piping at the following minimum slopes unless otherwise indicated:

1. Building Storm 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 Storm-Drainage Piping: 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.
M. 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.

N. Install steel piping according to applicable plumbing code.

O. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

P. Install aboveground ABS piping according to ASTM D 2661.

Q. Install aboveground PVC piping according to ASTM D 2665.

R. Plumbing Specialties:
   1. Install cleanouts at grade and extend to where building storm drains connect to building storm sewers in storm drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in storm drainage force-main piping. Comply with requirements for cleanouts specified in Section 15165 "Storm Drainage Piping Specialties."
   2. Install drains in storm drainage gravity-flow piping. Comply with requirements for drains specified in Section 15165 "Storm Drainage Piping Specialties."

S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

T. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 15092 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 15097 "Escutcheons for Plumbing Piping."

3.03 JOINT CONSTRUCTION


3.04 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Division 15 Section "Hangers and Supports for Plumbing Piping and Equipment."
   1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
   2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
   3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
   4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
   5. Vertical Piping: MSS Type 8 or Type 42, clamps.
   6. Install 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.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting and coupling.
C. Support vertical piping and tubing at base and at each floor.
D. Rod diameter may be reduced one 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 and NPS 8: 60 inches with 3/4-inch rod.
   5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.
G. Install supports for vertical copper tubing every 10 feet.
H. Support piping and tubing not listed above according to MSS SP-69 and manufacturer's written instructions.

3.05 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.
   1. Install test tees (wall cleanouts) in conductors near floor, and floor cleanouts with cover flush with floor.
D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.
E. 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.
3.06 IDENTIFICATION

A. Identify exposed storm drainage piping. Comply with requirements for identification specified in Section 15076 "Identification for Plumbing Piping and Equipment."

3.07 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 until 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.

3.08 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.

3.09 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground storm drainage piping shall be the following:
1. Hubless, cast-iron soil pipe and fittings; CISPI hubless-piping couplings; and coupled joints.

END OF SECTION
SECTION 15165

STORM DRAINAGE PIPING SPECIALTIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Roof drains.
   2. Miscellaneous storm drainage piping specialties.
   3. Cleanouts.
   4. Through-penetration firestop assemblies.
   5. Flashing materials.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 QUALITY ASSURANCE

A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

PART 2 - PRODUCTS

2.01 ROOF DRAINS

A. Cast-Iron, Medium-Sump, General-Purpose Roof Drains
   1. Basis-of-Design Product: Watts model RD 300-W-D with overflow drain Watts RD 300-F-D combined roof drain and secondary overflow system. Provide comparable product by one of the following:
      a. Watts
      c. Josam Company.
   2. Standard: ASME A112.6.4, for general-purpose roof drains.
   4. Combination Flashing Ring and Gravel Stop.
   5. Extension Collars
2.02 CLEANOUTS

A. Accessible cleanouts shall be installed at the base of all vertical soils, wastes, drainage, and storm water lines, on inlet handholes of running traps, on exposed or accessible fixture traps, and at the change of direction on horizontal runs. Cleanouts shall be the same size as the pipe up to 4" size. Piping above 4" size shall have at least 4" cleanouts. Cleanouts on horizontal piping shall be a maximum distance of 50 feet apart and shall not be less than 18" from masonry wall or obstruction that would reduce accessibility.

B. Cleanouts underground shall be brought up near the floor surface with long turn fittings and closed gas tight with ferrules and cast brass plugs, and then covered with brass cleanout cover similar and equal to J. R. Smith 4890, Wade W-8450-P, or Zurn ZAB 1455-6 cleanout cover.

C. Cleanouts in waterproofed floors shall be made accessible through a modified, J. R. Smith 4313, Wade ZN 1455-4C with flashing clamp and 6 lb. lead flashing. Flashing shall be extended at least 12" beyond drain body in all directions. Cover of cleanout shall be nickel bronze or recessed to receive asphalt tiles, Zurn ZN 1455-5C.

D. Cleanouts behind walls shall be extended to finished wall and closed gas tight with bronze plug and stainless steel cover similar to J. R. Smith 4422 or 4472, Wade W-8450-R or W-8470-R, or Zurn ZN 1440-1 in cast iron pipe or Fig. ZN 1460-8 in steel pipe. Cleanout plugs shall be made up with a graphite lubricant or teflon tape to insure easy removal. No pipe compound shall be used on cleanouts. Cleanout covers shall have no lettering on the finished surface.

2.03 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

A. Through-Penetration Firestop Assemblies:
1. Basis-of-Design Product: Subject to compliance with requirements, provide or comparable product by one of the following:
   a. ProSet Systems Inc.

2. Standard: ASTM E 814, for through-penetration firestop assemblies.
3. Certification and Listing: acceptable to authorities having jurisdiction for through-penetration firestop assemblies.
4. Size: Same as connected pipe.
5. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
7. Special Coating: Corrosion resistant on interior of fittings.
2.04 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

A. Downspout Adaptors

1. Description: Manufactured, gray-iron casting, for attaching to horizontal-outlet, parapet roof drain and to exterior, sheet metal downspout.
2. Size: Inlet size to match parapet drain outlet.

B. Downspout Boots

1. Description: Manufactured, ASTM A 48/A 48M, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
2. Size: Inlet size to match downspout and NPS 4 outlet.
3. 

2.05 FLASHING MATERIALS

A. Copper Sheet: ASTM B 152/B 152M, 12 oz./sq. ft..

B. 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. Fasteners: Metal compatible with material and substrate being fastened.

E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.

PART 3 - EXECUTION

3.01 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 downspout adapters on outlet of back-outlet parapet roof drains and connect to sheet metal downspouts.

C. Install downspout boots at grade with top 12 inches above grade. Secure to building wall.

D. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.

E. 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 base of each vertical soil and waste stack.

F. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.

G. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.

H. Install wall cleanouts in vertical conductors. Install access door in wall if indicated.

I. Install through-penetration firestop assemblies in plastic conductors at concrete floor penetrations.

J. Install sleeve flashing device with each conductor passing through floors with waterproof membrane.

3.02 CONNECTIONS

A. Comply with requirements for piping specified in Section 15160 "Facility Storm Drainage Piping." Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 FLASHING INSTALLATION

A. Fabricate flashing from single piece of metal unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:

1. Lead Sheets: Burn joints of 6.0-lb/sq. ft. lead sheets, 0.0938-inch thickness or thicker. Solder joints of 4.0-lb/sq. ft. lead sheets, 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 the pipe size, with a minimum length of 10 inches and with 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. Fabricate and install flashing and pans, sumps, and other drainage shapes.
3.04 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 15182

HYDRONIC PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Hot-water heating piping.
2. Condensate-drain piping.

B. Related Sections include the following:

1. Not applicable.

1.03 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

1.04 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Hot-Water Heating Piping: 200 deg F.
2. Condensate-Drain Piping: 150 deg F.

1.05 SUBMITTALS

A. Product Data: For each type of the following:
1. Pressure-seal fittings.
2. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
3. 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.

G. Water Analysis: Submit a copy of the water analysis to illustrate water quality available at Project site.

1.06 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 1.

1.07 EXTRA MATERIALS

A. Water-Treatment Chemicals: Furnish enough chemicals for initial system startup and for preventive maintenance for one year from date of Substantial Completion.

B. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.
B. Wrought-Copper Fittings: ASME B16.22.

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
   a. Anvil International, Inc.
   b. S. P. Fittings; a division of Star Pipe Products.
   c. Propress system.
4. Grooved-End Copper Fittings: ASTM B 75, copper tube or ASTM B 584, bronze casting.
5. Grooved-End-Tube Couplings: Rigid pattern, unless otherwise indicated; gasketed fitting. Ductile-iron housing with keys matching pipe and fitting grooves, prelubricated EPDM gasket rated for minimum 230 deg F for use with housing, and steel bolts and nuts.

C. Copper or Bronze Pressure-Seal Fittings:

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
   a. Stadler-Viega.
4. Housing: Copper.
5. O-Rings and Pipe Stops: EPDM.
6. Tools: Manufacturer's special tools.
7. Minimum 200-psig working-pressure rating at 250 deg F.

D. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.

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:
2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
3. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
   a. T-DRILL Industries Inc.

E. Wrought-Copper Unions: ASME B16.22.
2.02 STEEL FITTINGS


B. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

2.03 JOINING MATERIALS

A. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

B. 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.

2.04 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:

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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Central Plastics Company.
   d. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
   e. Zurn Plumbing Products Group; AquaSpec Commercial Products Division.

3. Factory-fabricated union assembly, for 250-psig minimum working pressure at 180 deg F.

D. Dielectric Flanges:

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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   b. Central Plastics Company.
   c. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

3. Factory-fabricated companion-flange assembly, for 150- or 300-psig minimum working pressure as required to suit system pressures.
E. Dielectric-Flange Kits:

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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Advance Products & Systems, Inc.
   b. Calpico, Inc.
   c. Central Plastics Company.
   d. Pipeline Seal and Insulator, Inc.

3. 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.

4. 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 Couplings:

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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Calpico, Inc.
   b. Lochinvar Corporation.

3. Galvanized-steel coupling with inert and noncorrosive thermoplastic lining; threaded ends; and 300-psig minimum working pressure at 225 deg F.

G. Dielectric Nipples:

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:

2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

   a. Perfection Corporation; a subsidiary of American Meter Company.
   b. Precision Plumbing Products, Inc.
   c. Sioux Chief Manufacturing Company, Inc.
   d. Victaulic Company of America.

3. Electroplated steel nipple with inert and noncorrosive, thermoplastic lining; plain, threaded, or grooved ends; and 300-psig minimum working pressure at 225 deg F.

2.05 VALVES

A. Gate, Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Division 15 Section "Valves."
B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Division 15 Section "HVAC Instrumentation and Controls."

C. Bronze, Calibrated-Orifice, Balancing Valves:
   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:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
      a. Armstrong Pumps, Inc.
      b. Bell & Gossett Domestic Pump; a division of ITT Industries.
      c. Flow Design Inc.
      d. Gerard Engineering Co.
      e. Griswold Controls.
      f. Taco.
   4. Body: Bronze, ball or plug type with calibrated orifice or venturi.
   5. Ball: Brass or stainless steel.
   6. Plug: Resin.
   7. Seat: PTFE.
   8. End Connections: Threaded or socket.
   10. Handle Style: Lever, with memory stop to retain set position.
   12. Maximum Operating Temperature: 250 deg F.

D. Automatic Flow-Control Valves:
   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:
   2. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   3. Basis-of-Design Product: Subject to compliance with requirements, provide or a comparable product by one of the following:
      a. Flow Design Inc.
      b. Griswold Controls.
   4. Body: Brass or ferrous metal.
   5. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
   6. Combination Assemblies: Include bronze or brass-alloy ball valve.
   7. Identification Tag: Marked with zone identification, valve number, and flow rate.
   8. Size: Same as pipe in which installed.
   9. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
   11. Maximum Operating Temperature: 200 deg F.
2.06 AIR CONTROL DEVICES

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. Amtrol, Inc.
   2. Armstrong Pumps, Inc.
   3. Bell & Gossett Domestic Pump; a division of ITT Industries.
   4. Taco.

C. Manual Air Vents:
   1. Body: Bronze.
   2. Internal Parts: Nonferrous.
   3. Operator: Screwdriver or thumbscrew.
   4. Inlet Connection: NPS 1/2.
   7. Maximum Operating Temperature: 225 deg F.

D. Automatic Air Vents:
   1. Body: Bronze or cast iron.
   2. Internal Parts: Nonferrous.
   4. Inlet Connection: NPS 1/2.
   7. Maximum Operating Temperature: 240 deg F.

2.07 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:
   1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.

B. Basket Strainers:
   1. Body: ASTM A 126, Class B, high-tensile cast iron with bolted cover and bottom drain connection.
   2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
   3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
C. T-Pattern Strainers:
   1. Body: Ductile or malleable iron with removable access coupling and end cap for strainer maintenance.
   2. End Connections: Grooved ends.
   3. Strainer Screen: 60-mesh startup strainer, and perforated stainless-steel basket with 57 percent free area.
   4. CWP Rating: 750 psig.

D. Expansion fittings are specified in Division 15 Section "Pipe Expansion Fittings and Loops."

PART 3 - EXECUTION

3.01 PIPING APPLICATIONS

A. Hot-water heating piping, aboveground, NPS 3 and smaller shall be the following:
   1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered brazed pressure-seal joints.

B. Condensate-Drain Piping: Type DWV, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.

3.02 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install throttling-duty calibrated-orifice, balancing valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.03 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 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 15 Section "Valves."

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 15 Section "Pipe Expansion Fittings and Loops."

U. Identify piping as specified in Division 15 Section "Mechanical Identification."

3.04 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Division 15 Section "Hangers and Supports." 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.

C. 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.
5. NPS 2-1/2: Maximum span, 9 feet; minimum rod size, 3/8 inch.
6. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.

D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.05 PIPE JOINT CONSTRUCTION

A. Join pipe and fittings according to the following requirements and Division 15 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.


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.


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. Mechanically Formed, Copper-Tube-Outlet Joints: Use manufacturer-recommended tool and procedure, and brazed joints.


3.06 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

3.07 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections.

3.08 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Flush hydronic piping systems with clean water; then remove and clean or replace strainer screens.
4. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
5. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to
pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."

5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.

6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION
SECTION 15184

REFRIGERANT PIPING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes refrigerant piping used for air-conditioning applications.

1.03 PERFORMANCE REQUIREMENTS

A. Line Test Pressure for Refrigerant R-410A:


1.04 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. Hot-gas bypass valves.
4. Filter dryers.
5. Strainers.
6. 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.

1.05 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."


C. Comply with ASME B31.5, "Refrigeration Piping and Heat Transfer Components."

1.06 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.

1.07 COORDINATION

A. Coordinate size and location wall penetrations.

PART 2 - PRODUCTS

2.01 COPPER TUBE AND FITTINGS

A. Copper Tube: 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:
   2. End Connections: Socket ends.
   3. Offset Performance: Capable of minimum 3/4-inch misalignment in minimum 7-inch- long assembly.
   5. Maximum Operating Temperature: 250 deg F.
2.02 VALVES AND SPECIALTIES

A. Diaphragm Packless Valves:
   1. Body and Bonnet: Forged brass or cast bronze; globe design with straight-through or angle pattern.
   3. Operator: Rising stem and hand wheel.
   5. End Connections: Socket, union, or flanged.
   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.
   5. Seal Cap: Forged-brass or valox hex cap.
   6. End Connections: Socket, union, threaded, or flanged.
   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.
   6. End Connections: Socket, union, threaded, or flanged.
   7. Maximum Opening Pressure: 0.50 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.
   4. End Connections: Copper spring.

E. Solenoid Valves: Comply with ARI 760 and UL 429; listed and labeled by an NRTL.
   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 24 115 208-V ac coil.
   7. Maximum Operating Temperature: 240 deg F.
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.
4. End Connections: Threaded.
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.
4. Capillary and Bulb: Copper tubing filled with refrigerant charge.
5. Suction Temperature: Compatible with equipment.
7. Reverse-flow option (for heat-pump applications).
8. End Connections: Socket, flare, or threaded union.
10. Suction Temperature: Compatible with equipment.
14. Maximum Operating Temperature: 240 deg F.

H. Hot-Gas Bypass Valves: Comply with UL 429; listed and labeled by an NRTL.

1. Body, Bonnet, and Seal Cap: Ductile iron or steel.
5. Seat: Polytetrafluoroethylene.
7. Electrical: Molded, watertight coil in NEMA 250 enclosure of type required by location with 1/2-inch conduit adapter, and [24] [115] [208]-V ac coil.
10. Throttling Range: Maximum 5 psig.
12. Maximum Operating Temperature: 240 deg F.

I. Straight-Type Strainers:

2. Screen: 100-mesh stainless steel.
3. End Connections: Socket or flare.
5. Maximum Operating Temperature: 275 deg F.

J. 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.
6. Maximum Operating Temperature: 275 deg F.
K. Moisture/Liquid Indicators:
   2. Window: Replaceable, clear, fused glass window with indicating element protected by filter screen.
   3. Indicator: Color coded to show moisture content in ppm.
   5. End Connections: Socket or flare.
   7. Maximum Operating Temperature: 240 deg F.

L. 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.
   5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
   7. Rated Flow: Compatible with equipment.
   9. Maximum Operating Temperature: 240 deg F.

M. Permanent Filter Dryers: Comply with ARI 730.
   2. Filter Media: 10 micron, pleated with integral end rings; stainless-steel support.
   5. Access Ports: NPS 1/4 connections at entering and leaving sides for pressure differential measurement.
   7. Rated Flow: Compatible with equipment.
   9. Maximum Operating Temperature: 240 deg F.

N. Mufflers:
   2. End Connections: Socket or flare.
   4. Maximum Operating Temperature: 275 deg F.

O. 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.
   4. Tappings: Inlet, outlet, liquid level indicator, and safety relief valve.
   5. End Connections: Socket or threaded.
   7. Maximum Operating Temperature: 275 deg F.
P. Liquid Accumulators: Comply with ARI 495.
   2. End Connections: Socket or threaded.
   4. Maximum Operating Temperature: 275 deg F.

2.03 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-134a: Tetrafluoroethane.

D. ASHRAE 34, R-407C: Difluormethane/Pentafluoroethane/1,1,1,2 Tetrafluoroethane.

E. ASHRAE 34, R-410A: Pentafluoroethane/Difluoromethane.

PART 3 - EXECUTION

3.01 VALVE AND SPECIALTY APPLICATIONS

A. Install diaphragm packless packed-angle 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 packed-angle 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.

3.02 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Shop Drawings. Piping shall be sized and installed in accordance with manufacturer’s instructions.

B. Install refrigerant piping according to ASHRAE 15.

C. Piping and accessories shall duplicate feature originally installed on the existing condensers.

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 adjacent to machines to allow service and maintenance.

F. Install piping free of sags and bends.

G. Install fittings for changes in direction and branch connections.

H. Select system components with pressure rating equal to or greater than system operating pressure.

I. Refer to Division 15 Sections "HVAC Instrumentation and Controls" and "Sequence of Operation" for solenoid valve controllers, control wiring, and sequence of operation.

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. 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.

M. 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.

N. Install pipe sleeves at penetrations in exterior walls and floor assemblies.

O. Seal penetrations through fire and smoke barriers with UL listed firestop systems.

P. Install piping with adequate clearance between pipe and adjacent walls and hangers or between pipes for insulation installation.

Q. Install sleeves through floors, walls, or ceilings, sized to permit installation of full-thickness insulation.

R. Seal pipe penetrations through exterior walls with approved sealants for materials and methods.

S. Identify refrigerant piping and valves according to Division 15 Section "Mechanical Identification."

3.03 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs.

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. Soldered Joints: Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. 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.

3.04 HANGERS AND SUPPORTS

A. Hanger, support, and anchor products are specified in Division 15 Section "Hangers and Supports."
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.
6. NPS 2: Maximum span, 96 inches; minimum rod size, 3/8 inch.
7. NPS 2-1/2: Maximum span, 108 inches; minimum rod size, 3/8 inch.
8. NPS 3: Maximum span, 10 feet; minimum rod size, 3/8 inch.
9. NPS 4: Maximum span, 12 feet; minimum rod size, 1/2 inch.

3.05 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.

3.06 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.
3.07 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 controllers to the system design temperature.

D. Perform the following adjustments before operating the refrigeration system, according to manufacturer's written instructions:
   1. Open shutoff valves in condenser water circuit.
   2. Verify that compressor oil level is correct.
   3. Open compressor suction and discharge valves.
   4. Open refrigerant valves except bypass valves that are used for other purposes.
   5. 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 15185
HYDRONIC PUMPS

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:

1.03 DEFINITIONS
A. Buna-N: Nitrile rubber.
B. EPT: Ethylene propylene terpolymer.

1.04 ACTION SUBMITTALS
A. Product Data: For each type of pump. Include certified performance curves and rated capacities, operating characteristics, furnished specialties, final impeller dimensions, and accessories for each type of product indicated. Indicate pump's operating point on curves.
B. Shop Drawings: For each pump.
   1. Show pump layout and connections.
   2. Include setting drawings with templates for installing foundation and anchor bolts and other anchorages.
   3. Include diagrams for power, signal, and control wiring.

1.05 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For pumps to include in emergency, operation, and maintenance manuals.

1.06 MAINTENANCE MATERIAL SUBMITTALS
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. Mechanical Seals: One mechanical seal(s) for each pump.

PART 2 - PRODUCTS

2.01 CLOSE-COUPLED, IN-LINE CENTRIFUGAL PUMPS

A. Acceptable manufacturers:
   1. Bell & Gossett
   2. Taco
   3. Armstrong
   4. Grundfos
   5. Aurora

B. Description: Factory-assembled and -tested, centrifugal, overhung-impeller, close-coupled, in-line pump as defined in HI 1.1-1.2 and HI 1.3; designed for installation with pump and motor shafts mounted horizontally or vertically.

C. Pump Construction:
   1. Casing: Radially split, cast iron, with threaded gage tappings at inlet and outlet, replaceable bronze wear rings, and threaded companion-flange union-end connections.
   2. Impeller: ASTM B 584, cast bronze; statically and dynamically balanced, keyed to shaft, and secured with a locking cap screw. For constant-speed pumps, trim impeller to match specified performance.
   4. Seal: Mechanical seal consisting of carbon rotating ring against a ceramic seat held by a stainless-steel spring, and Buna-N EPT bellows and gasket. Include water slinger on shaft between motor and seal.
   5. Seal: Packing seal consisting of stuffing box with a minimum of four rings of graphite-impregnated braided yarn with bronze lantern ring between center two graphite rings, and bronze packing gland.
   6. Pump Bearings: Permanently lubricated ball bearings Oil lubricated; bronze-journal or thrust type.

D. Motor: Single speed and rigidly mounted to pump casing.
   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.
   2. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 15055 "Common Motor Requirements for HVAC Equipment."
      a. Enclosure: Open, dripproof.
      b. Enclosure Materials: Cast iron Rolled steel.
      d. Efficiency: Premium efficient.

E. Capacities and Characteristics: See contract drawings.
PART 3 - EXECUTION

3.01 EXAMINATION
A. Examine equipment foundations and anchor-bolt locations for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
B. Examine roughing-in for piping systems to verify actual locations of piping connections before pump installation.
C. Examine foundations and inertia bases for suitable conditions where pumps are to be installed.
D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 PUMP INSTALLATION
A. Install pumps to provide access for periodic maintenance including removing motors, impellers, couplings, and accessories.
B. Independently support pumps and piping so weight of piping is not supported by pumps and weight of pumps is not supported by piping.
C. Equipment Mounting: Install in-line pumps with continuous-thread hanger rods and elastomeric hangers of size required to support weight of in-line pumps.
   1. Comply with requirements for hangers and supports specified in Section 15060 "Hangers and Supports."

3.03 ALIGNMENT
A. Engage a factory-authorized service representative to perform alignment service.
B. Comply with requirements in Hydronics Institute standards for alignment of pump and motor shaft. Add shims to the motor feet and bolt motor to base frame. Do not use grout between motor feet and base frame.
C. Comply with pump and coupling manufacturers' written instructions.
D. After alignment is correct, tighten foundation bolts evenly but not too firmly. Completely fill baseplate with nonshrink, nonmetallic grout while metal blocks and shims or wedges are in place. After grout has cured, fully tighten foundation bolts.

3.04 CONNECTIONS
A. Where installing piping adjacent to pump, allow space for service and maintenance.
B. Connect piping to pumps. Install valves that are same size as piping connected to pumps.
C. Install suction and discharge pipe sizes equal to or greater than diameter of pump nozzles.
D. Install check, shutoff, and throttling valves check valve and throttling valve with memory stop on discharge side of pumps.
E. Install Y-type strainer and shutoff valve on suction side of pumps.

F. Install pressure gages on pump suction and discharge or at integral pressure-gage tapping, or install single gage with multiple-input selector valve.

G. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

H. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.05 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. Check piping connections for tightness.
   3. Clean strainers on suction piping.
   4. Perform the following startup checks for each pump before starting:

      a. Verify bearing lubrication.
      b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
      c. Verify that pump is rotating in the correct direction.

   5. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
   7. Open discharge valve slowly.

3.06 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain hydronic pumps.
SECTION 15190

FACILITY NATURAL-GAS PIPING

PART 1 - GENERAL

1.01 LEED REQUIREMENTS

A. For LEED requirements, refer to Division 1, General Requirements.

1.02 WORK INCLUDED

A. Furnish and install a complete gas piping installation to all outlets and appliances as indicated on the drawings and herein specified. Work shall conform to the requirements of the National Fire Protection Association Standard No. 54, the Utility Company, and all authorities having jurisdiction.

B. Arrange with the Utility Company to install that portion of the work that is normally installed by said Company and which is allowed by trade jurisdiction. Pay all fees and charges in connection with this work.

C. Furnish and install the various pressure gas systems and gas piping installation to all outlets and equipment as indicated on the drawings and herein specified.

1.03 DESCRIPTION OF WORK

A. Connect to the Utility Company gas mains and install the gas mains as indicated and then extend to the meter, or meters, and from said meters to risers, branches, and apparatus as indicated. Provide necessary piping, fittings, valves, etc., to make a complete system.

B. Verify the size and number of meters the Gas Company intends to furnish and the size of connections required for the meter, or meters. Provide the proper size manifold valves, etc., not furnished by the Utility Company.

B. Pressure regulating valves shall have the relief piped to the outside air.

1.04 SUBMITTALS

A. Submit Shop Drawings indicating all operating pressures and catalog cuts for the following:

1. Gas piping materials

2. Gas piping layout including service, meter and distribution piping, with gas booster, if applicable.

3. Gas Lubricated Plug Valves and Gas Cocks
4. Strainers
5. Pipe joint sealing materials
6. Flanges and Gaskets

B. Submit copies of Certified Welder Qualifications. Submittal shall be made no less than seven (7) working days prior to commencement of work.

1.05 QUALITY ASSURANCE


B. Welders installing gas piping at any pressure shall be qualified for all pipe sizes, wall thicknesses, and all positions in accordance with the latest editions of either API 1104 or ASME Section IX Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.01 MATERIALS

Gas piping shall be standard weight (Schedule 40) black steel pipe. Gas control, vent and relief piping shall also be standard weight, schedule 40 black steel pipe. Steel pipe shall be seamless or welded made in accordance with the Current Edition of the ASTM A53 Specification.

1. In no case shall any gas pipe be less than 3/4". The sizes of pipe indicate nominal pipe size.

2. Gas distribution piping for systems operating at 1/2 PSIG or less shall be in accordance with NFPA-54 National Fuel Code. International Fuel Gas Code.

3. Materials used in gas service and meter piping systems shall be in accordance with the requirements as specified by the gas utility company providing the services, and of the International Plumbing Code.

5. Gas service piping run underground outside the building shall be mill wrapped in accordance with the serving utility company requirements for service piping. Gas distribution piping located on the roof or exposed to the elements shall receive one coat of rust inhibitor paint, and one coat of yellow finish paint.

6. Piping Joints for Gas Distribution Piping:

a. Piping at 1/2 psig (14" WC) and less:
   1) 4" and Smaller......Screwed
   2) Over 4".............Welded

B. Fittings
1. Fittings for screwed gas piping shall be 150 lbs. black malleable iron fittings, conforming to ASTM A197, latest edition.

2. Compression type fittings and steel welding fittings shall be as specified and approved by the Gas Company.

3. Steel butt welding fittings shall conform to ANSI B16.9 requirements.

4. Fitting for control, vent and relief piping shall be 300 lb. black malleable iron screwed fittings conforming to ASTM A197, latest edition.

C. Flanges

1. All flanges shall be steel and compatible in type and pressure ratings with mating flange and shall comply with ANSI B16.5.

2. Flanges shall be welding neck or threaded end. Slip on flanges are not permitted.

3. Where 150 pound steel flanges are bolted to Class 125 cast iron flanges, the raised face on the steel flange shall be removed.

D. Gaskets

1. Gaskets shall be compatible with the gas service on which they are used, without change to their chemical or physical properties.

2. Gasket shall be BLUE-GARD compressed asbestos free gaskets, style 3000 or GYLON gasketing style 3500, color: Fawn with Blue brand both as manufactured by Garlock Inc.

3. Gaskets of metal or metal-jackets, aluminum o-rings and spiral wound metal gaskets, or other materials, if approved by the Utility Company may be used.

4. Full face gaskets shall be used with all bronze and cast iron flanges.

E. Bolts and Nuts

Bolts and nuts shall be of best quality bolt steel with square head bolts and hexagon nuts with machine cut V-threads.

F. Thread joint sealant materials

Thread sealant to be used on natural gas piping shall be RectorSeal Corp No. 5, Oatey Great Blue pipe joint compound or approved equal. Thread sealant shall be a non-toxic, soft setting, slow drying sealant made from inert fillers. The joint sealant material shall not contain any Teflon. Teflon tapes shall not be used in natural gas lines. Teflon tapes are prone to tearing when pipes are being assembled and tightened and bits of torn tape can migrate into the fluid system, clogging valves, screens, and filters.

2.02 ACCEPTABLE MATERIALS & MANUFACTURERS

A. Valves

Walworth
PART 3 - EXECUTION

3.01 INSTALLATION

A. Installation shall be made in accordance with NFPA Pamphlet #54 and the authorities having jurisdiction, except that a plugged tee shall be provided at the base of every riser.

B. Each piece of equipment shall be provided with an individual valve or gas cock.

C. Welding Joints:

1. Welding of pipe shall be done only by certified welders approved by the authorities having jurisdiction.

2. Welded pipe connections may be done by either gas welding or electric arc welding, and shall conform to the recommendations and rules of "Standard Manual on Pipe Welding" of the MCAA, AWS and the ASME.

3. Welded joints on high pressure gas piping shall be x-ray inspected and certified.

3.02 TESTS

A. Gas piping shall be tested with air at a pressure of 100 psig with no pressure drop for a period of 4 hours. If any leaks are indicated by the pressure test and cannot be detected by standard soap and water tests, the chlorinated hydrocarbon shall be introduced into the line and a halogen detector shall be used to pinpoint the locations of leaks. The leaks shall be corrected and the line retested.

B. After the systems have been tested and approved by the authorities having jurisdiction, they shall be kept under constant pressure until final acceptance.

3.03 GAS PIPING VENTING

A. Gas service piping and gas meter piping shall have vent and relief piping installed and sized in full accordance with the requirements of the serving utility.

B. Gas train venting (Boilers and Water Heater):

1. Gas vents from one boiler shall not be manifolded to gas vents from other boilers.

2. All normally open vent valves must be piped separately and directly to the outside.

3. All gas vents shall be equipped with a utility approved weatherproof vent cap.

   a. Vents shall terminate at least 10' laterally from any building opening, window, door or ventilation air intake duct. Vents shall terminate a minimum of 10' above grade.
b. If the above is not possible due to the location of existing windows, then vents shall terminate a minimum of 18" above the parapet. Vents shall terminate at least 10' away from any chimney. Vents shall not be routed on the front façade of the building.

3.04 PAINTING

A. Paints and coatings used in the interior of building to mark piping for identification purposes shall not:


B. All exposed gas pipe shall receive one (1) coat of Tnemec 10-99 or Benjamin Moore Iron Clad Retardo Rust Inhibitive primer paint and one (1) finished coat of safety yellow. Gas vent piping exposed to public view outside the building shall receive one (1) coat of Tnemec 10-99 or Benjamin Moore Iron Clad Retardo Rust Inhibitive primer paint and one coat of finished paint selected by the filing architect.

C. Mill-wrapped piping shall not be painted.

D. Piping at different pressure levels in the same space shall be color coded and labeled.

3.05 LABELING

A. General Requirements: Gas piping operating at different pressures shall have labeling markers indicating operating pressure within that piping.

B. All valves shall be suitably tagged to indicate the operating pressure level within the distribution piping.

END OF SECTION
SECTION 15410
PLUMBING FIXTURES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Faucets.
   2. Lavatories.
   5. Toilet seats.
   6. Urinals.

1.03 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for lavatories.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:
   1. Product Data for Prerequisite WE 1 [and Credit WE 3]: Documentation indicating flow and water consumption requirements.
   2. Product Data for Prerequisite WE 1: Documentation indicating flow and water consumption requirements.
   3. Product Data for Prerequisite WE 1 [and Credit WE 2]: Documentation indicating flow and water consumption requirements.

C. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Counter cutout templates for mounting of counter-mounted plumbing fixtures.

B. Sample Warranty: For special warranty.
1.05  CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For plumbing fixtures and faucets to include in emergency, operation, and operation and maintenance manuals.

1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:

   a. Servicing and adjustments of all plumbing fixtures needing maintenance.

1.06  WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of all applicable fixtures 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.

PART 2 - PRODUCTS

2.01  KITCHEN SINK

A. Kitchen Sink: Countertop Mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Elkay
   b. Kohler Co.
   c. Approved equal.

2. EIKAY double bowl sink Model "Lustertone" LRQ3322, 33 x 22" x 8 ½" deep 4 faucet holes 4" on center. LK99 stainless conical strainer for 3-1/2" opening with C.P. brass 1-1/2" O.D. tailpiece. Mcguire or Brasscraft cast brass 1-1/2" x 2" "P" trap with Mcguire or brasscraft, 2" chrome brass nipple with cast setscrew escutcheon. Supplies - Mc Quire Products or Brasscraft; supply with 1/2" O.D. x 12" flexible riser and 1/2" I.P.S. x 1/2" O.D. wheel handle stop with wrought escutcheon. Faucet :Moen single handle deck mount 4 hole faucet Model 7454,chrome plated finish. Complies with ASME/NSI A112.18.1,ADA.

2.02  LAVATORIES VITREOUS-CHINA

A. Lavatories: Wall Mounted.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   b. Kohler Co.
   c. Approved equal.

2. American Standard #0356.041 LUCERNE “Center Hole” shaped bowl vitreous china lavatory for concealed arms. Faucet shall be Sloan Optima ETF-610-P-BDT, 0.5 GPM electric faucet.

3. Fixture trap, tailpiece, stops and supplies shall be McQuire Products or Brasscraft & Truebro “Trap-Wrap.” Where required for ADA applications.

2.03 WATER CLOSETS

A. Water Closets: Wall mounted, top spud.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. Kohler Co.
   c. Approved equal.

2. Bowl:

   b. Material: Vitreous china.
   c. Type: Siphon jet.
   d. Style: Flushometer valve.
   e. Height: Standard.
   f. Rim Contour: Elongated.
   g. Water Consumption: 1.6 gal. (6 L) per flush.
   h. Spud Size and Location: NPS 1-1/2 (DN 40); top.


4. Toilet Seat: Church 9500 c open front seat.

5. Support:

   a. Standard: ASME A112.6.1M.
   b. Description: Waste-fitting assembly as required to match drainage piping material and arrangement with faceplates, couplings gaskets, and feet; bolts and hardware matching fixture. Include additional extension coupling, faceplate, and feet for installation in wide pipe space.
   c. Water-Closet Mounting Height: Standard or according to ICC/ANSI A117.1, refer to Architectural drawings for ADA fixture locations.
2.04 URINALS

A. Urinals: Wall hung, back outlet, siphon jet.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   b. Kohler Co.
   c. Approved equal.

2. Fixture:

   b. Material: Vitreous china.
   c. Type: Siphon jet.
   d. Strainer or Trapway: Manufacturer's standard strainer with integral trap.
   e. Water Consumption: Low consumption.
   f. Spud Size and Location: NPS 3/4 (DN 20); top.
   g. Outlet Size and Location: NPS 2 (DN 50); back.
   h. Color: White.

3. Flushometer Valve: Sloan Optima 186-1.0-ES-S

4. Waste Fitting:

   b. Size: NPS 2 (DN 50).

5. Support: ASME A112.6.1M, Type I, urinal carrier with fixture support plates and coupling with seal and fixture bolts and hardware matching fixture.

2.05 MOP SINK

A. Mop Sink, Floor Mounted.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Fiat.
   b. Advance Tabco.
   c. Approved equal.

2. Fixture:

   b. Shape: Square.
   c. Nominal Size: [24 by 24 inches (610 by 610 mm).
   d. Height: 10 inches (255 mm).
   e. Rim Guard: On all top surfaces.
g. Drain: Grid with NPS 3 (DN 80) outlet.

3. Mounting: On floor and flush to wall.
4. Faucet: Elkay, two handle commercial faucet, #LKB940C.

### 2.06 WATER COOLER

A. Water Cooler, Floor Mounted with Bottle Filling Station.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

   a. Elkay.
   b. Haws.
   c. Approved equal.

2. Standards: ADA Compliant, Comply with NSF 61 Annex G.
3. Bubbler: One, with adjustable stream regulator, located on deck.
5. Drain: Grid type with NPS 1-1/4 (DN 32) tailpiece.
7. Electric: Plug-in type (Duplex outlet) 115v/60Hz.

### PART 3 - EXECUTION

#### 3.01 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 walls, floors, cabinets, and counters for suitable conditions where fixtures will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

#### 3.02 INSTALLATION

A. Install plumbing fixtures level and plumb according to roughing-in drawings.

B. Install floor-mounted water closets on closet flange attachments to drainage piping.

C. Install counter-mounting fixtures in and attached to casework.

D. 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. Comply with valve requirements specified in Division 22 Section "General-Duty Valves for Plumbing Piping."

E. Install tanks for accessible, tank-type water closets with lever handle mounted on wide side of compartment.

F. Install toilet seats on water closets.

G. 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.

H. Install shower flow-control fittings with specified maximum flow rates in shower arms.

I. Install traps on fixture outlets.
   1. Exception: Omit trap on fixtures with integral traps.
   2. Exception: Omit trap on indirect wastes unless otherwise indicated.

J. Install disposer in outlet of each sink indicated to have a disposer. Install switch where indicated or in wall adjacent to sink if location is not indicated.

K. Loop dishwasher discharge hose up high under counter and fasten to underside of counter. Connect inlet hose to dishwasher and outlet hose to disposer.

L. Set bathtubs and shower receptors in leveling bed of cement grout.

M. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories (Non-residential building). Comply with requirements in Division 22 Section "Plumbing Piping Insulation."

N. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations. Use deep-pattern escutcheons if required to conceal protruding fittings. Comply with escutcheon requirements specified in Division 22 Section "Escutcheons for Plumbing Piping."

O. Seal joints between plumbing fixtures, counters, floors, and walls using sanitary-type, one-part, mildew-resistant silicone sealant. Match sealant color to fixture color. Comply with sealant requirements specified in Division 07 Section "Joint Sealants."

3.03 CONNECTIONS

A. Connect fixtures with water supplies, stops, and risers, and with traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Division 22 Section "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Division 22 Section "Sanitary Waste and Vent Piping."

D. Install protective shielding pipe covers and enclosures on exposed supplies and waste piping of accessible lavatories (Non-Residential building). Comply with requirements in Division 22 Section "Plumbing Piping Insulation."
3.04 ADJUSTING

A. Operate and adjust plumbing fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at faucets to produce proper flow.

3.05 CLEANING AND PROTECTION

A. After completing installation of plumbing fixtures, inspect and repair damaged finishes.

B. Clean plumbing fixtures, faucets, and other fittings with manufacturers' recommended cleaning methods and materials.

C. Provide protective covering for installed plumbing fixtures and fittings.

D. Do not allow use of plumbing fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION
SECTION 15480
FUEL-FIRED, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

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

1.02 SUMMARY

A. Section Includes:
   1. Commercial, atmospheric, gas-fired, storage, domestic-water heaters.
   2. Commercial, gas-fired, high-efficiency, storage, domestic-water heaters.
   4. Residential, power-vent, gas-fired, storage, domestic-water heaters.
   5. Domestic-water heater accessories.

1.03 ACTION SUBMITTALS

A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:
   1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."

C. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.

1.04 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For fuel-fired, domestic-water heaters, accessories, and components, from manufacturer.

   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.
B. Product Certificates: For each type of commercial, gas-fired, gas-fired, tankless, residential, gas-fired, and domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuel-fired, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.06 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. ASHRAE/IESNA Compliance: Fabricate and label fuel-fired, domestic-water heaters to comply with ASHRAE/IESNA 90.1.

C. ASME Compliance:
   1. 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.
   2. Where ASME-code construction is indicated, fabricate and label commercial, finned-tube, domestic-water heaters to comply with ASME Boiler and Pressure Vessel Code: Section IV.

D. NSF Compliance: Fabricate and label equipment components that will be in contact with potable water to comply with NSF 61, "Drinking Water System Components - Health Effects."

1.07 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.08 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of fuel-fired, domestic-water heaters that fail in materials or workmanship within specified warranty period.

   1. Failures include, but are not limited to, the following:

      a. Structural failures including storage tank and supports.
      b. Faulty operation of controls.
c. Deterioration of metals, metal finishes, and other materials beyond normal use.

2. Warranty Periods: From date of Substantial Completion.
   a. Commercial, Gas-Fired, Storage, Domestic-Water Heaters:
      1) Storage Tank: Five years.
      2) Controls and Other Components: Two year(s).

PART 2 - PRODUCTS

2.01 COMMERCIAL GAS FIRED WATER HEATER

A. Commercial, Gas-Fired, High-Efficiency, Storage, Domestic-Water Heater:
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
      c. State Industries.
      d. Approve equal.

   4. Description: Manufacturer's proprietary design to provide at least 95% High Efficiency.

   5. Factory-Installed Storage-Tank Appurtenances:
      a. Coil heat: Helical coil heat exchanger.
      b. Drain Valve: Corrosion-resistant metal complying with ASSE 1005.
      c. Heat Exchanger: Comply with UL 795 or approved testing agency requirements for gas-fired, high-efficiency, domestic-water heaters and natural-gas fuel.
      d. Temperature Control: Adjustable thermostat.
      e. Safety Controls: Automatic, high-temperature-limit and low-water cutoff devices or systems.
      f. Combination Temperature-and-Pressure Relief Valves: ANSI Z21.22/CSA 4.4-M. Include one or more relief valves with total relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select one relief valve with sensing element that extends into storage tank.

B. Capacity and Characteristics:
   1. Capacity: 60 gal.
   2. Recovery: 138 gph at 100 deg F temperature rise.
   3. Fuel Gas Input: 120,000 Btu/h.

   4. Electrical Characteristics:
a. Volts: 120  
b. Phase: Single  
c. Hertz: 60.

5. Vent & fresh air intake Diameter: 3”.

2.02 DOMESTIC-WATER HEATER ACCESSORIES

A. Domestic-Water Compression Tanks:
   1. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
      a. AMTROL Inc.  
      b. Flexcon Industries.  
      c. Honeywell International Inc.  
      d. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.  
      e. Approved equal.

   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 barrier materials for potable-water tank linings, including extending finish into and through tank fittings and outlets.  
      c. Air-Charging Valve: Factory installed.

B. Piping-Type Heat Traps: Field-fabricated piping arrangement according to ASHRAE/IESNA 90.1

C. Heat-Trap Fittings: ASHRAE 90.2.


E. Gas Pressure Regulators (if required): ANSI Z21.18/CSA 6.3, appliance type. Include pressure rating as required to match gas supply.

F. Combination Temperature-and-Pressure Relief Valves: Include relieving capacity at least as great as heat input, and include pressure setting less than domestic-water heater working-pressure rating. Select relief valves with sensing element that extends into storage tank.

G. Pressure Relief Valves (if required): Include pressure setting less than domestic-water heater working-pressure rating.

H. Vacuum Relief Valves: ANSI Z21.22/CSA 4.4-M.
2.03 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect assembled domestic-water heaters specified to be ASME-code construction, according to ASME Boiler and Pressure Vessel Code.

B. Hydrostatically test commercial domestic-water heaters and storage tanks to minimum of one and one-half times pressure rating before shipment.

C. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Domestic-Water Heater Mounting: Install commercial domestic-water heaters on concrete base. Comply with requirements for concrete base specified in Division 03 Section "Cast-in-Place Concrete, Miscellaneous Cast-in-Place Concrete."

1. Exception: Omit concrete bases for commercial 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 (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 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 domestic-water heaters level and plumb, according to 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 Division 15 Section "General-Duty Valves for Plumbing Piping."

C. Install gas-fired, domestic-water heaters according to NFPA 54.

1. Install gas shutoff valves on gas supply piping to gas-fired, domestic-water heaters without shutoff valves.
2. Install gas pressure regulators on gas supplies to gas-fired, domestic-water heaters without gas pressure regulators if gas pressure regulators are required to reduce gas pressure at burner.
3. Install automatic gas valves on gas supplies to gas-fired, domestic-water heaters if required for operation of safety control.

4. Comply with requirements for gas shutoff valves, gas pressure regulators, and automatic gas valves specified in Division 15 Section "Facility Natural-Gas Gas Piping."

D. Install combination temperature-and-pressure relief valves in top portion of storage tanks. Use relief valves with sensing elements that extend into tanks. Extend commercial-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 combination temperature-and-pressure relief valves in water piping for domestic-water heaters without storage. Extend commercial-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.

F. 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 domestic-water heaters that do not have tank drains. Comply with requirements for hose-end drain valves specified in Division 15 Section "Domestic Water Piping Specialties."

G. Install thermometer on outlet piping of domestic-water heaters.

H. Assemble and install inlet and outlet piping manifold kits for multiple domestic-water heaters. Fabricate, modify, or arrange manifolds for balanced water flow through each domestic-water heater. Include shutoff valve and thermometer in each domestic-water heater inlet and outlet, and throttling valve in each domestic-water heater outlet. Comply with requirements for valves specified in Division 15 Section "General-Duty Valves for Plumbing Piping," and comply with requirements for thermometers.

I. Install piping-type heat traps on inlet and outlet piping of domestic-water heater storage tanks without integral or fitting-type heat traps.

J. Fill domestic-water heaters with water.

K. Charge domestic-water compression tanks with air.

3.02 CONNECTIONS

A. Comply with requirements for domestic-water piping specified in Division 15 Section "Domestic Water Piping."

B. Comply with requirements for gas piping specified in Division 15 Section "Facility Natural-Gas Piping."

C. Drawings indicate general arrangement of piping, fittings, and specialties.

D. Where installing piping adjacent to fuel-fired, domestic-water heaters, allow space for service and maintenance of water heaters. Arrange piping for easy removal of domestic-water heaters.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 15 Section "Identification for Plumbing Piping and Equipment."
3.04 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.
2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial, gas-fired, storage, gas-fired, domestic-water heaters.

END OF SECTION
SECTION 15485
ELECTRIC, DOMESTIC-WATER HEATERS

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Commercial, electric, storage, domestic-water heaters.
   2. Domestic-water heater accessories.

1.03 PERFORMANCE REQUIREMENTS
A. Seismic Performance: Commercial domestic-water heaters shall withstand the effects of earthquake motions determined according to
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified

1.04 ACTION SUBMITTALS
A. Product Data: For each type and size of domestic-water heater indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. LEED Submittals:
   1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, Section 7, "Service Water Heating."
C. Shop Drawings:
   1. Wiring Diagrams: For power, signal, and control wiring.

1.05 INFORMATIONAL SUBMITTALS
A. Seismic Qualification Certificates: For commercial domestic-water heaters, accessories, and components, from manufacturer.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

B. Product Certificates: For each type of commercial residential and tankless, electric, domestic-water heater, from manufacturer.

C. Domestic-Water Heater Labeling: Certified and labeled by testing agency acceptable to authorities having jurisdiction.

D. Source quality-control reports.

E. Field quality-control reports.

F. Warranty: Sample of special warranty.

1.06 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For electric, domestic-water heaters to include in emergency, operation, and maintenance manuals.

1.07 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. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 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, "Drinking Water System Components - Health Effects."

1.08 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

1.09 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of electric, domestic-water heaters that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including storage tank and supports.
   b. Faulty operation of controls.
   c. Deterioration of metals, metal finishes, and other materials beyond normal use.
2. Warranty Periods: From date of Substantial Completion.
   a. Commercial, Electric, Storage, Domestic-Water Heaters:
      1) Storage Tank: Three years.
      2) Controls and Other Components: Three years.

PART 2 - PRODUCTS

A. Commercial, Light-Duty, Storage, Electric "Mini" Domestic-Water Heaters:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Eemax, Inc.
   c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
   d. Approved equal.

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
   a. Eemax, Inc.
   c. Smith, A. O. Water Products Co.; a division of A. O. Smith Corporation.
   d. Approved equal.

   a. Fitting: NPT pipe thread.
   b. Pressure Rating: 150 psig (1035 kPa).

4. Factory-Installed Storage-Tank Appurtenances:
   a. Glass lined Tank.
   b. Adjustable temperature control 50 degree to 140 degree.
   c. Temperature/pressure relief valve.
   d. Wall mountable bracket.
   e. Power plug outlet capable.

Capacity and Characteristics:


3. Electrical Characteristics:
   a. Volts: 120
   b. Amperage: 12
   c. Phases: Single
   d. Hertz: 60.
2.02 SOURCE QUALITY CONTROL

A. Factory Tests: Test and inspect domestic-water heaters specified to be ASME-code construction, according to 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. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

D. Prepare test and inspection reports.

PART 3 - EXECUTION

3.01 DOMESTIC-WATER HEATER INSTALLATION

A. Commercial, Electric, Domestic-Water Heater Mounting:

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.

B. Install electric, domestic-water heaters level and plumb, according to 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 Division 15 Section "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 commercial-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 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 Division 15 Section "Domestic Water Piping Specialties."

E. Install thermometers on outlet piping of electric, domestic-water heaters Fill electric, domestic-water heaters with water.

F. Charge domestic-water compression tanks with air.
3.02 CONNECTIONS

A. Comply with requirements for piping specified in Division 15 Section "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.

3.03 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Division 15 Section "Identification for Plumbing Piping and Equipment."

3.04 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.

2. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.

3. Operational Test: After electrical circuitry has been energized, start units to confirm proper operation.

4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Electric, domestic-water heaters will be considered defective if they do not pass tests and inspections. Comply with requirements in Division 01 Section "Quality Requirements" for retesting and reinspecting requirements and Division 01 Section "Execution" for requirements for correcting the Work.

C. Prepare test and inspection reports.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain commercial electric, domestic-water heaters.

END OF SECTION
SECTION 15513
CONDENSING BOILERS

PART 1 - GENERAL

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

1.02 SUMMARY
A. This Section includes 399 MBTU packaged, factory-fabricated and -assembled, gas-fired, fire-tube condensing boilers, trim and accessories for generating hot water.

1.03 SUBMITTALS
A. Product Data: Include performance data, operating characteristics, furnished specialties and accessories.
   1. Prior to flue vent installation, engineered calculations and drawings must be submitted to Architect/Engineer to thoroughly demonstrate that size and configuration conform to recommended size, length and footprint for each submitted boiler.

B. Pressure Drop Curve: Submit pressure drop curve for flows ranging from 0 GPM to maximum value of boiler
   1. If submitted material is different from that of the design basis, boiler manufacture shall incur all costs associated with reselection of necessary pumps. Possible differences include, but are not limited to, the pump type, pump pad size, electrical characteristics and piping changes.

C. Shop Drawings: For boilers, boiler trim and accessories, include:
   1. Plans, elevations, sections, details and attachments to other work
   2. Wiring Diagrams for power, signal and control wiring

D. Source Quality Control Test Reports: Reports shall be included in submittals.

E. Field Quality Control Test Reports: Reports shall be included in submittals.

F. Operation and Maintenance Data: Data to be included in boiler emergency, operation and maintenance manuals.

G. Warranty: Standard warranty specified in this Section

H. Other Informational Submittals
   1. ASME Stamp Certification and Report: Submit "A," "S," or "PP" stamp certificate of authorization, as required by authorities having jurisdiction, and document hydrostatic testing of piping external to boiler.
1.04 QUALITY ASSURANCE

A. Electrical Components, Devices and Accessories: Boilers must be 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. I=B=R Performance Compliance: Condensing boilers must be rated in accordance with applicable federal testing methods and verified by AHRI as capable of achieving the energy efficiency and performance ratings as tested within prescribed tolerances.

C. ASME Compliance: Condensing boilers must be constructed in accordance with ASME Boiler and Pressure Vessel Code, Section IV “Heating Boilers”.

D. ASHRAE/IESNA 90.1 Compliance: Boilers shall have minimum efficiency according to "Gas and Oil Fired Boilers - Minimum Efficiency Requirements."


F. ETL Certified and Listed to ANSI Z21.13/CSA 4.9 test standards for US and Canada

G. NOx Emission Standards. When installed and operated in accordance with manufacturer's instructions, condensing boilers shall comply with the NOx emission standards outlined in South Coast Air Quality Management District (SCAQMD), Rule 1146.2; and the Texas Commission on Environmental Quality (TCEQ), Title 30, Chapter 117, Rule 117.465.

1.05 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement and formwork requirements are specified in Division 03. (If the floor mount kit is supplied)

1.06 WARRANTY

A. Standard Warranty: Boilers shall include manufacturer's standard form in which manufacturer agrees to repair or replace components of boilers that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Fire-Tube Condensing Boilers
   a. The pressure vessel/heat exchanger shall carry a 10-year from shipment, prorated, limited warranty against any failure due to condensate corrosion, thermal stress, mechanical defects or workmanship.
   b. All other components, with the exception of the igniter and flame detector, are conditionally guaranteed against any failure for 18 months from shipment

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide AERCO International, EST 399 or a comparable product by one of the following:

1. AERCO International
2. Buderus

2.02 CONSTRUCTION

A. Description: Boiler shall be natural gas fired fully condensing, and fire tube design. Power burner shall have full modulation (the minimum firing rate shall not exceed 112,000 BTU/HR input. Boilers that have an input greater than 112,000 BTU/Hr at minimum fire will not be considered) and discharge into a positive pressure vent. Boiler efficiency shall increase with decreasing load (output), while maintaining setpoint. Boiler shall be factory-fabricated, factory-assembled and factory-tested, fire-tube condensing boiler with heat exchanger sealed pressure-tight, built on a steel base, including insulated jacket, flue-gas vent, combustion-air intake connections, water supply, return and condensate drain connections, and controls.

B. Heat Exchanger: The heat exchanger shall be constructed of 439 stainless steel fire tubes and tubesheets, with a one-pass combustion gas flow design. The fire tubes shall be a flatten 0.976" x 0.256" Channel, with no less than 0.0394" wall thickness. The upper and lower 439 stainless steel tube sheet shall be no less than 0.0984" thick. The pressure vessel/heat exchanger shall be welded construction. The heat exchanger shall be ASME stamped for a working pressure not less than 30 psig. Access to the tubesheets and heat exchanger shall be available by burner and exhaust manifold removal. Minimum access opening shall be no less than 4-inch diameter.

C. Pressure Vessel: The pressure vessel shall have a maximum water volume of 7 gallons. The boiler water pressure drop shall not exceed 3.0 psig at 38 gpm. The boiler water connections shall be 1 ½-inch male NPT threaded connection. The pressure vessel shall be constructed of 439 stainless steel, with a .0984-inch (2.5MM) thick wall. Inspection openings in the pressure vessel shall be in accordance with ASME Section IV pressure vessel code. The boiler shall be designed so that the thermal efficiency increases as the boiler firing rate decreases.

D. Modulating Gas Venturi, Burner, and Pre-Mix Blower, The boiler burner shall be capable of a 3.6-to-1 turndown ratio of the firing rate without loss of combustion efficiency or staging of gas valves. The burner shall produce less than 12 ppm of NOx corrected to 3% excess oxygen. The unit shall be certified by the South Coast Air Quality Management District (SCAQMD) as compliant with Rule 1146.2 for boilers and water heaters less than or equal to 2 MBTUs, and the Texas Commission on Environmental Quality (TCEQ) as being compliant with Section 117.465 for boilers and water heaters less than or equal to 2 MBTUs. The burner shall be metal-fiber mesh covering a stainless steel body with spark ignition and flame rectification. All burner material exposed to the combustion zone shall be of stainless steel construction. There shall be no moving parts within the burner itself. A variable speed pre-mix blower and gas venturi shall meter the air and fuel input. The pre-mix blower shall be used to ensure the optimum mixing of air and fuel before the burner.

E. Minimum IBR boiler efficiency shall be 95.1%

F. The exhaust manifold shall be constructed of corrosion resistant 316 stainless steel with a four-inch diameter flue connection. The exhaust manifold shall have a collecting reservoir and a gravity drain for the elimination of condensation.
G. Blower. The boiler shall include a variable-speed, DC centrifugal fan to operate during the burner firing sequence and pre-purge the combustion chamber.

1. Motors: Blower motors shall comply with requirements specified in Division 15 Section "Common Motor Requirements for HVAC Equipment."
   a. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require a motor to operate in the service factor range above 1.0.

H. Ignition: Ignition shall be via spark ignition with 100 percent main-valve shutoff and electronic flame supervision.

2.03 CONTROLS

A. Refer to Division 15, Section "Instrumentation and Control of HVAC."

B. The boiler control system shall be a TriMax Control Panel.

C. The combustion safeguard/flame monitoring system shall use spark ignition and a rectification-type flame sensor.

D. The control panel hardware shall support remote communications via MODBUS.

E. The controls shall annunciate boiler and sensor status and include extensive self-diagnostic capabilities that incorporate a minimum of eight separate status messages and 18 separate fault messages that can be sent to a building automation system.

F. TriMax Controller shall have a built-in sequencing function and be capable of controlling up to 6 units. The controller shall have the ability to vary the firing rate and energy input of each individual boiler throughout its full modulating range to maximize the condensing capability and thermal efficiency output of the entire heating plant. The ACS shall control the boiler outlet header temperature within +6°F. The controller shall be a PID type controller and uses Ramp Up/Ramp Down control algorithm for accurate temperature control with excellent variable load response. The TriMax controller shall provide contact closure for auxiliary equipment such as system pumps and combustion air inlet dampers based upon outdoor air temperature.

G. Boiler Control Modes

1. Internal Set Point: Boiler shall include integral factory wired operating controls to control all operation and energy input of the boiler. Control of discharge water temperature shall be set through an internal set point with an adjustment of 60°F to 194°F. The controller shall have the ability to vary boiler input throughout its full range to maximize the condensing capability of the boiler and without header temperature swings. The boiler will operate to maintain a constant header temperature outlet to +6°F. Maximum efficiency shall be achieved at minimum firing input. Controls shall be fully field adjustable from 60°F to 194°F in operation. Main Header outlet temperature shall not be more than +6°F from set point at any point of operation. The boiler shall have LCD display for monitoring of all sensors.

2. Outdoor Reset: Boiler shall include integral factory wired operating controls to control all operation and energy input of the boiler plant. The controller shall have the ability to vary boiler input throughout its full range to maximize the condensing capability of the boiler and without header temperature swings. The boiler will operate to vary header temperature set point on an inverse ratio in response to outdoor temperature to control discharge temperature ±6°F.

3. 0VDC to 10VDC BMS Control: A Boiler Management System (BMS) shall send a 0VDC
to 10 VDC signal to control all operation and energy input of the boiler. The boiler will operate to vary firing rate linearly as an externally applied 0VDC to 10VDC mA signal is supplied to the Controller.

H. The Boiler Control System shall have a Boost Feature that if the call for heat is not satisfied in an adjustable time setting the set point will be raised by 18 ºF for each time period that the call for heat is not satisfied until the maximum boiler operating set point is reached.

I. The boiler control system shall incorporate the following additional features for enhanced external system interface:
   1. Primary Pump Control
      a. Continuous operation
      b. Activation when there is a call for heat
   2. Inlet temperature sensor
   3. Optional External limits - auto reset
   4. Optional External Limits – manual reset
   5. Fault relay for remote fault alarm

2.04 ELECTRICAL POWER

A. Controllers, Electrical Devices and Wiring: Electrical devices and connections are specified in Division 26 sections.

B. Single-Point Field Power Connection: Factory-installed and factory-wired switches, motor controllers, transformers and other electrical devices shall provide a single-point field power connection to the boiler.

C. Electrical Characteristics:
   1. Voltage: 120 V
   2. Phase: Single
   3. Frequency: 60 Hz
   4. 15 Amp Service

2.05 VENTING

A. The exhaust vent shall be PVC, CPVC, PP Polypropylene or UL-listed vents of Al 29-4C stainless steel must be used with boilers.

B. The minimum exhaust vent duct size for each boiler is four-inch diameter.

C. Combustion-Air Intake: Boilers shall be capable of drawing combustion air from the outdoors via a metal or PVC duct connected between the boiler and the outdoors.

D. The minimum sealed combustion air duct size for each boiler is four-inch diameter.

E. Follow guidelines specified in manufacturer’s venting guide.
2.06 SOURCE QUALITY CONTROL

A. Burner and Hydrostatic Test: Factory adjust burner to eliminate excess oxygen, carbon dioxide, oxides of nitrogen emissions and carbon monoxide in flue gas, and to achieve combustion efficiency. Perform hydrostatic testing.

B. Test and inspect factory-assembled boilers, before shipping, according to ASME Boiler and Pressure Vessel Code.
   1. If boilers are not factory assembled and fire-tested, the local vendor is responsible for all field assembly and testing.

C. Allow Owner access to source quality-control testing of boilers. Notify Architect fourteen days in advance of testing.

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine piping and electrical connections to verify actual locations, sizes and other conditions affecting boiler performance, maintenance and operations.
   1. Final boiler locations indicated on Drawings are approximate. Determine exact locations before roughing-in for piping and electrical connections.

B. Examine mechanical spaces for suitable conditions where boilers will be installed.

C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 BOILER INSTALLATION

A. Install boilers as wall hung equipment.

B. Install gas-fired boilers according to NFPA 54.

C. Assemble and install boiler trim.

D. Install electrical devices furnished with boiler but not specified to be factory mounted.

E. Install control wiring to field-mounted electrical devices.

3.03 CONNECTIONS

A. Piping installation requirements are specified in other Division 15 sections. Drawings indicate general arrangement of piping, fittings and specialties.

B. Install piping adjacent to boiler to permit service and maintenance.

C. Install piping from equipment drain connection to nearest floor drain. Piping shall be at least full size of connection. Provide an isolation valve if required.

D. Connect gas piping to boiler gas-train inlet with unions. Piping shall be at least full size of gas train connection. Provide a reducer if required.
E. Connect hot-water piping to supply and return boiler tappings with shutoff valve and union or flange at each connection.

F. Install piping from safety relief valves to nearest floor drain.

G. Boiler Venting
   1. Install flue venting kit and combustion-air intake.
   2. Connect venting full size to boiler connections.

H. Ground equipment according to Division 16 Section "Grounding and Bonding for Electrical Systems."

I. Connect wiring according to Division 16 Section "Low-Voltage Electrical Power Conductors and Cables."

3.04 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. Installation and Startup Test: Perform installation and startup checks according to manufacturer's written instructions.
   2. Leak Test: Perform hydrostatic test. Repair leaks and retest until no leaks exist.
   3. Operational Test: Start units to confirm proper motor rotation and unit operation. Adjust air-fuel ratio and combustion.
   4. Controls and Safeties: Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
      a. Check and adjust initial operating set points and high- and low-limit safety set points of fuel supply, water level and water temperature.
      b. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

C. Remove and replace malfunctioning units and retest as specified above.

D. Occupancy Adjustments: When requested within 2 months of date of Substantial Completion, provide on-site assistance adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other than normal occupancy hours for this purpose.

END OF SECTION
SECTION 15732
PACKAGED OUTDOOR CENTRAL-STATION AIR-HANDLING UNITS
AIR CONDITIONERS

PART 1 - GENERAL

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

1.02 SUMMARY
A. This Section includes packaged, outdoor, central-station air-handling units (rooftop units) with the following components and accessories:
   1. Direct-expansion cooling.
   2. Hot-gas reheat.
   3. Economizer outdoor- and return-air damper section.
   4. Integral, space temperature controls.
   5. Roof curbs.
B. Related Sections include the following: Not used

1.03 DEFINITIONS
A. DDC: Direct-digital controls.
B. ECM: Electrically commutated motor.
C. RTU: Rooftop unit. As used in this Section, this abbreviation means packaged, outdoor, central-station air-handling units. This abbreviation is used regardless of whether the unit is mounted on the roof or on a concrete base on ground.
D. Supply-Air Fan: The fan providing supply air to conditioned space. "Supply air" is defined as the air entering a space from air-conditioning, heating, or ventilating apparatus.

1.04 PERFORMANCE REQUIREMENTS
A. Delegated Design: Design RTU supports to comply with wind and seismic performance requirements, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
B. Wind-Restraint Performance:
   1. Basic Wind Speed: 90 mph.
2. Building Classification Category: II.
3. Minimum 10 lb/sq. ft multiplied by the maximum area of the mechanical component projected on a vertical plane that is normal to the wind direction, and 45 degrees either side of normal.

C. Seismic Performance: RTUs shall withstand the effects of earthquake motions determined according to SEI/ASCE 7.
   1. The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified."

1.05 ACTION SUBMITTALS

A. Product Data: Include manufacturer’s technical data for each RTU, including rated capacities, dimensions, required clearances, characteristics, furnished specialties, and accessories.

B. LEED Submittals:
   1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
   2. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."

C. 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.

D. Delegated-Design Submittal: For RTU supports 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. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
   2. Detail mounting, securing, and flashing of roof curb to roof structure. Indicate coordinating requirements with roof membrane system.
   3. Wind- and Seismic-Restraint Details: Detail fabrication and attachment of wind and seismic restraints and snubbers. Show anchorage details and indicate quantity, diameter, and depth of penetration of anchors.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: 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 RTUs will be attached.
   2. Roof openings
   3. Roof curbs and flashing.

B. Manufacturer Wind Loading Qualification Certification: Submit certification that specified equipment will withstand wind forces identified in "Performance Requirements" Article.
1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculations.
2. Dimensioned Outline Drawings of Equipment Unit: Identify center of wind force and locate and describe mounting and anchorage provisions.
3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

C. Manufacturer Seismic Qualification Certification: Submit certification that RTUs, accessories, and components will withstand seismic forces defined in "Performance Requirements" Article.
   1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.
   2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.
   3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

D. Field quality-control test reports.
E. Warranty: Special warranty specified in this Section.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For RTUs to include in emergency, operation, and maintenance manuals.

1.08 MAINTENANCE MATERIAL SUBMITTALS

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. Fan Belts: One set for each belt-driven fan.
   2. Filters: One set of filters for each unit.

1.09 QUALITY ASSURANCE

A. ARI Compliance:
   1. Comply with ARI 203/110 and ARI 303/110 for testing and rating energy efficiencies for RTUs.
   2. Comply with ARI 270 for testing and rating sound performance for RTUs.

B. ASHRAE Compliance:
   1. Comply with ASHRAE 15 for refrigeration system safety.
   2. Comply with ASHRAE 33 for methods of testing cooling and heating coils.
   3. Comply with 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."
D. NFPA Compliance: Comply with NFPA 90A and NFPA 90B.

E. UL Compliance: Comply with UL 1995.

F. 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.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to replace components of RTUs that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Compressors: Manufacturer's standard, but not less than five years from date of Substantial Completion.
2. Warranty Period for Control Boards: Manufacturer's standard, but not less than three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Acceptable Manufacturers:
   1. Daikin
   2. Trane
   3. Carrier
   4. York

2.02 CASING

A. General Fabrication Requirements for Casings: Formed and reinforced double-wall insulated panels, fabricated to allow removal for access to internal parts and components, with joints between sections sealed.

B. Exterior Casing Material: Galvanized steel with factory-painted finish, with pitched roof panels and knockouts with grommet seals for electrical and piping connections and lifting lugs.

1. Exterior Casing Thickness: 0.052 inch 0.0626 inch 0.079 inch thick.

C. Inner Casing Fabrication Requirements:

1. Inside Casing: Galvanized steel, 0.034 inch 0.028 inch thick, perforated 40 percent free area.

D. Casing Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.

1. Materials: ASTM C 1071, Type I.
2. Thickness: 1 inch.
3. Liner materials shall have air-stream surface coated with an erosion- and temperature-resistant coating or faced with a plain or coated fibrous mat or fabric.
4. Liner Adhesive: Comply with ASTM C 916, Type I.
E. Condensate Drain Pans: Formed sections of stainless-steel sheet, a minimum of 2 inches deep, and complying with ASHRAE 62.1.

1. Double-Wall Construction: Fill space between walls with foam insulation and seal moisture tight.
2. Drain Connections: Threaded nipple both sides of drain pan.
3. Pan-Top Surface Coating: Corrosion-resistant compound.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

2.03 FANS

A. Belt-Driven Supply-Air Fans: Single width, air foil centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the casing. Aluminum or painted-steel wheels, and galvanized- or painted-steel fan scrolls.

B. Condenser-Coil Fan: Propeller, mounted on shaft of permanently lubricated motor.

C. Relief-Air Fan: Backward inclined, shaft mounted on permanently lubricated motor.

D. Seismic Fabrication Requirements: Fabricate fan section, internal mounting frame and attachment to fans, fan housings, motors, casings, accessories, and other fan section components with reinforcement strong enough to withstand seismic forces when fan-mounted frame and RTU-mounted frame are anchored to building structure.

E. Fan Motor: Comply with requirements in Section 15055 "Common Motor Requirements for HVAC Equipment."

2.04 COILS

A. Supply-Air Refrigerant Coil:

1. Aluminum-plate fin and seamless internally grooved copper tube in steel casing with equalizing-type vertical distributor.
2. Polymer strip shall prevent all copper coil from contacting steel coil frame or condensate pan.
4. Baked phenolic coating.

B. Hot water heater coil.

2.05 REFRIGERANT CIRCUIT COMPONENTS

A. Number of Refrigerant Circuits: Two.

B. Compressor: Hermetic, scroll, mounted on vibration isolators; with internal overcurrent and high-temperature protection, internal pressure relief, and crankcase heater.

C. Refrigeration Specialties:
1. Refrigerant: R-410A.
2. Expansion valve with replaceable thermostatic element.
3. Refrigerant filter/dryer.
5. Automatic-reset low-pressure safety switch.
8. Brass service valves installed in compressor suction and liquid lines.
9. Low-ambient kit high-pressure sensor.
11. Hot-gas bypass solenoid valve with a replaceable magnetic coil.
12. Four-way reversing valve with a replaceable magnetic coil, thermostatic expansion valves with bypass check valves, and a suction line accumulator.

2.06 AIR FILTRATION

A. Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.
   1. Pleated: Minimum 90 percent arrestance, and MERV 11.

2.07 DAMPERS

A. Outdoor-Air Damper: Linked damper blades, for 0 to 25 percent outdoor air, with motorized damper filter.

B. Outdoor- and Return-Air Mixing Dampers: Parallel- or opposed-blade galvanized-steel dampers mechanically fastened to cadmium plated for galvanized-steel operating rod in reinforced cabinet. Connect operating rods with common linkage and interconnect linkages so dampers operate simultaneously.
   1. Damper Motor: Modulating with adjustable minimum position.
   2. Relief-Air Damper: Gravity actuated or motorized, as required by ASHRAE/IESNA 90.1, with bird screen and hood.

2.08 ELECTRICAL POWER CONNECTION

A. Provide for single connection of power to unit with unit-mounted disconnect switch accessible from outside unit and control-circuit transformer with built-in overcurrent protection.

2.09 CONTROLS

A. Control equipment and sequence of operation are specified in Section 15910 "Direct Digital Control (DDC) System for HVAC".

B. Basic Unit Controls:
   1. Control-voltage transformer.
   2. Wall-mounted thermostat or sensor with the following features:
      b. Fan on-auto switch.
c. Fan-speed switch.
d. Automatic changeover.
e. Adjustable deadband.
f. Concealed set point.
g. Exposed indication.
h. Degree F indication.
i. Unoccupied-period-override push button.
j. Data entry and access port to input temperature and humidity set points, occupied and unoccupied periods, and output room temperature and humidity, supply-air temperature, operating mode, and status.

3. Wall-mounted humidistat or sensor with the following features:
   a. Concealed set point.
   b. Concealed indication.

4. Remote Wall-Mounted Annunciator Panel for Each Unit:
   a. Lights to indicate power on, cooling, heating, fan running, filter dirty, and unit alarm or failure.
   b. DDC controller or programmable timer and interface with HVAC instrumentation and control system.
   c. Digital display of outdoor-air temperature, supply-air temperature, return-air temperature, economizer damper position, indoor-air quality, and control parameters.

C. DDC Controller:

1. Controller shall have volatile-memory backup.
2. Safety Control Operation:
   a. Smoke Detectors: Stop fan and close outdoor-air damper if smoke is detected. Provide additional contacts for alarm interface to fire alarm control panel.
   b. Firestats: Stop fan and close outdoor-air damper if air greater than 130 deg F enters unit. Provide additional contacts for alarm interface to fire alarm control panel.
   c. Fire Alarm Control Panel Interface: Provide control interface to coordinate with operating sequence.
   d. Low-Discharge Temperature: Stop fan and close outdoor-air damper if supply air temperature is less than 40 deg F.
   e. Defrost Control for Condenser Coil: Pressure differential switch to initiate defrost sequence.

3. Scheduled Operation: Occupied and unoccupied periods on seven-day clock with a minimum of four programmable periods per day.
4. Unoccupied Period:
   a. Heating Setback: 10 deg F.
   c. Override Operation: Two hours.

5. Supply Fan Operation:
   a. Occupied Periods: Run fan continuously.
   b. Unoccupied Periods: Cycle fan to maintain setback temperature.
6. Refrigerant Circuit Operation:
   a. Occupied Periods: Cycle or stage compressors, and operate hot-gas bypass to match compressor output to cooling load to maintain discharge temperature and humidity. Cycle condenser fans to maintain maximum hot-gas pressure. Operate low-ambient control kit to maintain minimum hot-gas pressure.
   b. Unoccupied Periods: Compressors off.
   c. Switch reversing valve for heating or cooling mode on air-to-air heat pump.

7. Hot-Gas Reheat-Coil Operation:
   a. Occupied Periods: Humidistat opens hot-gas valve to provide hot-gas reheat, and cycles compressor.
   b. Unoccupied Periods: Reheat not required.

8. Economizer Outdoor-Air Damper Operation:
   a. Occupied Periods: Open to 10 percent fixed minimum intake, and maximum 100 percent of the fan capacity to comply with ASHRAE Cycle II. Controller shall permit air-side economizer operation when outdoor air is less than 60 deg F. Use mixed-air temperature and select between outdoor-air and return-air enthalpy to adjust mixing dampers. Start relief-air fan with end switch on outdoor-air damper. During economizer cycle operation, lock out cooling.
   b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.
   c. Outdoor-Airflow Monitor: Accuracy maximum plus or minus 5 percent within 15 and 100 percent of total outdoor air. Monitor microprocessor shall adjust for temperature, and output shall range from 4 to 20 mA.

9. Carbon Dioxide Sensor Operation:
   a. Occupied Periods: Reset minimum outdoor-air ratio down to minimum 10 percent to maintain maximum 1000-ppm concentration.
   b. Unoccupied Periods: Close outdoor-air damper and open return-air damper.

10. VAV Relays:
    a. Provide heating- and cooling-mode changeover relays compatible with VAV terminal control system required in Section "Air Terminal Units" and Section 15910 "Direct Digital Control (DDC) System for HVAC."

D. Interface Requirements for HVAC Instrumentation and Control System:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation and diagnostic code storage.
3. Provide BACnet compatible interface for central HVAC control workstation for the following:
   a. Adjusting set points.
   b. Monitoring supply fan start, stop, and operation.
   c. Inquiring data to include outdoor-air damper position, supply- and room-air temperature and humidity.
   d. Monitoring occupied and unoccupied operations.
   e. Monitoring constant and variable motor loads.
   f. Monitoring variable-frequency drive operation.
g. Monitoring cooling load.
h. Monitoring economizer cycles.
i. Monitoring air-distribution static pressure and ventilation air volume.

2.10 ACCESSORIES

A. Duplex, 115-V, ground-fault-interrupter outlet with 15-A overcurrent protection. Include transformer if required. Outlet shall be energized even if the unit main disconnect is open.

B. Low-ambient kit using staged damper on variable-speed condenser fans for operation down to 35 deg F.

C. Filter differential pressure switch with sensor tubing on either side of filter. Set for final filter pressure loss.

D. Coil guards of painted, galvanized-steel wire.

E. Hail guards of galvanized steel, painted to match casing.

2.11 ROOF CURBS

A. Roof curbs with vibration isolators and wind or seismic restraints.

B. Materials: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; complying with NRCA standards.

1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
   a. Materials: ASTM C 1071, Type I or II.
   b. Thickness: 2 inches.

2. Application: Factory applied with adhesive and mechanical fasteners to the internal surface of curb.
   a. Liner Adhesive: Comply with ASTM C 916, Type I.
   b. Mechanical Fasteners: Galvanized steel, suitable for adhesive attachment, mechanical attachment, or welding attachment to duct without damaging liner when applied as recommended by manufacturer and without causing leakage in cabinet.
   c. Liner materials applied in this location shall have air-stream surface coated with a temperature-resistant coating or faced with a plain or coated fibrous mat or fabric depending on service air velocity.
   d. Liner Adhesive: Comply with ASTM C 916, Type I.

C. Wind and Seismic Restraints: Metal brackets compatible with the curb and casing, painted to match RTU, used to anchor unit to the curb, and designed for loads at Project site. Comply with requirements.
2.12  **CAPACITIES AND CHARACTERISTICS:** See contract drawings

**PART 3 - EXECUTION**

3.01  **EXAMINATION**

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of RTUs.

B. Examine roughing-in for RTUs to verify actual locations of piping and duct connections before equipment installation.

C. Examine roofs for suitable conditions where RTUs will be installed.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02  **INSTALLATION**

A. Roof Curb: Install on roof structure or concrete base, level and secure, according to NRCA's "Low-Slope Membrane Roofing Construction Details Manual," Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." ARI Guideline B. Install RTUs on curbs and coordinate roof penetrations and flashing with roof construction. Secure RTUs to upper curb rail, and secure curb base to roof framing or concrete base with anchor bolts.

3.03  **CONNECTIONS**

A. Install condensate drain, minimum connection size, with trap and indirect connection to nearest roof drain or area drain.

B. Install piping adjacent to RTUs to allow service and maintenance.

   1. Hot water piping.

C. Duct installation requirements are specified in other HVAC Sections. Drawings indicate the general arrangement of ducts. The following are specific connection requirements:

   1. Install ducts to termination at top of roof curb.
   2. Remove roof decking only as required for passage of ducts. Do not cut out decking under entire roof curb.
   3. Connect supply ducts to RTUs with flexible duct connectors specified in Section 15820 "Duct Accessories."
   4. Install return-air duct continuously through roof structure.

3.04  **FIELD QUALITY CONTROL**

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections. Report results in writing.

B. Perform tests and inspections and prepare test reports.
1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing. Report results in writing.

C. Tests and Inspections:

1. After installing RTUs and after electrical circuitry has been energized, test units for compliance with requirements.
2. Inspect for and remove shipping bolts, blocks, and tie-down straps.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

D. Remove and replace malfunctioning units and retest as specified above.

3.05 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

B. Complete installation and startup checks according to manufacturer's written instructions and do the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, coils, and fans.
3. Inspect internal insulation.
4. Verify that labels are clearly visible.
5. Verify that clearances have been provided for servicing.
6. Verify that controls are connected and operable.
7. Verify that filters are installed.
8. Clean condenser coil and inspect for construction debris.
9. Connect and purge gas line.
10. Remove packing from vibration isolators.
11. Inspect operation of barometric relief dampers.
12. Verify lubrication on fan and motor bearings.
13. 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 according to manufacturer's written instructions.
   a. Start refrigeration system.
   b. Do not operate below recommended low-ambient temperature.
   c. Complete startup sheets and attach copy with Contractor's startup report.

17. Operate unit for an initial period as recommended or required by manufacturer.

18. Calibrate thermostats.
19. Adjust and inspect high-temperature limits.
20. Inspect outdoor-air dampers for proper stroke and interlock with return-air dampers.
21. Start refrigeration system and measure and record the following when ambient is a minimum of 15 deg F above return-air temperature:
   a. Coil leaving-air, dry- and wet-bulb temperatures.
   b. Coil entering-air, dry- and wet-bulb temperatures.
c. Outdoor-air, dry-bulb temperature.

22. Inspect controls for correct sequencing of heating, mixing dampers, refrigeration, and normal and emergency shutdown.

23. Measure and record the following minimum and maximum airflows. Plot fan volumes on fan curve.
   a. Supply-air volume.
   b. Return-air volume.
   c. Relief-air volume.
   d. Outdoor-air intake volume.

24. Simulate maximum cooling demand and inspect the following:
   a. Compressor refrigerant suction and hot-gas pressures.
   b. Short circuiting of air through condenser coil or from condenser fans to outdoor-air intake.

25. Verify operation of remote panel including pilot-light operation and failure modes. Inspect the following:
   a. Low-temperature safety operation.
   b. Filter high-pressure differential alarm.
   c. Economizer to minimum outdoor-air changeover.
   d. Relief-air fan operation.
   e. Smoke and firestat alarms.

26. After startup and performance testing and prior to Substantial Completion, replace existing filters with new filters.

3.06 CLEANING AND ADJUSTING

A. 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 site during other-than-normal occupancy hours for this purpose.

B. After completing system installation and testing, adjusting, and balancing RTU and air-distribution systems, clean filter housings and install new filters.

3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain RTUs.

END OF SECTION
SECTION 15738

SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section includes split-system air-conditioning and heat-pump units consisting of separate evaporator-fan and compressor-condenser components.

1.03 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, and electrical characteristics.
B. LEED Submittals:
   1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
C. 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.
D. Samples for Initial Selection: For units with factory-applied color finishes.

1.04 INFORMATIONAL SUBMITTALS
A. Field quality-control reports.
B. Warranty: Sample of special warranty.

1.05 CLOSEOUT SUBMITTALS
A. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
1.06 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(s) for each air-handling unit.
   2. Gaskets: One set(s) for each access door.
   3. Fan Belts: One set(s) for each air-handling unit fan.

1.07 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. ASHRAE Compliance:
   1. Fabricate and label refrigeration system to comply with ASHRAE 15, "Safety Standard for Refrigeration Systems."
   2. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 4 - "Outdoor Air Quality," Section 5 - "Systems and Equipment," Section 6 - "Procedures," and Section 7 - "Construction and System Start-up."
C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1.

1.08 COORDINATION
A. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.
B. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.

1.09 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: One year(s) from date of Substantial Completion.
      c. For Labor: One year(s) from date of Substantial Completion.

PART 2 - PRODUCTS

2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

2. Coleman Company Inc. (The).
3. First Operations LP.
4. Friedrich Air Conditioning Company.
5. Koldwave, Inc.; a Mestek company.
6. Lennox International Inc.
7. Mitsubishi Electric & Electronics USA, Inc.; HVAC Advanced Products Division.
8. Mitsubishi Electric Sales Canada Inc.
9. Mitsubishi Heavy Industries America, Inc.
10. SANYO North America Corporation; SANYO Fisher Company.
11. Trane; a business of American Standard companies.
12. YORK; a Johnson Controls company.

2.02 INDOOR UNITS (5 TONS OR LESS)

A. Wall-Mounted, Evaporator-Fan Components:

1. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect, and discharge drain pans with drain connection.
2. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and thermal-expansion valve. Comply with ARI 206/110.
5. Fan Motors:
   a. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements specified in Section 15058 "Common Motor Requirements for HVAC Equipment."
   b. Multitapped, multispeed with internal thermal protection and permanent lubrication.
   c. Enclosure Type: Totally enclosed, fan cooled.
   d. NEMA Premium (TM) efficient motors as defined in NEMA MG 1.
   e. Controllers, Electrical Devices, and Wiring: Comply with requirements for electrical devices and connections specified in electrical Sections.
   f. Mount unit-mounted disconnect switches on interior of unit.
6. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.
7. Condensate Drain Pans:
   a. Fabricated with one percent slope in at least two planes to collect condensate from cooling coils (including coil piping connections, coil headers, and return bends) and humidifiers, and to direct water toward drain connection.
      1) Length: Extend drain pan downstream from leaving face to comply with ASHRAE 62.1.
      2) Depth: A minimum of 1 inch deep.
c. Double-wall, stainless-steel sheet with space between walls filled with foam insulation and moisture-tight seal.
d. Drain Connection: Located at lowest point of pan and sized to prevent overflow. Terminate with threaded nipple on one end of pan.
   1) Minimum Connection Size: NPS 1.
e. Pan-Top Surface Coating: Asphaltic waterproofing compound.

8. Air Filtration Section:

a. General Requirements for Air Filtration Section:
   1) Comply with NFPA 90A.
   2) Minimum Arrestance: According to ASHRAE 52.1 and MERV according to ASHRAE 52.2.
   3) Filter-Holding Frames: Arranged for flat or angular orientation, with access doors on both sides of unit. Filters shall be removable from one side or lifted out from access plenum.

b. Disposable Panel Filters:
   1) Factory-fabricated, viscous-coated, flat-panel type.
   2) Thickness: 1 inch.
   3) Arrestance according to ASHRAE 52.1: 80.
   4) Merv according to ASHRAE 52.2: 5.
   5) Media: Interlaced glass fibers sprayed with nonflammable adhesive and antimicrobial agent.
   6) Frame: Galvanized steel, with metal grid on outlet side, steel rod grid on inlet side, and hinged; with pull and retaining handles.

c. Extended-Surface, Disposable Panel Filters:
   1) Factory-fabricated, dry, extended-surface type.
   2) Thickness: 1 inch.
   3) Arrestance according to ASHRAE 52.1: 90.
   4) Merv according to ASHRAE 52.2: 7.
   5) Media: Fibrous material formed into deep-V-shaped pleats with antimicrobial agent and held by self-supporting wire grid.
   6) Media-Grid Frame: Galvanized steel.
   7) Mounting Frames: Welded, galvanized steel, with gaskets and fasteners; suitable for bolting together into built-up filter banks.

2.03 OUTDOOR UNITS (5 TONS OR LESS)

A. Air-Cooled, Compressor-Condenser Components:

1. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
2. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation device. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
a. Compressor Type: Scroll.
b. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.
c. Refrigerant Charge: R-407C R-410A.
d. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins and liquid subcooler. Comply with ARI 206/110.

4. Fan: Aluminum-propeller type, directly connected to motor.
5. Motor: Permanently lubricated, with integral thermal-overload protection.
6. Low Ambient Kit: Permits operation down to 45 deg F.

2.04 ACCESSORIES

A. Control equipment and sequence of operation are specified in Section 15910 "Direct Digital Control (DDC) System for HVAC".

B. Thermostat: Low voltage with subbase to control compressor and evaporator fan.

C. Thermostat: Wireless infrared functioning to remotely control compressor and evaporator fan, with the following features:
   1. Compressor time delay.
   2. 24-hour time control of system stop and start.
   3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
   4. Fan-speed selection including auto setting.

D. Automatic-reset timer to prevent rapid cycling of compressor.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.

F. Drain Hose: For condensate.

G. Additional Monitoring:
   1. Monitor constant and variable motor loads.
   3. Monitor economizer cycle.
   4. Monitor cooling load.
   5. Monitor air distribution static pressure and ventilation air volumes.

2.05 CAPACITIES AND CHARACTERISTICS

A. For unit capacities see Contract Drawings.
PART 3 - EXECUTION

3.01 INSTALLATION

A. Install units level and plumb.

B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

C. Install roof-mounted, compressor-condenser components on equipment supports specified in Section 07720 "Roof Accessories." Anchor units to supports with removable, cadmium-plated fasteners.

D. Equipment Mounting:
   1. Install ground-mounted, compressor-condenser components on cast-in-place concrete equipment base(s).

E. Install and connect precharged refrigerant tubing to component's quick-connect fittings in accordance with manufacturers instructions. Install tubing to allow access to unit.

3.02 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. 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.

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.
3.04 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.

3.05 DEMONSTRATION
A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain units.

END OF SECTION
SECTION 15763
FAN-COIL UNITS

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. Ducted fan coil units and accessories.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include rated capacities, operating characteristics, and furnished specialties and accessories.
B. LEED Submittals:
   1. Product Data for Credit EA 4: Documentation indicating that equipment and refrigerants comply.
   2. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
C. Shop Drawings:
   1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Include diagrams for power, signal, and control wiring.
D. Samples for Initial Selection: For units with factory-applied color finishes.
E. Samples for Verification: For each type of fan coil unit indicated.

1.04 INFORMATIONAL SUBMITTALS
A. Coordination Drawings: Floor plans, reflected ceiling 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 fan coil units will be attached.
   2. Method of attaching hangers to building structure.
B. Sample Warranty: For special warranty.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fan coil units to include in emergency, operation, and maintenance manuals.
   1. Include the following:
      a. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.06 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. Fan Coil Unit Filters: Furnish one spare filters for each filter installed.

1.07 QUALITY ASSURANCE

A. Comply with NFPA 70.
B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."
C. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.08 COORDINATION

A. Coordinate layout and installation of fan coil units and suspension system components with structural steel.

1.09 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.
   1. Failures include, but are not limited to, the following:
      a. Electric heater coil.
   2. Warranty Period: Five years from date of Substantial Completion.
PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

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. Factory-packaged and -tested units rated according to AHRI 440, ASHRAE 33, and UL 1995.

2.02 DUCTED FAN COIL UNITS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

1. Carrier Corporation; a UTC company.
2. DRS Marlo Coil; part of DRS Technologies, Inc.
4. Engineered Air.
5. ENVIRO-TEC; by Johnson Controls, Inc.
6. First Company Products.
8. IEC; a subsidiary of LSB Industries, Inc.
9. McQuay International; a member of Daikin Group.
10. Nailor Industries Inc.
11. Rosemex.
12. Superior Rex.
13. Titus.
14. Trane Inc.
15. USA Coil & Air.
17. YORK; by Johnson Controls, Inc.

C. Fan Coil Unit Configurations:

1. Number of Heating Coils: One.

D. Coil Section Insulation: 1-inch thick, coated foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

E. Coil Section Insulation: Insulate coil section according to Section 15087 "HVAC Equipment Insulation."

1. Surface-Burning Characteristics: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84 by a qualified testing agency.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

G. Filters: Minimum arrestance and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2 and all addendums.

H. MERV Rating: 6 when tested according to ASHRAE 52.2.

1. Washable.

I. Electric-Resistance Heating Coils: Nickel-chromium heating wire, free of expansion noise and hum, mounted in ceramic inserts in a galvanized-steel housing; with fuses in terminal box for overcurrent protection and limit controls for high-temperature protection of heaters. Terminate elements in stainless-steel machine-staked terminals secured with stainless-steel hardware.

J. Direct-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, multispeed motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

K. Belt-Driven Fans: Double width, forward curved, centrifugal; with permanently lubricated, single-speed motor installed on an adjustable fan base resiliently mounted in the cabinet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

1. Motors: Comply with requirements in Section 15058 "Common Motor Requirements for HVAC Equipment."

L. Basic Unit Controls:

1. Control voltage transformer.

2. Wall-mounting Unit-mounted thermostat with the following features.

3. Heating-Coil Operation:

   a. Energize electric-resistance coil to provide heating if room temperature falls below thermostat set point.

M. Electrical Connection: Factory wire motors and controls for a single electrical connection.

N. Capacities and Characteristics: See contract drawings

PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine areas, with Installer present, to receive fan coil units 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 fan coil unit installation.

C. Proceed with installation only after unsatisfactory conditions have been corrected.
3.02 INSTALLATION

A. Install fan coil units level and plumb.

B. Install fan coil units to comply with NFPA 90A.

C. Suspend fan coil units from structure with elastomeric hangers.

D. Install new filters in each fan coil unit within two weeks after Substantial Completion.

3.03 CONNECTIONS

A. Connect supply-air and return-air ducts to fan coil units with flexible duct connectors specified in Section 15820 "Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

B. Ground equipment according to Section 16060 "Grounding and Bonding."

C. Connect wiring according to Section 16120 "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

   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.

D. Remove and replace malfunctioning units and retest as specified above.

E. Prepare test and inspection reports.

3.05 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.
3.06  DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan coil units.

END OF SECTION
SECTION 15765
PROPELLEr UNIT HEATERS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes propeller unit heaters with hot-water coils and electric coils.

1.03 SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each unit type and configuration.

B. Shop Drawings: Submit the following for each unit type and configuration:

1. Plans, elevations, sections, and details.
2. Details of anchorages and attachments to structure and to supported equipment.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.

C. Coordination Drawings: Plan(s) 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. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Other items, including the following:
   a. Lighting fixtures.
   b. Sprinklers.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For propeller unit heaters to include in emergency, operation, and maintenance manuals.

1.04 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.
PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Airtherm; a Mestek Company.
2. Engineered Air Ltd.
4. Rosemex Products.
5. Ruffneck Heaters; a division of Lexa Corporation.
6. Trane.
7. Markel.

2.02 UNIT HEATERS

A. Description: An assembly including casing, coil, fan, and motor in horizontal discharge configuration with adjustable discharge louvers or vertical discharge where indicated.

B. Comply with UL 2021.

C. Comply with UL 823.

2.03 CASING

A. Cabinet: Removable panels for maintenance access to controls.

B. Cabinet Finish: Manufacturer’s standard baked enamel applied to factory-assembled and tested propeller unit heater before shipping.

C. Discharge Louver: Adjustable fin diffuser for horizontal units and for vertical units.

2.04 COILS

A. Test and rate hot-water propeller unit-heater coils according to ASHRAE 33. Electric unit heaters shall be UL listed and conform to NEC.

B. Hot-Water Coil: Copper tube, minimum 0.025-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 325 deg F, with manual air vent. Test for leaks to 350 psig underwater.

C. Electric coil: Steel tubular finned type.
2.05 FAN  
A. Propeller type, aluminum wheel directly mounted on motor shaft in the fan venturi.

2.06 FAN MOTORS  
A. Comply with requirements in Division 15 Section "Motors."
B. Motor Type: Permanently lubricated.

2.07 CONTROLS  
A. Control Devices:  
1. Wall-mounted 24 volt thermostat.

2.08 CAPACITIES AND CHARACTERISTICS  
A. Heating Capacity:  
1. Refer to drawings

PART 3 - EXECUTION

3.01 EXAMINATION  
A. Examine areas to receive propeller 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 propeller unit-heater installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION  
A. Install propeller unit heaters level and plumb.
B. Install propeller unit heaters to comply with NFPA 90A.
C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers. Hanger rods and attachments to structure are specified in Division 15 Section "Hangers and Supports."

3.03 CONNECTIONS  
A. Piping installation requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Install piping adjacent to machine to allow service and maintenance.

C. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Division 15 Section "Hydronic Piping."

D. Ground equipment according to Division 16 Section "Grounding and Bonding."

E. Connect wiring according to Division 16 Section "Conductors and Cables."

3.04 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing and report results in writing:

1. 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 safeties.

B. Remove and replace malfunctioning units and retest as specified above.

3.05 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain propeller unit heaters. Refer to Division 1 Section “Closeout Procedures”.

END OF SECTION
SECTION 15810
METAL DUCTS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY
A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 1- to plus 2-inch wg. Metal ducts include the following:
   1. Rectangular ducts and fittings.
B. Related Sections include the following:
   1. Division 15 Section "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.03 DEFINITIONS
A. FRP: Fiberglass-reinforced plastic.

1.04 SYSTEM DESCRIPTION
A. Duct system design, as indicated, has been used to select size and type of air-moving and distribution equipment and other air system components. Changes to layout or configuration of duct system must be specifically approved in writing by Architect. Accompany requests for layout modifications with calculations showing that proposed layout will provide original design results without increasing system total pressure.

1.05 SUBMITTALS
A. Shop Drawings: CAD-generated and drawn to 3/8 inch equals 1 foot scale. Show fabrication and installation details for metal ducts.
   1. Shop drawings required for mechanical room and toilet exhaust fan.
   2. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
   3. Duct layout indicating sizes and pressure classes.
   4. Elevations of top and bottom 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. Duct accessories, including access doors and panels.
12. Hangers and supports, including methods for duct and building attachment, vibration isolation.

B. Welding certificates.

C. Field quality-control test reports.

1.06 QUALITY ASSURANCE

A. Welding: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code-Steel," for hangers and supports.

B. NFPA Compliance:
   1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
   2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."


PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
   1. 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.

2.02 SHEET METAL 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: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts.
2.03 SEALANT MATERIALS

A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.


C. Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.

D. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.

E. Solvent-Based Joint and Seam Sealant: One-part, nonsag, solvent-release-curing, polymerized butyl sealant formulated with a minimum of 75 percent solids.

F. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.

G. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.04 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. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports: Steel shapes complying with ASTM A 36/A 36M.
   3. Supports for Aluminum Ducts: Aluminum support materials unless materials are electrolytically separated from ducts.
2.05 RECTANGULAR DUCT FABRICATION

A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.

1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."

B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Nexus Inc.
   c. Ward Industries, Inc.

C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.

1. Manufacturers:
   a. Ductmate Industries, Inc.
   b. Lockformer.

2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

D. Cross Breaking or Cross Beading: Cross break or cross bead duct sides 19 inches and larger and 0.0359 inch thick or less, with more than 10 sq. ft. of nonbraced panel area unless ducts are lined.

PART 3 - EXECUTION

3.01 DUCT APPLICATIONS

A. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

2. Return Ducts (Negative Pressure): 2-inch wg.

B. All ducts shall be galvanized steel:
3.02 DUCT INSTALLATION

A. Construct and install ducts according to SMACNA’s "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.

B. Install ducts with fewest possible joints.

C. Install fabricated fittings for changes in directions, size, and shape and for connections.

D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.

E. Install ducts, unless otherwise indicated, vertically and horizontally and parallel and perpendicular to building lines; avoid diagonal runs.

F. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

G. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

H. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.

I. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.

J. Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls, install appropriately rated fire dampers, sleeves, and firestopping sealant. Fire and smoke dampers are specified in Division 15 Section "Duct Accessories."

K. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA’s "Duct Cleanliness for New Construction."

3.03 SEAM AND JOINT SEALING

A. Seal duct seams and joints according to SMACNA’s "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

1. For pressure classes lower than 2-inch wg, seal transverse joints.

B. Seal ducts before external insulation is applied.

3.04 HANGING AND SUPPORTING

A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

B. Support vertical ducts at maximum intervals of 16 feet and at each floor.
C. Install upper attachments to structures with an allowable load not exceeding one-fourth of failure (proof-test) load.

D. Install concrete inserts before placing concrete.

E. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
   1. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

3.05 CONNECTIONS

A. Make connections to equipment with flexible connectors according to Division 15 Section "Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.06 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections according to SMACNA's "HVAC Air Duct Leakage Test Manual" and prepare test reports:
   1. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
   2. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If pressure classes are not indicated, test entire system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure. Give seven days' advance notice for testing.
   3. Maximum Allowable Leakage: Comply with requirements for Leakage Class 3 for round and flat-oval ducts, Leakage Class 12 for rectangular ducts in pressure classes lower than and equal to 2-inch wg (both positive and negative pressures), and Leakage Class 6 for pressure classes from 2- to 10-inch wg.
   4. Remake leaking joints and retest until leakage is equal to or less than maximum allowable.

3.07 CLEANING NEW SYSTEMS

A. Mark position of dampers and air-directional mechanical devices before cleaning new ductwork, and perform cleaning before air balancing.

B. Use service openings, as required, for physical and mechanical entry and for inspection.
   1. Create other openings to comply with duct standards.
   2. Disconnect flexible ducts as needed for cleaning and inspection.
   3. Remove and reinstall ceiling sections to gain access during the cleaning process.

C. Vent vacuuming system to the outside. Include filtration to contain debris removed from HVAC systems, and locate exhaust down wind and away from air intakes and other points of entry into building.
D. Clean the following new metal duct systems in mechanical room by removing surface contaminants and deposits:
1. Supply and exhaust fans including fan housings, plenums scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
2. Air-handling unit internal surfaces and components including mixing box, coil section, condensate drain pans, filters and filter sections, and condensate collectors and drains.
3. Coils and related components.
4. Return-air ducts, dampers, and actuators in mechanical equipment room.
5. Supply-air ducts, dampers, actuators, and turning vanes in mechanical equipment room.

E. Mechanical Cleaning Methodology:
1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.

F. Cleanliness Verification:
1. Visually inspect metal ducts for contaminants.
2. Where contaminants are discovered, re-clean and reinspect ducts.

END OF SECTION
SECTION 15820
DUCT ACCESSORIES

PART 1 - GENERAL

1.01 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY

A. This Section includes the following:

1. Backdraft dampers.
2. Volume dampers.
3. Motorized control dampers.
4. Fire dampers.
5. Turning vanes.
6. Duct-mounting access doors.
7. Flexible connectors.
8. Duct accessory hardware.

B. Related Sections include the following:

1. Division 13 Section "Fire Alarm" for duct-mounting fire and smoke detectors.
2. Division 15 Section "HVAC Instrumentation and Controls" for electric and pneumatic damper actuators.

1.03 SUBMITTALS

A. Product Data: For the following:

1. Backdraft dampers.
2. Volume dampers.
3. Motorized control dampers.
4. Fire dampers.
5. Turning vanes.
6. Duct-mounting access doors.
7. Flexible connectors.

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. Special fittings.
3. Motorized-control damper installations.
4. Fire-damper installations, including sleeves and duct-mounting access doors.
5. **Wiring Diagrams**: Power, signal, and control wiring.

### 1.04 QUALITY ASSURANCE


### 1.05 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. **Fusible Links**: Furnish quantity equal to 10 percent of amount installed.

### PART 2 - PRODUCTS

#### 2.01 MANUFACTURERS

A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

1. **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.

#### 2.02 SHEET METAL 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.

B. **Galvanized Sheet Steel**: Lock-forming quality; complying with ASTM A 653/A 653M and having G90 coating designation; ducts shall have mill-phosphatized finish for surfaces exposed to view.

C. **Stainless Steel**: ASTM A 480/A 480M.

D. **Aluminum Sheets**: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts.

E. **Extruded Aluminum**: ASTM B 221, alloy 6063, temper T6.

F. **Reinforcement Shapes and Plates**: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

G. **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.
2.03 BACKDRAFT DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
7. Prefco Products, Inc.
8. Ruskin Company.

B. Description: Multiple-blade, parallel action gravity balanced, with center-pivoted blades of maximum 6-inch width, with sealed edges, assembled in rattle-free manner with 90-degree stop, steel ball bearings, and axles; adjustment device to permit setting for varying differential static pressure.

C. Frame: 0.052-inch- thick, galvanized sheet steel 0.063-inch- thick extruded aluminum, with welded corners and mounting flange.

D. Blades: 0.025-inch- thick, roll-formed aluminum 0.050-inch- thick aluminum sheet.

E. Blade Seals: Vinyl Neoprene.


G. Tie Bars and Brackets: Aluminum Galvanized steel.

H. Return Spring: Adjustable tension.

2.04 VOLUME DAMPERS

A. Manufacturers:

1. Air Balance, Inc.
2. American Warming and Ventilating.
3. Flexmaster U.S.A., Inc.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Ruskin Company.

B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.

C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Steel Frames: Hat-shaped, galvanized sheet steel channels, minimum of 0.064 inch thick, with mitered and welded corners; frames with flanges where indicated for attaching to walls and flangeless frames where indicated for installing in ducts.
2. Roll-Formed Steel Blades: 0.064-inch thick, galvanized sheet steel.
3. Aluminum Frames: Hat-shaped, 0.10-inch thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
4. Roll-Formed Aluminum Blades: 0.10-inch thick aluminum sheet.
5. Extruded-Aluminum Blades: 0.050-inch thick extruded aluminum.
8. Tie Bars and Brackets: Aluminum.

D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.05 MOTORIZED CONTROL DAMPERS

A. Manufacturers:
1. Air Balance, Inc.
2. American Warming and Ventilating.
3. CESCO Products.
4. Duro Dyne Corp.
5. Greenheck.
7. METALAIRE, Inc.
8. Nailor Industries Inc.
10. Ruskin Company.

B. General Description: AMCA-rated, parallel opposed-blade design; minimum of 0.1084-inch thick, galvanized-steel frames with holes for duct mounting; minimum of 0.0635-inch thick, galvanized-steel damper blades with maximum blade width of 8 inches.

1. Secure blades to 1/2-inch diameter, zinc-plated axles using zinc-plated hardware, with nylon blade bearings, blade-linkage hardware of zinc-plated steel and brass, ends sealed against spring-stainless-steel blade bearings, and thrust bearings at each end of every blade.
2. Operating Temperature Range: From minus 40 to plus 200 deg F.
3. Provide closed-cell neoprene edging parallel- or opposed-blade design with inflatable seal blade edging, or replaceable rubber seals, rated for leakage at less than 10 cfm per sq. ft. of damper area, at differential pressure of 4-inch wg when damper is being held by torque of 50 in. x lbf; when tested according to AMCA 500D.

2.06 FIRE DAMPERS

A. Manufacturers:
1. Air Balance, Inc.
2. CESCO Products.
5. METALAIRE, Inc.
6. Nailor Industries Inc.
7. Penn Ventilation Company, Inc.
8. Prefco Products, Inc.

B. Fire dampers shall be labeled according to UL 555.

C. Fire Rating: 1-1/2 hours.

D. Frame: Curtain type with blades outside airstream; fabricated with roll-formed, 0.034-inch-thick galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve: Factory- or field-installed, galvanized sheet steel.
   1. Minimum Thickness: 0.052 or 0.138 inch thick as indicated and of length to suit application.
   2. Exceptions: Omit sleeve where damper frame width permits direct attachment of perimeter mounting angles on each side of wall or floor, and thickness of damper frame complies with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, 0.034-inch-thick, galvanized sheet steel. In place of interlocking blades, use full-length, 0.034-inch-thick, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Fusible Links: Replaceable, 165 deg F rated.

2.07 TURNING VANES

A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.

B. Manufactured Turning Vanes: Fabricate 1-1/2-inch-wide, [single] [double]-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.

   1. Manufacturers:
      a. Ductmate Industries, Inc.
      b. Duro Dyne Corp.
      c. METALAIRE, Inc.
      d. Ward Industries, Inc.
2.08 DUCT-MOUNTING ACCESS DOORS

A. General Description: Fabricate doors airtight and suitable for duct pressure class.

B. Door: Double wall, duct mounting, and rectangular; fabricated of galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class. Include vision panel where indicated. Include 1-by-1-inch butt or piano hinge and cam latches.

1. Manufacturers:
   a. American Warming and Ventilating.
   b. CESCO Products.
   c. Ductmate Industries, Inc.
   d. Flexmaster U.S.A., Inc.
   e. Greenheck.
   g. Nailor Industries Inc.
   h. Ventfabrics, Inc.
   i. Ward Industries, Inc.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.

3. Provide number of hinges and locks as follows:
   a. Less Than 12 Inches Square: Secure with two sash locks.
   b. Up to 18 Inches Square: Two hinges and two sash locks.
   c. Up to 24 by 48 Inches: Three hinges and two compression latches with outside and inside handles.
   d. Sizes 24 by 48 Inches and Larger: One additional hinge.

C. Seal around frame attachment to duct and door to frame with neoprene or foam rubber.

D. Insulation: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.09 FLEXIBLE CONNECTORS

A. Manufacturers:
   1. Ductmate Industries, Inc.
   2. Duro Dyne Corp.
   3. Ventfabrics, Inc.

B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.

   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.
2.10 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.

PART 3 - EXECUTION

3.01 APPLICATION AND INSTALLATION

A. Install duct accessories according to applicable details in SMACNA’s "HVAC Duct Construction Standards--Metal and Flexible" for metal ducts.

B. Provide duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel ducts.

C. Install backdraft dampers on exhaust fans or exhaust ducts nearest to outside and where indicated.

D. Provide balancing dampers as shown on the drawings for air balancing.

E. Provide test holes at fan inlets and outlets and elsewhere as indicated.

F. Install fire dampers, with fusible links, according to manufacturer’s UL-approved written instructions.

G. Install duct access doors to allow for inspecting, adjusting, and maintaining accessories:
   1. Adjacent to fire dampers, providing access to reset or reinstall fusible links.
   2. On sides of ducts where adequate clearance is available.

H. Install the following sizes for duct-mounting, rectangular access doors:
   1. One-Hand or Inspection Access: 8 by 5 inches.
   2. Two-Hand Access: 12 by 6 inches.

I. Label access doors according to Division 15 Section "Mechanical Identification."

J. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators.

K. Install duct test holes where indicated and required for testing and balancing purposes.

3.02 ADJUSTING

A. Adjust duct accessories for proper settings.
B. Adjust fire dampers for proper action.

C. Final positioning of manual-volume dampers is specified in Division 15 Section "Testing, Adjusting, and Balancing."

END OF SECTION
SECTION 15830
POWER VENTILATORS

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY
A. This Section includes the following:
1. Centrifugal roof ventilators.

1.03 PERFORMANCE REQUIREMENTS
A. Project Altitude: Base fan-performance ratings on sea level.
B. Operating Limits: Classify according to AMCA 99.

1.04 SUBMITTALS
A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and 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: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   2. Design Calculations: Calculate requirements for selecting vibration isolators.

C. Coordination Drawings: Reflected ceiling 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. Roof framing and support members relative to duct penetrations.
D. Field quality-control test reports.

E. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.05 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. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.

D. UL Standard: Power ventilators shall comply with UL 705.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled unit, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.07 COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 3.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

1.08 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. Belts: One set for each belt-driven unit.
PART 2 - PRODUCTS

2.01 CENTRIFUGAL ROOF VENTILATORS

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:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

   2. Aerovent; a Twin City Fan Company
   3. American Coolair Corp.
   4. Ammerman; General Resource Corp.
   5. Breidert Air Products.
   7. Carnes Company HVAC.
   8. Central Blower Co.
   10. Delhi Industries Inc.
   12. Hartzell Fan, Inc.
   13. JencoFan; Div. of Breidert Air Products.
   14. Loren Cook Company.
   15. NuTone Inc.
   17. Quietaire Corporation.

D. Description: Direct- or belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, curb base, and accessories.

E. 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.

F. Fan Wheels: Aluminum hub and wheel with backward-inclined blades.

G. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

   1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
   4. Fan and motor isolated from exhaust airstream.

H. 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 mounted inside outside fan housing, 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.

I. 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 and cricket on upper side of roof slope.
   2. Overall Height: 12 inches minimum.
   5. Metal Liner: Galvanized steel.

J. Capacities and Characteristics: See drawings

2.02 MOTORS
A. Comply with requirements in Division 15 Section "Motors."
B. Enclosure Type: Totally enclosed, fan cooled.

2.03 SOURCE QUALITY CONTROL
A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.01 INSTALLATION
A. Install power ventilators level and plumb.
B. Secure roof-mounting fans to roof curbs with cadmium-plated hardware.
C. Install units with clearances for service and maintenance.
D. Label units according to requirements specified in Division 15 Section "Mechanical Identification."
E. Roof curb shall be installed by roofing contractor so as to maintain warranty on existing roof.
3.02 CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 15 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 15 Section "Duct Accessories."

B. Install ducts adjacent to power ventilators to allow service and maintenance.

C. Ground equipment according to Division 16 Section "Grounding and Bonding."

D. Connect wiring according to Division 16 Section "Conductors and Cables."

3.03 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

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.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.04 ADJUSTING

A. Adjust damper linkages for proper damper operation.

B. Adjust belt tension.

C. Refer to Division 15 Section "Testing, Adjusting, and Balancing" 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 15840
AIR TERMINAL UNITS

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
1. Shutoff, single-duct air terminal units.
2. Casing liner.

1.03 ACTION SUBMITTALS
A. Product Data: For each type of air terminal unit.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for air terminal units.
   2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. LEED Submittals:
   1. Product Data for Prerequisite IEQ 1: Documentation indicating that units comply with ASHRAE 62.1, Section 5 - "Systems and Equipment."
   2. Product Data for Credit IEQ 4.1: For adhesives and sealants, documentation including printed statement of VOC content.

C. Shop Drawings: For air terminal units.
   1. Include plans, elevations, sections, and mounting 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. Include diagrams for power, signal, and control wiring.
   4. Hangers and supports, including methods for duct and building attachment and vibration isolation.

D. Delegated-Design Submittal:
   1. Materials, fabrication, assembly, and spacing of hangers and supports.
1.04 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. Size and location of initial access modules for acoustic tile.
   3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.

B. Field quality-control reports.

1.05 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air terminal units to include in emergency, operation, and maintenance manuals.
   1. Include the following:
      a. Instructions for resetting minimum and maximum air volumes.
      b. Instructions for adjusting software set points.

1.06 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.

PART 2 - PRODUCTS

2.01 SYSTEM DESCRIPTION

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. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."

C. ASHRAE Compliance: Applicable requirements in ASHRAE/IES 90.1, "Section 6 - Heating, Ventilating, and Air Conditioning."

2.02 SHUTOFF, SINGLE-DUCT AIR TERMINAL UNITS

A. Acceptable manufacturers:
   1. Envirotec
   2. Price
   3. Titus
   4. Tutle & Bailey
   5. Krugger
   6. Carrier
B. Configuration: Volume-damper assembly inside unit casing with control components inside a protective metal shroud.

C. Casing: 0.040 inch thick galvanized steel, single wall.
   2. Air Inlet: Round stub connection or S-slip and drive connections for duct attachment.
   3. Air Outlet: S-slip and drive connections.
   4. Access: Removable panels for access to parts requiring service, adjustment, or maintenance; with airtight gasket.
   5. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Regulator Assembly: System-air-powered bellows section incorporating polypropylene bellows for volume regulation and thermostatic control. Bellows shall operate at temperatures from zero to 140 deg F, shall be impervious to moisture and fungus, shall be suitable for 10-inch wg static pressure, and shall be factory tested for leaks.

E. Volume Damper: Galvanized steel with peripheral gasket and self-lubricating bearings.
   1. Maximum Damper Leakage: AHRI 880 rated, 2 percent of nominal airflow at 3-inch wg inlet static pressure.

F. Hydronic Heating Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, and rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

G. Control devices shall be compatible with temperature controls system specified in Section 230923 "Direct Digital Control (DDC) System for HVAC."
   1. Electronic Damper Actuator: 24 V, powered open, spring return.
   2. Electronic Thermostat: Wall-mounted electronic type with temperature set-point display in Fahrenheit and Celsius.
   3. Electronic Velocity Controller: Factory calibrated and field adjustable to minimum and maximum air volumes; shall maintain constant airflow dictated by thermostat within 5 percent of set point while compensating for inlet static-pressure variations up to 4-inch wg; and shall have a multipoint velocity sensor at air inlet.
   4. Terminal Unit Controller: Pressure-independent, variable-air-volume (VAV) controller with electronic airflow transducer with multipoint velocity sensor at air inlet, factory calibrated to minimum and maximum air volumes, and having the following features:
      a. Occupied and unoccupied operating mode.
      b. Remote reset of airflow or temperature set points.
      c. Adjusting and monitoring with portable terminal.
      d. Communication with temperature-control system specified in Section 15910 "Direct Digital Control (DDC) System for HVAC."
   5. Room Sensor: Wall mounted with temperature set-point adjustment and access for connection of portable operator terminal.

H. Controls:
   1. Suitable for operation with duct pressures between 0.25- and 3.0-inch wg inlet static pressure.
2. System-powered, wall-mounted thermostat.

I. Control Sequences:

1. Occupied:
   a. In a call for cooling, airflow will increase as the damper opens towards maximum setting to satisfy set point.
   b. In a call for less cooling, airflow will decrease as the damper closes towards minimum setting to satisfy set point.

2. Unoccupied:
   a. Damper closes to minimum maximum setting.

2.03 CASING LINER

A. Casing Liner: Fibrous-glass duct liner, complying with ASTM C 1071, NFPA 90A, or NFPA 90B; and with NAIMA AH124, "Fibrous Glass Duct Liner Standard."

1. Minimum Thickness: 1/2 inch.
   a. 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. Antimicrobial Erosion-Resistant Coating: Apply to the surface of the liner that will form the interior surface of the duct to act as a moisture repellent and erosion-resistant coating. Antimicrobial compound shall be tested for efficacy by an NRTL and registered by the EPA for use in HVAC systems.

3. Water-Based Liner Adhesive: Comply with NFPA 90A or NFPA 90B and with ASTM C 916.
   a. Adhesive VOC Content: 80 g/L or less.
   b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

B. Casing Liner: Flexible elastomeric duct liner fabricated of preformed, cellular, closed-cell, sheet materials complying with ASTM C 534, Type II, Grade 1; and with NFPA 90A or NFPA 90B.

1. Minimum Thickness: 1/2 inch.
2. Surface-Burning Characteristics: Maximum flame-spread index of 25 and maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
3. Liner Adhesive: As recommended by insulation manufacturer and complying with NFPA 90A or NFPA 90B.
   a. Adhesive VOC Content: 50 g/L or less.
   b. Adhesive shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of
2.04 SOURCE QUALITY CONTROL

A. Factory Tests: Test assembled air terminal units according to AHRI 880.
   1. Label each air terminal unit with plan number, nominal airflow, maximum and minimum factory-set airflows, coil type, and AHRI certification seal.

PART 3 - EXECUTION

3.01 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Ch. 5, "Hangers and Supports" and with Section 15060 "Hangers and Supports for HVAC Piping and Equipment."

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 and for slabs more than 4 inches thick.
   4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes and for slabs less than 4 inches thick.
   5. Do not use powder-actuated concrete fasteners for seismic restraints.

C. Hangers Exposed to View: Threaded rod and angle or channel supports.

D. 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.

3.02 TERMINAL UNIT INSTALLATION

A. Install air terminal units according to NFPA 90A, "Standard for the Installation of Air Conditioning and Ventilating Systems."

B. Install air terminal units level and plumb. Maintain sufficient clearance for normal service and maintenance.

C. Install wall-mounted thermostats.

3.03 CONNECTIONS

A. Where installing piping adjacent to air terminal unit, allow space for service and maintenance.
B. Hot-Water Piping: Comply with requirements in Section 15182 "Hydronic Piping" and Section 232116 Hydronic Piping Specialties," and connect heating coils to supply with shutoff valve, strainer, control valve, and union or flange; and to return with balancing valve and union or flange.

C. Comply with requirements in Section 15810 "Metal Ducts" for connecting ducts to air terminal units.

D. Make connections to air terminal units with flexible connectors complying with requirements in Section 15820 "Air Duct Accessories."

3.04 IDENTIFICATION

A. Label each air terminal unit with plan number, nominal airflow, and maximum and minimum factory-set airflows. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for equipment labels and warning signs and labels.

3.05 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.

B. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. After installing air terminal units and after electrical circuitry has been energized, test for compliance with requirements.
2. Leak Test: After installation, fill water coils and test for leaks. Repair leaks and retest until no leaks exist.
3. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
4. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Air terminal unit will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.06 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. Verify that inlet duct connections are as recommended by air terminal unit manufacturer to achieve proper performance.
3. Verify that controls and control enclosure are accessible.
4. Verify that control connections are complete.
5. Verify that nameplate and identification tag are visible.
6. Verify that controls respond to inputs as specified.
3.07 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain air terminal units.

END OF SECTION
SECTION 15910
DIRECT DIGITAL CONTROL (DDC) SYSTEM FOR HVAC

PART 1 - GENERAL

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

1.02 SUMMARY
A. Section Includes:
   1. DDC system for monitoring and controlling of HVAC systems.
   2. Delivery of selected control devices to equipment and systems manufacturers for factory installation and to HVAC systems installers for field installation.

1.03 DEFINITIONS
A. Algorithm: A logical procedure for solving a recurrent mathematical problem. A prescribed set of well-defined rules or processes for solving a problem in a finite number of steps.
B. Analog: A continuously varying signal value, such as current, flow, pressure, or temperature.
C. BACnet Specific Definitions:
   2. BACnet Interoperability Building Blocks (BIBBs): BIBB defines a small portion of BACnet functionality that is needed to perform a particular task. BIBBs are combined to build the BACnet functional requirements for a device.
   3. BACnet/IP: Defines and allows using a reserved UDP socket to transmit BACnet messages over IP networks. A BACnet/IP network is a collection of one or more IP subnetworks that share the same BACnet network number.
   5. PICS (Protocol Implementation Conformance Statement): Written document that identifies the particular options specified by BACnet that are implemented in a device.
D. Binary: Two-state signal where a high signal level represents "ON" or "OPEN" condition and a low signal level represents "OFF" or "CLOSED" condition. "Digital" is sometimes used interchangeably with "Binary" to indicate a two-state signal.
E. Controller: Generic term for any standalone, microprocessor-based, digital controller residing on a network, used for local or global control. Three types of controllers are indicated: Network Controller, Programmable Application Controller, and Application-Specific Controller.
F. Control System Integrator: An entity that assists in expansion of existing enterprise system and support of additional operator interfaces to I/O being added to existing enterprise system.

G. COV: Changes of value.

H. DDC System Provider: Authorized representative of, and trained by, DDC system manufacturer and responsible for execution of DDC system Work indicated.

I. Distributed Control: Processing of system data is decentralized and control decisions are made at subsystem level. System operational programs and information are provided to remote subsystems and status is reported back. On loss of communication, subsystems shall be capable of operating in a standalone mode using the last best available data.

J. DOCSIS: Data-Over Cable Service Interface Specifications.

K. E/P: Voltage to pneumatic.

L. Gateway: Bidirectional protocol translator that connects control systems that use different communication protocols.

M. HLC: Heavy load conditions.

N. I/O: System through which information is received and transmitted. I/O refers to analog input (AI), binary input (BI), analog output (AO) and binary output (BO). Analog signals are continuous and represent control influences such as flow, level, moisture, pressure, and temperature. Binary signals convert electronic signals to digital pulses (values) and generally represent two-position operating and alarm status. "Digital," (DI and (DO), is sometimes used interchangeably with "Binary," (BI) and (BO), respectively.

O. I/P: Current to pneumatic.

P. LAN: Local area network.

Q. LNS: LonWorks Network Services.

R. LON Specific Definitions:

1. FTT-10: Echelon Transmitter-Free Topology Transceiver.
2. LonMark: Association comprising suppliers and installers of LonTalk products. Association provides guidelines for implementing LonTalk protocol to ensure interoperability through a standard or consistent implementation.
3. LonTalk: An open standard protocol developed by the Echelon Corporation that uses a "Neuron Chip" for communication. LonTalk is a register trademark of Echelon.
4. LonWorks: Network technology developed by Echelon.
5. Node: Device that communicates using CEA-709.1-C protocol and that is connected to a CEA-709.1-C network.
6. Node Address: The logical address of a node on the network, consisting of a Domain number, Subnet number, and Node number. "Node number" portion of an address is a number assigned to device during installation, is unique within a subnet, and is not a factory-set unique Node ID.
7. Node ID: A unique 48-bit identifier assigned at factory to each CEA-709.1-C device. Sometimes called a "Neuron ID."
8. Program ID: An identifier (number) stored in a device (usually EEPROM) that identifies node manufacturer, functionality of device (application and sequence), transceiver used, and intended device usage.

10. Standard Network Variable Type (SNVT): Pronounced "snivet." A standard format type maintained by LonMark used to define data information transmitted and received by individual nodes. "SNVT" is used in two ways. It is an acronym for "Standard Network Variable Type" and is often used to indicate a network variable itself (i.e., it can mean "a network variable of a standard network variable type").

11. Subnet: Consists of a logical grouping of up to 127 nodes, where logical grouping is defined by node addressing. Each subnet is assigned a number, which is unique within a Domain. See "Node Address."

12. TP/FT-10: Free Topology Twisted Pair network defined by CEA-709.3 and is most common media type for a CEA-709.1-C control network.

13. TP/XF-1250: High-speed, 1.25-Mbps, twisted-pair, doubly terminated bus network defined by "LonMark Interoperability Guidelines" typically used only to connect multiple TP/FT-10 networks.

14. User-Defined Configuration Property Type (UCPT): Pronounced "U-Keep-It." A Configuration Property format type that is defined by device manufacturer.

15. User-Defined Network Variable Type (UNVT): Network variable format defined by device manufacturer. UNVTs create non-standard communications that other vendors’ devices may not correctly interpret and may negatively impact system operation. UNVTs are not allowed.

S. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

T. Modbus TCP/IP: An open protocol for exchange of process data.

U. MS/TP: Master-slave/token-passing, IEE 8802-3. Datalink protocol LAN option that uses twisted-pair wire for low-speed communication.

V. MTBF: Mean time between failures.

W. Network Controller: Digital controller, which supports a family of programmable application controllers and application-specific controllers, that communicates on peer-to-peer network for transmission of global data.

X. Network Repeater: Device that receives data packet from one network and rebroadcasts it to another network. No routing information is added to protocol.

Y. PDA: Personal digital assistant.

Z. Peer to Peer: Networking architecture that treats all network stations as equal partners.

AA. POT: Portable operator's terminal.

BB. PUE: Performance usage effectiveness.

CC. RAM: Random access memory.

DD. RF: Radio frequency.

EE. Router: Device connecting two or more networks at network layer.

FF. Server: Computer used to maintain system configuration, historical and programming database.
GG. TCP/IP: Transport control protocol/Internet protocol incorporated into Microsoft Windows.

HH. UPS: Uninterruptible power supply.

II. USB: Universal Serial Bus.

JJ. User Datagram Protocol (UDP): This protocol assumes that the IP is used as the underlying protocol.

KK. VAV: Variable air volume.

LL. WLED: White light emitting diode.

1.04 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.05 ACTION SUBMITTALS

A. Multiple Submissions:

1. If multiple submissions are required to execute work within schedule, first submit a coordinated schedule clearly defining intent of multiple submissions. Include a proposed date of each submission with a detailed description of submittal content to be included in each submission.

2. Clearly identify each submittal requirement indicated and in which submission the information will be provided.

3. Include an updated schedule in each subsequent submission with changes highlighted to easily track the changes made to previous submitted schedule.

B. Product Data: For each type of product include the following:

1. Construction details, material descriptions, dimensions of individual components and profiles, and finishes.

2. Operating characteristics, electrical characteristics, and furnished accessories indicating process operating range, accuracy over range, control signal over range, default control signal with loss of power, calibration data specific to each unique application, electrical power requirements, and limitations of ambient operating environment, including temperature and humidity.


4. Installation, operation and maintenance instructions including factors effecting performance.

5. Bill of materials of indicating quantity, manufacturer, and extended model number for each unique product.

a. Operator workstations.

b. Servers.

c. Printers.

d. Gateways.

e. Routers.

f. Protocol analyzers.

g. DDC controllers.
h. Enclosures.
i. Electrical power devices.
j. UPS units.
k. Accessories.
l. Instruments.
m. Control dampers and actuators.
n. Control valves and actuators.

6. When manufacturer's product datasheets apply to a product series rather than a specific product model, clearly indicate and highlight only applicable information.

7. Each submitted piece of product literature shall clearly cross reference specification and drawings that submittal is to cover.

C. Software Submittal:

1. Cross-referenced listing of software to be loaded on each operator workstation, server, gateway, and DDC controller.
2. Description and technical data of all software provided, and cross-referenced to products in which software will be installed.
3. Operating system software, operator interface and programming software, color graphic software, DDC controller software, maintenance management software, and third-party software.
4. Include a flow diagram and an outline of each subroutine that indicates each program variable name and units of measure.
5. Listing and description of each engineering equation used with reference source.
6. Listing and description of each constant used in engineering equations and a reference source to prove origin of each constant.
7. Description of operator interface to alphanumeric and graphic programming.
8. Description of each network communication protocol.
9. Description of system database, including all data included in database, database capacity and limitations to expand database.
10. Description of each application program and device drivers to be generated, including specific information on data acquisition and control strategies showing their relationship to system timing, speed, processing burden and system throughout.
11. 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.

D. Shop Drawings:

1. General Requirements:

a. Include cover drawing with Project name, location, Owner, Architect, Contractor and issue date with each Shop Drawings submission.
b. Include a drawing index sheet listing each drawing number and title that matches information in each title block.
c. Prepare Drawings using CAD.

2. Include plans, elevations, sections, and mounting details where applicable.
3. Include details of product assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail means of vibration isolation and show attachments to rotating equipment.
5. Plan Drawings indicating the following:

a. Screened backgrounds of walls, structural grid lines, HVAC equipment, ductwork and piping.
b. Room names and numbers with coordinated placement to avoid interference with control products indicated.
c. Each desktop operator workstation, server, gateway, router, DDC controller, control panel instrument connecting to DDC controller, and damper and valve connecting to DDC controller, if included in Project.
d. Exact placement of products in rooms, ducts, and piping to reflect proposed installed condition.
e. Network communication cable and raceway routing.
f. Information, drawn to scale, of 1/8" = 1'-0".
g. Proposed routing of wiring, cabling, conduit, and tubing, coordinated with building services for review before installation.

6. Schematic drawings for each controlled HVAC system indicating the following:
   a. I/O points labeled with point names shown. Indicate instrument range, normal operating set points, and alarm set points. Indicate fail position of each damper and valve, if included in Project.
   b. I/O listed in table format showing point name, type of device, manufacturer, model number, and cross-reference to product data sheet number.
   c. A graphic showing location of control I/O in proper relationship to HVAC system.
   d. Wiring diagram with each I/O point having a unique identification and indicating labels for all wiring terminals.
   e. Unique identification of each I/O that shall be consistently used between different drawings showing same point.
   f. Elementary wiring diagrams of controls for HVAC equipment motor circuits including interlocks, switches, relays and interface to DDC controllers.
   g. Narrative sequence of operation.
   h. Graphic sequence of operation, showing all inputs and output logical blocks.

7. Control panel drawings indicating the following:
   a. Panel dimensions, materials, size, and location of field cable, raceways, and tubing connections.
   b. Interior subpanel layout, drawn to scale and showing all internal components, cabling and wiring raceways, nameplates and allocated spare space.
   c. Front, rear, and side elevations and nameplate legend.
   d. Unique drawing for each panel.

8. DDC system network riser diagram indicating the following:
   a. Each device connected to network with unique identification for each.
   b. Interconnection of each different network in DDC system.
   c. For each network, indicate communication protocol, speed and physical means of interconnecting network devices, such as copper cable type, or fiber-optic cable type. Indicate raceway type and size for each.
   d. Each network port for connection of an operator workstation or other type of operator interface with unique identification for each.

9. DDC system electrical power riser diagram indicating the following:
   a. Each point of connection to field power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
   b. Each control power supply including, as applicable, transformers, power-line conditioners, transient voltage suppression and high filter noise units, DC power supplies, and UPS units with unique identification for each.
   c. Each product requiring power with requirements (volts/phase/hertz/amperes/connection type) listed for each.
   d. Power wiring type and size, race type, and size for each.
10. Monitoring and control signal diagrams indicating the following:

a. Control signal cable and wiring between controllers and I/O.
b. Point-to-point schematic wiring diagrams for each product.
c. Control signal tubing to sensors, switches and transmitters.
d. Process signal tubing to sensors, switches and transmitters.
e. Pneumatic main air and control signal tubing to pneumatic damper and valve actuators, pilot-positioners if applicable, and associated transducers.

11. Color graphics indicating the following:

a. Itemized list of color graphic displays to be provided.
b. For each display screen to be provided, a true color copy showing layout of pictures, graphics and data displayed.
c. Intended operator access between related hierarchical display screens.

E. System Description:

1. Full description of DDC system architecture, network configuration, operator interfaces and peripherals, servers, controller types and applications, gateways, routers and other network devices, and power supplies.
2. Complete listing and description of each report, log and trend for format and timing and events which initiate generation.
3. System and product operation under each potential failure condition including, but not limited to, the following:

   a. Loss of power.
   b. Loss of network communication signal.
   c. Loss of controller signals to inputs and outpoints.
   d. Operator workstation failure.
   e. Server failure.
   f. Gateway failure.
   g. Network failure
   h. Controller failure.
   i. Instrument failure.
   j. Control damper and valve actuator failure.

4. Complete bibliography of documentation and media to be delivered to Owner.
5. Description of testing plans and procedures.
6. Description of Owner training.

F. Delegated-Design Submittal: For DDC system products and installation indicated as being delegated.

1. Supporting documentation showing DDC system design complies with performance requirements indicated, including calculations and other documentation necessary to prove compliance.
2. Schedule and design calculations for control dampers and actuators.

   a. Flow at Project design and minimum flow conditions.
   b. Face velocity at Project design and minimum airflow conditions.
   c. Pressure drop across damper at Project design and minimum airflow conditions.
   d. AMCA 500-D damper installation arrangement used to calculate and schedule pressure drop, as applicable to installation.
   e. Maximum close-off pressure.
f. Leakage airflow at maximum system pressure differential (fan close-off pressure).
g. Torque required at worst case condition for sizing actuator.
h. Actuator selection indicating torque provided.
i. Actuator signal to control damper (on, close or modulate).
j. Actuator position on loss of power.
k. Actuator position on loss of control signal.

3. Schedule and design calculations for control valves and actuators.
   a. Flow at Project design and minimum flow conditions.
   b. Pressure-differential drop across valve at Project design flow condition.
   c. Maximum system pressure-differential drop (pump close-off pressure) across valve at Project minimum flow condition.
   d. Design and minimum control valve coefficient with corresponding valve position.
   e. Maximum close-off pressure.
   f. Leakage flow at maximum system pressure differential.
   g. Torque required at worst case condition for sizing actuator.
   h. Actuator selection indicating torque provided.
   i. Actuator signal to control damper (on, close or modulate).
   j. Actuator position on loss of power.
   k. Actuator position on loss of control signal.

4. Schedule and design calculations for selecting flow instruments.
   a. Instrument flow range.
   b. Project design and minimum flow conditions with corresponding accuracy, control signal to transmitter and output signal for remote control.
   c. Extreme points of extended flow range with corresponding accuracy, control signal to transmitter and output signal for remote control.
   d. Pressure-differential loss across instrument at Project design flow conditions.
   e. Where flow sensors are mated with pressure transmitters, provide information for each instrument separately and as an operating pair.

1.06 INFORMATIONAL SUBMITTALS

A. Coordination Drawings:
   1. Plan drawings and corresponding product installation details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
      a. Product installation location shown in relationship to room, duct, pipe and equipment.
      b. Structural members to which products will be attached.
      c. Wall-mounted instruments located in finished space showing relationship to light switches, fire-alarm devices and other installed devices.
      d. Size and location of wall access panels for products installed behind walls and requiring access.
   2. 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:
      a. Ceiling components.
      b. Size and location of access panels for products installed above inaccessible ceiling assemblies and requiring access.
      c. Items penetrating finished ceiling including the following:
1) Lighting fixtures.
2) Air outlets and inlets.
3) Speakers.
4) Sprinklers.
5) Access panels.
6) Motion sensors.
7) Pressure sensors.
8) Temperature sensors and other DDC control system instruments.

B. Qualification Data:

1. Systems Provider Qualification Data:
   a. Resume of project manager assigned to Project.
   b. Resumes of application engineering staff assigned to Project.
   c. Resumes of installation and programming technicians assigned to Project.
   d. Resumes of service technicians assigned to Project.
   e. Brief description of past project including physical address, floor area, number of floors, building system cooling and heating capacity and building's primary function.
   f. Description of past project DDC system, noting similarities to Project scope and complexity indicated.
   g. Names of staff assigned to past project that will also be assigned to execute work of this Project.
   h. Owner contact information for past project including name, phone number, and e-mail address.
   i. Contractor contact information for past project including name, phone number, and e-mail address.
   j. Architect and Engineer contact information for past project including name, phone number, and e-mail address.

2. Manufacturer's qualification data.
3. Testing agency's qualifications data.

C. Welding certificates.

D. Product Certificates:

1. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with ASHRAE 135.
2. Data Communications Protocol Certificates: Certifying that each proposed DDC system component complies with LonWorks.

E. Product Test Reports: For each product that requires testing to be performed by manufacturer.

F. Source quality-control reports.

G. Field quality-control reports.

H. Sample Warranty: For manufacturer’s warranty.

1.07 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For DDC system to include in emergency, operation and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:
a. Project Record Drawings of as-built versions of submittal Shop Drawings provided in electronic PDF format.
b. Testing and commissioning reports and checklists of completed final versions of reports, checklists, and trend logs.
c. As-built versions of submittal Product Data.
d. Names, addresses, e-mail addresses and 24-hour telephone numbers of Installer and service representatives for DDC system and products.
e. Operator's manual with procedures for operating control systems including logging on and off, handling alarms, producing point reports, trending data, overriding computer control and changing set points and variables.
f. Programming manuals with description of programming language and syntax, of statements for algorithms and calculations used, of point database creation and modification, of program creation and modification, and of editor use.
g. Engineering, installation, and maintenance manuals that explain how to:
   1) Design and install new points, panels, and other hardware.
   2) Perform preventive maintenance and calibration.
   3) Debug hardware problems.
   4) Repair or replace hardware.

h. Documentation of all programs created using custom programming language including set points, tuning parameters, and object database.
i. Backup copy of graphic files, programs, and database on electronic media such as DVDs.
j. List of recommended spare parts with part numbers and suppliers.
k. Complete original-issued documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.
l. Complete original-issued copies of furnished software, including operating systems, custom programming language, operator workstation software, and graphics software.
m. Licenses, guarantees, and warranty documents.
n. Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.
o. Owner training materials.

1.08 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials and parts that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

B. Include product manufacturers’ recommended parts lists for proper product operation over four-year period following warranty period. Parts list shall be indicated for each year.

C. Furnish parts, as indicated by manufacturer's recommended parts list, for product operation during one-year period following warranty period.

1.09 QUALITY ASSURANCE

A. DDC System Manufacturer Qualifications:

1. Nationally recognized manufacturer of DDC systems and products.
2. DDC systems with similar requirements to those indicated for a continuous period of five years within time of bid.
3. DDC systems and products that have been successfully tested and in use on at least three past projects.
4. Having complete published catalog literature, installation, operation and maintenance manuals for all products intended for use.
5. Having full-time in-house employees for the following:
   a. Product research and development.
   b. Product and application engineering.
   c. Product manufacturing, testing and quality control.
   d. Technical support for DDC system installation training, commissioning and troubleshooting of installations.
   e. Owner operator training.

B. DDC System Provider Qualifications:
   1. Authorized representative of, and trained by, DDC system manufacturer.
   2. In-place facility located within 50 miles of Project.
   3. Demonstrated past experience with installation of DDC system products being installed for period within three consecutive years before time of bid.
   4. Demonstrated past experience on five projects of similar complexity, scope and value.
   5. Each person assigned to Project shall have demonstrated past experience.
   6. Staffing resources of competent and experienced full-time employees that are assigned to execute work according to schedule.
   7. Service and maintenance staff assigned to support Project during warranty period.
   8. Product parts inventory to support on-going DDC system operation for a period of not less than 5 years after Substantial Completion.
   9. DDC system manufacturer's backing to take over execution of Work if necessary to comply with requirements indicated. Include Project-specific written letter, signed by manufacturer's corporate officer, if requested.

C. Testing Agency Qualifications: Member company of NETA or an NRTL.
   1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

D. 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."

E. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.10 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace products that fail in materials or workmanship within specified warranty period.
   1. Failures shall be adjusted, repaired, or replaced at no additional cost or reduction in service to Owner.
   2. Include updates or upgrades to software and firmware if necessary to resolve deficiencies.

a. Install updates only after receiving Owner's written authorization.
3. Warranty service shall occur during normal business hours and commence within 24 hours of Owner's warranty service request.

4. Warranty Period: Two year(s) from date of Substantial Completion.

a. For Gateway: Two-year parts and labor warranty for each.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

A. Logic

B. Carrier Comfort Controls

2.02 DDC SYSTEM DESCRIPTION

A. Microprocessor-based monitoring and control including analog/digital conversion and program logic. A control loop or subsystem in which digital and analog information is received and processed by a microprocessor, and digital control signals are generated based on control algorithms and transmitted to field devices to achieve a set of predefined conditions.

1. DDC system shall consist of a high-speed, peer-to-peer network of distributed DDC controllers, other network devices, operator interfaces, and software.

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.

2.03 WEB ACCESS

A. DDC system shall be Web compatible.

1. Web-Based Access to DDC System:

a. DDC system software shall be based on server thin-client architecture, designed around open standards of Web technology. DDC system server shall be accessed using a Web browser over DDC system network, using Owner's LAN, and remotely over Internet through Owner's LAN.

b. Intent of thin-client architecture is to provide operators complete access to DDC system via a Web browser. No special software other than a Web browser shall be required to access graphics, point displays, and trends; to configure trends, points, and controllers; and to edit programming.

c. Web access shall be password protected.

2. Web-Compatible Access to DDC System:

a. Operator workstation or server shall perform overall system supervision and configuration, graphical user interface, management report generation, and alarm annunciation.

b. DDC system shall support Web browser access to building data. Operator using a standard Web browser shall be able to access control graphics and change adjustable set points.

c. Web access shall be password protected.
2.04 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional to design DDC system to satisfy requirements indicated.

   1. System Performance Objectives:

      a. DDC system shall manage HVAC systems.
      b. DDC system control shall operate HVAC systems to achieve optimum operating costs while using least possible energy and maintaining specified performance.
      c. DDC system shall respond to power failures, HVAC equipment failures, and adverse and emergency conditions encountered through connected I/O points.
      d. DDC system shall operate while unattended by an operator and through operator interaction.
      e. DDC system shall record trends and transaction of events and produce report information such as performance, energy, occupancies, and equipment operation.

B. Surface-Burning Characteristics: Products installed in ducts, equipment, and return-air paths shall comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Flame-Spread Index: 25 or less.
   2. Smoke-Developed Index: 50 or less.

C. DDC System Speed:

   1. Response Time of Connected I/O:

      a. AI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
      b. BI point values connected to DDC system shall be updated at least every five seconds for use by DDC controllers. Points used globally shall also comply with this requirement.
      c. AO points connected to DDC system shall begin to respond to controller output commands within two second(s). Global commands shall also comply with this requirement.
      d. BO point values connected to DDC system shall respond to controller output commands within two second(s). Global commands shall also comply with this requirement.

   2. Display of Connected I/O:

      a. Analog point COV connected to DDC system shall be updated and displayed at least every 10 seconds for use by operator.
      b. Binary point COV connected to DDC system shall be updated and displayed at least every 10 seconds for use by operator.
      c. Alarms of analog and digital points connected to DDC system shall be displayed within 45 seconds of activation or change of state.
      d. Graphic display refresh shall update within eight seconds.
      e. Point change of values and alarms displayed from workstation to workstation when multiple operators are viewing from multiple workstations shall not exceed graphic refresh rate indicated.

D. Network Bandwidth: Design each network of DDC system to include at least 30 percent available spare bandwidth with DDC system operating under normal and heavy load conditions indicated. Calculate bandwidth usage, and apply a safety factor to ensure that requirement is satisfied when subjected to testing under worst case conditions.

E. DDC System Data Storage:
1. Include server(s) with disk drive data storage to archive not less than 24 consecutive months of historical data for all I/O points connected to system, including alarms, event histories, transaction logs, trends and other information indicated.

2. When logged onto a server, operator shall be able to also interact with any DDC controller connected to DDC system as required for functional operation of DDC system.

3. Server(s) shall be used for application configuration; for archiving, reporting and trending of data; for operator transaction archiving and reporting; for network information management; for alarm annunciation; and for operator interface tasks and controls application management.

4. Server(s) shall use IT industry-standard database platforms such as Microsoft SQL Server and Microsoft Data Engine (MSDE).

F. Future Expandability:

1. DDC system size shall be expandable to an ultimate capacity of at least two times total I/O points indicated.

2. Additional DDC controllers, I/O and associated wiring shall be all that is needed to achieve ultimate capacity. Initial network infrastructure shall be designed and installed to support ultimate capacity.

3. Operator interfaces installed initially shall not require hardware and software additions and revisions for ultimate capacity.

G. Reporting Accuracy. System shall report values with minimum end-to-end accuracy listed in table below:

<table>
<thead>
<tr>
<th>Measured Variable</th>
<th>Reported Accuracy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Space Temperature</td>
<td>±0.5ºC (±1ºF)</td>
</tr>
<tr>
<td>Ducted Air</td>
<td>±0.5ºC (±1ºF)</td>
</tr>
<tr>
<td>Outside Air</td>
<td>±1.0ºC (±2ºF)</td>
</tr>
<tr>
<td>Dew Point</td>
<td>±1.5ºC (±3ºF)</td>
</tr>
<tr>
<td>Water Temperature</td>
<td>±0.5ºC (±1ºF)</td>
</tr>
<tr>
<td>Delta-T</td>
<td>±0.15ºC (±0.25ºF)</td>
</tr>
<tr>
<td>Relative Humidity</td>
<td>±5% RH</td>
</tr>
<tr>
<td>Water Flow</td>
<td>±2% of full scale</td>
</tr>
<tr>
<td>Airflow (terminal)</td>
<td>±10% of full scale (see Note 1)</td>
</tr>
<tr>
<td>Airflow (measuring stations)</td>
<td>±5% of full scale</td>
</tr>
<tr>
<td>Airflow (pressurized spaces)</td>
<td>±3% of full scale</td>
</tr>
<tr>
<td>Air Pressure (ducts)</td>
<td>±25 Pa (±0.1 in. w.g.)</td>
</tr>
<tr>
<td>Air Pressure (space)</td>
<td>±3 Pa (±0.01 in. w.g.)</td>
</tr>
<tr>
<td>Water Pressure</td>
<td>±2% of full scale (see Note 2)</td>
</tr>
<tr>
<td>Electrical (A, V, W, Power Factor)</td>
<td>±1% of reading (see Note 3)</td>
</tr>
<tr>
<td>Carbon Monoxide (CO)</td>
<td>±5% of reading</td>
</tr>
<tr>
<td>Carbon Dioxide (CO₂)</td>
<td>±50 ppm</td>
</tr>
</tbody>
</table>

Note 1: Accuracy applies to 10% - 100% of scale
Note 2: For both absolute and differential pressure
Note 3: Not including utility-supplied meters
H. Precision of I/O Reported Values: Values reported in database and displayed shall have following precision:

1. Current:
   a. Milliamperes: Nearest 1/100th of a milliampere.
   b. Amperes: Nearest 1/10th of an ampere up to 100 A; nearest ampere for 100 A and more.

2. Energy:
   a. Electric Power:
      1) Rate (Watts): Nearest 1/10th of a watt through 1000 W.
      2) Rate (Kilowatts): Nearest 1/10th of a kilowatt through 1000 kW; nearest kilowatt above 1000 kW.
      3) Usage (Kilowatt-Hours): Nearest kilowatt through 10,000 kW; nearest 10 kW between 10,000 and 100,000 kW; nearest 100 kW for above 100,000 kW.
   b. Thermal, Rate:
      1) Heating: For Btu/h, nearest Btu/h up to 1000 Btu/h; nearest 10 Btu/h between 1000 and 10,000 Btu/h; nearest 100 Btu/h for above 10,000 Btu/h. For Mbh, round to nearest Mbh up to 1000 Mbh; nearest 10 Mbh between 1000 and 10,000 Mbh; nearest 100 Mbh above 10,000 Mbh.
      2) Cooling: For tons, nearest ton up to 1000 tons; nearest 10 tons between 1000 and 10,000 tons; nearest 100 tons above 10,000 tons.
   c. Thermal, Usage:
      1) Heating: For Btu, nearest Btu up to 1000 Btu; nearest 10 Btu between 1000 and 10,000 Btu; nearest 100 Btu for above 10,000 Btu. For Mbtu, round to nearest Mbtu up to 1000 Mbtu; nearest 10 Mbtu between 1000 and 10,000 Mbtu; nearest 100 Mbtu above 10,000 Mbtu.
      2) Cooling: For ton-hours, nearest ton-hours up to 1000 ton-hours; nearest 10 ton-hours between 1000 and 10,000 ton-hours; nearest 100 tons above 10,000 tons.

3. Flow:
   a. Air: Nearest 1/10th of a cfm through 100 cfm; nearest cfm between 100 and 1000 cfm; nearest 10 cfm between 1000 and 10,000 cfm; nearest 100 cfm above 10,000 cfm.
   b. Water: Nearest 1/10th gpm through 100 gpm; nearest gpm between 100 and 1000 gpm; nearest 10 gpm between 1000 and 10,000 gpm; nearest 100 gpm above 10,000 gpm.
   c. Steam: Nearest 1/10th lb/hr through 100 lbs/hr; nearest lbs/hr between 100 and 1000 lbs/hr; nearest 10 lbs/hr above 1000 lbs/hr.
   d. Carbon Dioxide (ppm): Nearest ppm.
   e. Refrigerant (ppm): Nearest ppm.

4. Moisture (Relative Humidity):
a. Relative Humidity (Percentage): Nearest 1 percent.

5. Level: Nearest 1/100th of an inch through 10 inches; nearest 1/10 of an inch between 10 and 100 inches; nearest inch above 100 inches. Speed:

a. Rotation (rpm): Nearest 1 rpm.
b. Velocity: Nearest 1/10th fpm through 100 fpm; nearest fpm between 100 and 1000 fpm; nearest 10 fpm above 1000 fpm.


7. Pressure:

a. Air, Ducts and Equipment: Nearest 1/10th in. w.c. Space: Nearest 1/100th in. w.c. Steam: Nearest 1/10th psig through 100 psig; nearest psig above 100 psig. Water: Nearest 1/10 psig through 100 psig; nearest psig above 100 psig.

8. Temperature:

a. Air, Ducts and Equipment: Nearest 1/10th of a degree.
b. Outdoor: Nearest degree.
c. Space: Nearest 1/10th of a degree.
d. Chilled Water: Nearest 1/10th of a degree.
e. Condenser Water: Nearest 1/10th of a degree.
f. Heating Hot Water: Nearest degree.
g. Heat Recovery Runaround: Nearest 1/10th of a degree.
h. Steam: Nearest degree.

9. Vibration: Nearest 1/10th in/s

10. Voltage: Nearest 1/10 volt up to 100 V; nearest volt above 100 V.

I. Control Stability: Control variables indicated within the following limits:

<table>
<thead>
<tr>
<th>Controlled Variable</th>
<th>Control Accuracy</th>
<th>Range of Medium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Air Pressure</td>
<td>±50 Pa (±0.2 in. w.g.)</td>
<td>0-1.5 kPa (0-6 in. w.g.)</td>
</tr>
<tr>
<td></td>
<td>±3 Pa (±0.01 in. w.g.)</td>
<td>-25 to 25 Pa (-0.1 to 0.1 in. w.g.)</td>
</tr>
<tr>
<td>Air Flow</td>
<td>±10% of full scale</td>
<td></td>
</tr>
<tr>
<td>Space Temperature</td>
<td>±1.0ºC (±2.0ºF)</td>
<td></td>
</tr>
<tr>
<td>Duct Temperature</td>
<td>±1.5ºC (±3ºF)</td>
<td></td>
</tr>
<tr>
<td>Humidity</td>
<td>±5% RH</td>
<td></td>
</tr>
<tr>
<td>Fluid Flow</td>
<td>+/- 2% of flow velocity</td>
<td>0 to 30 FPM</td>
</tr>
<tr>
<td>Fluid Pressure</td>
<td>±10 kPa (±1.5 psi)</td>
<td>MPa (1-150 psi)</td>
</tr>
<tr>
<td></td>
<td>±250 Pa (±1.0 in. w.g.)</td>
<td>0-12.5 kPa (0-50 in. w.g.) differential</td>
</tr>
</tbody>
</table>

J. Environmental Conditions for Controllers, Gateways, and Routers:

1. Products shall operate without performance degradation under ambient environmental temperature, pressure and humidity conditions encountered for installed location.

a. If product alone cannot comply with requirement, install product in a protective enclosure that is isolated and protected from conditions impacting performance. Enclosure shall be internally insulated, electrically heated, cooled and ventilated as required by product and application.

2. Products shall be protected with enclosures satisfying the following minimum requirements unless more stringent requirements are indicated. Products not available with integral
enclosures complying with requirements indicated shall be housed in protective secondary
enclosures. Installed location shall dictate the following NEMA 250 enclosure
requirements:

a. Outdoors, Protected: Type 4X.
b. Outdoors, Unprotected: Type 4X.
c. Indoors, Heated with Filtered Ventilation: Type 2.
d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
e. Indoors, Heated and Air Conditioned: Type 2
f. Mechanical Equipment Rooms:
   1) Chiller and Boiler Rooms: Type 4X.
   2) Air-Moving Equipment Rooms: Type 2.

g. Localized Areas Exposed to Washdown: Type 4X.
h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2.
i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.

K. Environmental Conditions for Instruments and Actuators:

1. Instruments and actuators shall operate without performance degradation under the
ambient environmental temperature, pressure, humidity, and vibration conditions specified
and encountered for installed location.

a. If instruments and actuators alone cannot comply with requirement, install instruments and
actuators in protective enclosures that are isolated and protected from conditions impacting
performance. Enclosure shall be internally insulated, electrically heated and ventilated as required
by instrument and application.

2. Instruments, actuators and accessories shall be protected with enclosures satisfying the
following minimum requirements unless more stringent requirements are indicated.
Instruments and actuators not available with integral enclosures complying with
requirements indicated shall be housed in protective secondary enclosures. Installed
location shall dictate the following NEMA 250 enclosure requirements:

a. Outdoors, Protected: Type 4X.
b. Outdoors, Unprotected: Type 4X.
c. Indoors, Heated with Filtered Ventilation: Type 2.
d. Indoors, Heated with Non-Filtered Ventilation: Type 2.
e. Indoors, Heated and Air Conditioned: Type 2
f. Mechanical Equipment Rooms:
   1) Chiller and Boiler Rooms: Type 4X.
   2) Air-Moving Equipment Rooms: Type 2.

g. Localized Areas Exposed to Washdown: Type 4X.
h. Within Duct Systems and Air-Moving Equipment Not Exposed to Possible Condensation: Type 2.
i. Within Duct Systems and Air-Moving Equipment Exposed to Possible Condensation: Type 4X.

L. DDC System Reliability:
1. Design, install and configure DDC controllers, gateways, and routers, to yield a MTBF of at least 40,000 hours, based on a confidence level of at least 90 percent. MTBF value shall include any failure for any reason to any part of products indicated.

2. If required to comply with MTBF indicated, include DDC system and product redundancy to maintain DCC system, and associated systems and equipment that are being controlled, operational and under automatic control.

3. Critical systems and equipment that require a higher degree of DDC system redundancy than MTBF indicated shall be indicated on Drawings.

M. Electric Power Quality:

1. Power-Line Surges:
   a. Protect DDC system products connected to ac power circuits from power-line surges to comply with requirements of IEEE C62.41.
   b. Do not use fuses for surge protection.
   c. Test protection in the normal mode and in the common mode, using the following two waveforms:
      1) 10-by-1000-mic.sec. waveform with a peak voltage of 1500 V and a peak current of 60 A.
      2) 8-by-20-mic.sec. waveform with a peak voltage of 1000 V and a peak current of 500 A.

2. Power Conditioning:
   a. Protect DDC system products connected to ac power circuits from irregularities and noise rejection. Characteristics of power-line conditioner shall be as follows:
      1) At 85 percent load, output voltage shall not deviate by more than plus or minus 1 percent of nominal when input voltage fluctuates between minus 20 percent to plus 10 percent of nominal.
      2) During load changes from zero to full load, output voltage shall not deviate by more than plus or minus 3 percent of nominal.
      3) Accomplish full correction of load switching disturbances within five cycles, and 95 percent correction within two cycles of onset of disturbance.
      4) Total harmonic distortion shall not exceed 3-1/2 percent at full load.

3. Ground Fault: Protect products from ground fault by providing suitable grounding. Products shall not fail due to ground fault condition.

N. Backup Power Source:

1. HVAC systems and equipment served by a backup power source shall have associated DDC system products that control such systems and equipment also served from a backup power source.

O. UPS:

1. DDC system products powered by UPS units shall include the following:
   a. Desktop operator workstations.
   b. Printers.
   c. Servers.
   d. Gateways.
   e. DDC controllers.
2. DDC system instruments and actuators powered by UPS units shall include those associated with HVAC systems required to on emergency power:

P. Continuity of Operation after Electric Power Interruption:

1. Equipment and associated factory-installed controls, field-installed controls, electrical equipment, and power supply connected to building normal and backup power systems shall automatically return equipment and associated controls to operating state occurring immediately before loss of normal power, without need for manual intervention by operator when power is restored either through backup power source or through normal power if restored before backup power is brought online.

2.05 PANEL-MOUNTED, MANUAL OVERRIDE SWITCHES

A. Manual Override of Control Dampers:

1. Include panel-mounted, two-position, selector switch for each automatic control damper being controlled by DDC controller.
2. Label each switch with damper designation served by switch.
3. Label switch positions to indicate either “Manual” or “Auto” control signal to damper.
4. With switch in “Auto” position signal to control damper actuator shall be control loop output signal from DDC controller.
5. With switch in “Manual” position, signal to damper actuator shall be controlled at panel with either an integral or separate switch to include local control.

a. For Binary Control Dampers: Manual two-position switch shall have “Close” and “Open” switch positions indicated. With switch in “Close” position, damper shall close. With switch in “Open” position, damper shall open.

b. For Analog Control Dampers: A gradual switch shall have “Close” and “Open” switch limits indicated. Operator shall be able to rotate switch knob to adjust damper to any position from close to open.

6. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that damper is under manual, not automatic, control.
7. Configure manual override switches to allow operator to manually operate damper while at panel without DDC controller installed and operational.
8. Terminal equipment including VAV units, do not require manual override unless otherwise indicated by sequence of operation.

B. Manual Override of Control Valves:

1. Include panel-mounted, two-position, selector switch for each automatic control valve being controlled by a DDC controller.
2. Label each switch with valve designation served by switch.
3. Label switch positions to indicate either “Manual” or “Auto” control signal to valve.
4. With switch in “Auto” position, signal to control-valve actuator shall be a control loop output signal from DDC controller.
5. With switch in “Manual” position, signal to valve actuator shall be controlled at panel with either an integral or a separate switch to include local control.

a. For Binary Control Dampers: Manual two-position switch shall have “Close” and “Open” switch positions indicated. With switch in “Close” position, damper shall close. With switch in “Open” position, damper shall open.
b. For Analog Control Dampers: A gradual switch shall have "Open" and "Close" switch limits indicated. Operator shall be able to rotate switch knob to adjust damper to any position from close to open.

6. DDC controller shall monitor and report position of each manual override selector switch. With switch placed in "manual" position, DDC controller shall signal an override condition to alert operator that valve is under manual, not automatic, control.
7. Configure manual override switches to allow operator to manually operate valve while at panel without DDC controller installed and operational.
8. Terminal equipment including VAV units, cabinet unit heaters, fin tube radiation and unit heaters do not require manual override unless otherwise indicated by sequence of operation.

2.06 SYSTEM ARCHITECTURE

A. System architecture shall consist of no more than two levels of LANs.
1. Level one LAN shall connect network controllers and operator workstations.
2. LAN shall connect programmable application controllers to other programmable application controllers, and to network controllers.
3. Level two LAN shall connect application-specific controllers to programmable application controllers and network controllers.

B. Minimum Data Transfer and Communication Speed:
1. LAN Connecting Operator Workstations and Network Controllers: 100 Mbps.
2. LAN Connecting Programmable Application Controllers: 1000 kbps.
3. LAN Connecting Application-Specific Controllers: 115,000 bps.

C. DDC system shall consist of dedicated LANs that are not shared with other building systems and tenant data and communication networks.

D. System architecture shall be modular and have inherent ability to expand to not less than two times system size indicated with no impact to performance indicated.

E. System architecture shall perform modifications without having to remove and replace existing network equipment.

F. Number of LANs and associated communication shall be transparent to operator. All I/O points residing on any LAN shall be capable of global sharing between all system LANs.

G. System design shall eliminate dependence on any single device for system alarm reporting and control execution. Each controller shall operate independently by performing its' own control, alarm management and historical data collection.

H. Special Network Architecture Requirements:
1. Air-Handling Systems: For control applications of an air-handling system that consists of air-handling unit(s) and VAV terminal units, include a dedicated LAN of application-specific controllers serving VAV terminal units connected directly to controller that is controlling air-handling system air-handling unit(s). Basically, create a DDC system LAN that aligns with air-handling system being controlled.
2.07 **DDC SYSTEM OPERATOR INTERFACES**

A. **Operator Means of System Access:** Operator shall be able to access entire DDC system through any of multiple means, including, but not limited to, the following:

1. Desktop and portable operator workstation with hardwired connection through LAN port.
2. Portable operator terminal with hardwired connection through LAN port.
3. Portable operator workstation with wireless connection through LAN router.
4. PDA with wireless connection through LAN router.
5. Remote connection using outside of system personal computer or PDA through Web access.

B. Access to system, regardless of operator means used, shall be transparent to operator.

C. **Network Ports:** For hardwired connection of desktop or portable operator workstation. Network port shall be easily accessible, properly protected, clearly labeled, and installed at the following locations:

1. Each mechanical equipment room.
2. Each boiler room.
3. Each different roof level with roof-mounted air-handling units or rooftop units.
5. Fire-alarm system command center.

D. **Desktop Workstations:**

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Able to communicate, with modems, remotely with any device connected to any DDC system LAN.
4. Communication via a modem shall not interfere with LAN activity and LAN activity shall not prevent workstation from handling incoming calls.

E. **Portable Workstations:**

1. Connect to DDC system Level one LAN through a communications port directly on LAN or through a communications port on a DDC controller.
2. Able to communicate with any device located on any DDC system LAN.
3. Connect to DDC system Level two LAN through a communications port on an application-specific controller, or a room temperature sensor connected to an application-specific controller.
4. Connect to system through a wireless router connected to Level one LAN.
5. Portable workstation shall be able to communicate with any device connected to any system LAN regardless of point of physical connection to system.
6. Monitor, program, schedule, adjust set points, and report capabilities of I/O connected anywhere in system.
7. Have dynamic graphic displays that are identical to desktop workstations.

F. **POT:**

1. Connect DDC controller through a communications port local to controller.
2. Able to communicate with any DDC system controller that is directly connected or with LAN.
G. Telephone Communications:

1. Through use of a standard modem, operator shall be able to communicate with any device connected to any system LAN.
2. Have auto-dial and auto-answer communications to allow desktop and portable workstations and DDC controllers to communicate with remote workstations and remote DDC controllers via telephone lines.

a. Desktop and Portable Operator Workstation Computers with Modems:

1) Operators shall be able to perform all control functions, report functions, and database generation and modification functions as if directly connected to system LAN.
2) Have routines to automatically answer calls, and either file or display information sent remotely.
3) Communications taking place over telephone lines shall be completely transparent to operator.
4) Dial-up program shall maintain a user-definable cross-reference and associated telephone numbers so it is not required to remember or manually dial telephone numbers.

b. DDC Controllers:

1) Not have modems unless specifically indicated for a unique controller.
2) Controllers with modems shall automatically place calls to report critical alarms, or to upload trend and historical information for archiving.
3) Analyze and prioritize alarms to minimize initiation of calls.
4) Buffer noncritical alarms in memory and report them as a group of alarms, or until an operator manually requests an upload.
5) Make provisions for handling busy signals, no-answers, and incomplete data transfers.
6) Call default devices when communications cannot be established with primary devices.

H. Critical Alarm Reporting:

1. Operator-selected critical alarms shall be sent by DDC system to notify operator of critical alarms that require immediate attention.
2. DDC system shall send alarm notification to multiple recipients that are assigned for each alarm.
3. DDC system shall notify recipients by any or all means, including e-mail, text message and prerecorded phone message to mobile and landline phone numbers.

I. Simultaneous Operator Use: Capable of accommodating up to five simultaneous operators that are accessing DDC system through any one of operator interfaces indicated.

2.08 NETWORKS

A. Acceptable networks for connecting operator workstations and network controllers include the following:

1. IP.
2. IEEE 8802-3, Ethernet.

B. Acceptable networks for connecting programmable application controllers include the following:
1. IP.
2. IEEE 8802-3, Ethernet.

C. Acceptable networks for connecting application-specific controllers include the following:
   1. IP.
   2. IEEE 8802-3, Ethernet.

### 2.09 NETWORK COMMUNICATION PROTOCOL

A. Network communication protocol(s) used throughout entire DDC system shall be open to public
   and available to other companies for use in making future modifications to DDC system.

B. ASHRAE 135 Protocol:
   1. ASHRAE 135 communication protocol shall be sole and native protocol used throughout
      entire DDC system.
   2. DDC system shall not require use of gateways except to integrate HVAC equipment and
      other building systems and equipment, not required to use ASHRAE 135 communication
      protocol.
   3. If used, gateways shall connect to DDC system using ASHRAE 135 communication
      protocol and Project object properties and read/write services indicated by interoperability
      schedule.
   4. Operator workstations, controllers and other network devices shall be tested and listed by
      BACnet Testing Laboratories.

### 2.10 DESKTOP OPERATOR WORKSTATIONS

A. Manufacturer shall be similar to Dell, Inc. or approved equal

B. Performance Requirements:
   1. Performance requirements may dictate equipment exceeding minimum requirements
      indicated.
   2. Energy Star compliant.

C. Personal Computer:
   1. Intel Pentium 2.66 GHz processor
   2. 8 GB RAM
   3. 400 GB hard disk providing data at 100 MB/sec, RAID 3 array
   4. DVD-RW drive
   5. USB and network communication ports and cables required for proper system operation

D. Keyboard:
   1. 101 enhanced keyboard.
   2. Full upper- and lowercase ASCII keyset, numeric keypad, dedicated cursor control keypad,
      and 12 programmable function keys.
   3. Wireless operation within up to 72 inches in front of workstation.

E. Pointing Device:
   1. Either a two- or three-button mouse.
2. Wireless operation within up to 72 inches in front of workstation.

F. Flat Panel Display Monitor:
   1. Display:
      a. Color display with 24 inches diagonal viewable area.
      b. Digital or analog input signal.
      d. Antiglare display.
      e. Dynamic Contrast Ratio: 50000 to 1.
      f. Brightness: 250 cd/sq. m.
      g. Tilt adjustable base.
      h. Energy Star compliant.
      i. Resolution: 1920 by 1080 pixels at 60 Hz with pixel size of 0.277 mm or smaller.
      j. Number of Displays: Two.

G. Speakers:
   1. Two, with individual controls for volume, bass and treble.
   2. Signal to Noise Ratio: At least 65 dB.
   3. Power: At least 4 W per speaker/channel.
   4. Magnetic shielding to prevent distortion on the video monitor.

H. I/O Cabling: Include applicable cabling to connect I/O devices.

I. Provide workstation with UPS unit.

2.11 POT

A. Description: Handheld device with integral keypad or touch screen operator interface.

B. Display: Multiple lines of text display for use in operator interaction with DDC system.

C. Cable: Flexible cable, at least 36 inches long, with a plug-in jack for connection to DDC controllers, network ports or instruments with an integral LAN port. As an alternative to hardwired connection, POT shall be accessible to DDC controllers through a wireless network connection.

D. POT shall be powered through network connection.

E. Connection of POT to DDC system shall not interrupt or interfere with normal network operation in any way, prevent alarms from being transmitted, or preclude central initiated commands and system modification.

F. POT shall give operator the ability to do the following:
   1. Display and monitor BI point status.
   2. Change BO point set point (on or off, open or closed).
   3. Display and monitor analog point values.
   4. Change analog control set points.
   5. Command a setting of AO point.
   6. Display and monitor I/O point in alarm.
   7. Add a new or delete an existing I/O point.
8. Enable and disable I/O points, initiators, and programs.
9. Display and change time and date.
10. Display and change time schedules.
11. Display and change run-time counters and run-time limits.
12. Display and change time and event initiation.
13. Display and change control application and DDC parameters.
14. Display and change programmable offset values.
15. Access DDC controller initialization routines and diagnostics.

2.12 SYSTEM SOFTWARE

A. System Software Minimum Requirements:

1. Real-time multitasking and multiuser 32- or 64-bit operating system that allows concurrent multiple operator workstations operating and concurrent execution of multiple real-time programs and custom program development.
2. Operating system shall be capable of operating DOS and Microsoft Windows applications.
3. Database management software shall manage all data on an integrated and non-redundant basis. Additions and deletions to database shall be without detriment to existing data. Include cross linkages so no data required by a program can be deleted by an operator until that data have been deleted from respective programs.
4. Network communications software shall manage and control multiple network communications to provide exchange of global information and execution of global programs.
5. Operator interface software shall include day-to-day operator transaction processing, alarm and report handling, operator privilege level and data segregation control, custom programming, and online data modification capability.
6. Scheduling software shall schedule centrally based time and event, temporary, and exception day programs.

B. Operator Interface Software:

1. Minimize operator training through use of English language prorating and English language point identification.
2. Minimize use of a typewriter-style keyboard through use of a pointing device similar to a mouse.
3. Operator sign-off shall be a manual operation or, if no keyboard or mouse activity takes place, an automatic sign-off.
4. Automatic sign-off period shall be programmable from one to 60 minutes in one-minute increments on a per operator basis.
5. Operator sign-on and sign-off activity shall be recorded and sent to printer.
6. Security Access:
   a. Operator access to DDC system shall be under password control.
   b. An alphanumeric password shall be field assignable to each operator.
   c. Operators shall be able to access DDC system by entry of proper password.
   d. Operator password shall be same regardless of which computer or other interface means is used.
   e. Additions or changes made to passwords shall be updated automatically.
   f. Each operator shall be assigned an access level to restrict access to data and functions the operator is capable of performing.
   g. Software shall have at least five access levels.
   h. Each menu item shall be assigned an access level so that a one-for-one correspondence between operator assigned access level(s) and menu item access level(s) is required to gain access to menu item.
i. Display menu items to operator with those capable of access highlighted. Menu and operator access level assignments shall be online programmable and under password control.

7. Data Segregation:
   a. Include data segregation for control of specific data routed to a workstation, to an operator or to a specific output device, such as a printer.
   b. Include at least 32 segregation groups.
   c. Segregation groups shall be selectable such as "fire points," "fire points on second floor," "space temperature points," "HVAC points," and so on.
   d. Points shall be assignable to multiple segregation groups. Display and output of data to printer or monitor shall occur where there is a match of operator or peripheral segregation group assignment and point segregations.
   e. Alarms shall be displayed and printed at each peripheral to which segregation allows, but only those operators assigned to peripheral and having proper authorization level will be allowed to acknowledge alarms.
   f. Operators and peripherals shall be assignable to multiple segregation groups and all assignments are to be online programmable and under password control.

8. Operators shall be able to perform commands including, but not limited to, the following:
   a. Start or stop selected equipment.
   b. Adjust set points.
   c. Add, modify, and delete time programming.
   d. Enable and disable process execution.
   e. Lock and unlock alarm reporting for each point.
   f. Enable and disable totalization for each point.
   g. Enable and disable trending for each point.
   h. Override control loop set points.
   i. Enter temporary override schedules.
   j. Define holiday schedules.
   k. Change time and date.
   l. Enter and modify analog alarm limits.
   m. Enter and modify analog warning limits.
   n. View limits.
   o. Enable and disable demand limiting.
   p. Enable and disable duty cycle.
   q. Display logic programming for each control sequence.

9. Reporting:
   a. Generated automatically and manually.
   b. Sent to displays, printers and disk files.
   c. Types of Reporting:
      1) General listing of points.
      2) List points currently in alarm.
      3) List of off-line points.
      4) List points currently in override status.
      5) List of disabled points.
      6) List points currently locked out.
      7) List of items defined in a "Follow-Up" file.
      8) List weekly schedules.
      9) List holiday programming.
     10) List of limits and deadbands.
10. Summaries: For specific points, for a logical point group, for an operator selected group(s),
or for entire system without restriction due to hardware configuration.

C. Graphic Interface Software:

1. Include a full interactive graphical selection means of accessing and displaying system
data to operator. Include at least five levels with the penetration path operator assignable
(for example, site, building, floor, air-handling unit, and supply temperature loop). Native
language descriptors assigned to menu items are to be operator defined and modifiable
under password control.

2. Include a hierarchical-linked dynamic graphic operator interface for accessing and
displaying system data and commanding and modifying equipment operation. Interface
shall use a pointing device with pull-down or penetrating menus, color and animation to
facilitate operator understanding of system.

3. Include at least 10 levels of graphic penetration with the hierarchy operator assignable.

4. Descriptors for graphics, points, alarms and such shall be modified through operator's
workstation under password control.

5. Graphic displays shall be online user definable and modifiable using the hardware and
software provided.

6. Data to be displayed within a graphic shall be assignable regardless of physical hardware
address, communication or point type.

7. Graphics are to be online programmable and under password control.

8. Points may be assignable to multiple graphics where necessary to facilitate operator
understanding of system operation.

9. Graphics shall also contain software points.

10. Penetration within a graphic hierarchy shall display each graphic name as graphics are
selected to facilitate operator understanding.

11. Back-trace feature shall permit operator to move upward in the hierarchy using a pointing
device. Back trace shall show all previous penetration levels. Include operator with option
of showing each graphic full screen size with back trace as horizontal header or by
showing a "stack" of graphics, each with a back trace.

12. Display operator accessed data on the monitor.

13. Operator shall select further penetration using pointing device to click on a site, building,
floor, area, equipment, and so on. Defined and linked graphic below that selection shall
then be displayed.

14. Include operator with means to directly access graphics without going through penetration
path.

15. Dynamic data shall be assignable to graphics.

16. Display points (physical and software) with dynamic data provided by DDC system with
appropriate text descriptors, status or value, and engineering unit.

17. Use color, rotation, or other highly visible means, to denote status and alarm states. Color
shall be variable for each class of points, as chosen by operator.

18. Points shall be dynamic with operator adjustable update rates on a per point basis from
one second to over a minute.

19. For operators with appropriate privilege, points shall be commanded directly from display
using pointing device.

a. For an analog command point such as set point, current conditions and limits shall be displayed
and operator can position new set point using pointing device.

b. For a digital command point such as valve position, valve shall show its current state such as open
or closed and operator could select alternative position using pointing device.

c. Keyboard equivalent shall be available for those operators with that preference.

20. Operator shall be able to split or resize viewing screen into quadrants to show one graphic
on one quadrant of screen and other graphics or spreadsheet, bar chart, word processing,
curve plot and other information on other quadrants on screen. This feature shall allow
real-time monitoring of one part of system while displaying other parts of system or data to better facilitate overall system operation.

21. Help Features:

a. On-line context-sensitive help utility to facilitate operator training and understanding.

b. Bridge to further explanation of selected keywords. Document shall contain text and graphics to clarify system operation.

1) If help feature does not have ability to bridge on keywords for more information, a complete set of user manuals shall be provided in an indexed word-processing program, which shall run concurrently with operating system software.

c. Available for Every Menu Item:

1) Index items for each system menu item.

22. Graphic generation software shall allow operator to add, modify, or delete system graphic displays.

a. Include libraries of symbols depicting HVAC symbols such as fans, coils, filters, dampers, valves, pumps, and electrical symbols.

b. Graphic development package shall use a pointing device in conjunction with a drawing program to allow operator to perform the following:

1) Define background screens.
2) Define connecting lines and curves.
3) Locate, orient and size descriptive text.
4) Define and display colors for all elements.
5) Establish correlation between symbols or text and associated system points or other displays.

D. Project-Specific Graphics: Graphics documentation including, but not limited to, the following:

1. Site plan showing each building, and additional site elements, which are being controlled or monitored by DDC system.
2. Plan for each building floor, including interstitial floors, and each roof level of each building, showing the following:

a. Room layouts with room identification and name.
b. Locations and identification of all monitored and controlled HVAC equipment and other equipment being monitored and controlled by DDC system.
c. Location and identification of each hardware point being controlled or monitored by DDC system.

3. Control schematic for each of following, including a graphic system schematic representation with point identification, set point and dynamic value indication, sequence of operation and control logic diagram.
4. Graphic display for each piece of equipment connected to DDC system through a data communications link. Include dynamic indication of all points associated with equipment.

E. Alarm Handling Software:

1. Include alarm handling software to report all alarm conditions monitored and transmitted through DDC controllers, gateways and other network devices.
2. Include first in, first out handling of alarms according to alarm priority ranking, with most critical alarms first, and with buffer storage in case of simultaneous and multiple alarms.

3. Alarm handling shall be active at all times to ensure that alarms are processed even if an operator is not currently signed on to DDC system.

4. Alarms display shall include the following:
   a. Indication of alarm condition such as "Abnormal Off," "Hi Alarm," and "Low Alarm."
   b. "Analog Value" or "Status" group and point identification with native language point descriptor such as "Space Temperature, Building 110, 2nd Floor, Room 212."
   c. Discrete per point alarm action message, such as "Call Maintenance Dept. Ext-5561."
   d. Include extended message capability to allow assignment and printing of extended action messages. Capability shall be operator programmable and assignable on a per point basis.

5. Alarms shall be directed to appropriate operator workstations, printers, and individual operators by privilege level and segregation assignments.

6. Send e-mail alarm messages to designated operators.

7. Send e-mail, page, text and voice messages to designated operators for critical alarms.

8. Alarms shall be categorized and processed by class.
   a. Class 1:
      1) Associated with fire, security and other extremely critical equipment monitoring functions; have alarm, trouble, return to normal, and acknowledge conditions printed and displayed.
      2) Unacknowledged alarms to be placed in unacknowledged alarm buffer.
      3) All conditions shall cause an audible sound and shall require individual acknowledgment to silence audible sound.
   b. Class 2:
      1) Critical, but not life-safety related, and processed same as Class 1 alarms, except do not require individual acknowledgment.
      2) Acknowledgement may be through a multiple alarm acknowledgment.
   c. Class 3:
      1) General alarms; printed, displayed and placed in unacknowledged alarm buffer queues.
      2) Each new alarm received shall cause an audible sound. Audible sound shall be silenced by "acknowledging" alarm or by pressing a "silence" key.
      3) Acknowledgement of queued alarms shall be either on an individual basis or through a multiple alarm acknowledgement.
      4) Alarms returning to normal condition shall be printed and not cause an audible sound or require acknowledgment.
   d. Class 4:
      1) Routine maintenance or other types of warning alarms.
      2) Alarms to be printed only, with no display, no audible sound and no acknowledgment required.

9. Include an unacknowledged alarm indicator on display to alert operator that there are unacknowledged alarms in system. Operator shall be able to acknowledge alarms on an individual basis or through a multiple alarm acknowledge key, depending on alarm class.
10. To ensure that no alarm records are lost, it shall be possible to assign a backup printer to accept alarms in case of failure of primary printer.

F. Reports and Logs:

1. Include reporting software package that allows operator to select, modify, or create reports using DDC system I/O point data available.
2. Each report shall be definable as to data content, format, interval and date.
3. Report data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation for historical reporting.
4. Operator shall be able to obtain real-time logs of all I/O points by type or status, such as alarm, point lockout, or normal.
5. Reports and logs shall be stored on workstation hard drives in a format that is readily accessible by other standard software applications, including spreadsheets and word processing.
6. Reports and logs shall be readily printed and set to be printed either on operator command or at a specific time each day.

G. Standard Reports: Standard DDC system reports shall be provided and operator shall be able to customize reports later.

1. All I/O: With current status and values.
2. Alarm: All current alarms, except those in alarm lockout.
3. Disabled I/O: All I/O points that are disabled.
4. Alarm Lockout I/O: All I/O points in alarm lockout, whether manual or automatic.
5. Alarm Lockout I/O in Alarm: All I/O in alarm lockout that are currently in alarm.
6. Logs:
   a. Alarm history.
   b. System messages.
   c. System events.
   d. Trends.

H. Custom Reports: Operator shall be able to easily define any system data into a daily, weekly, monthly, or annual report. Reports shall be time and date stamped and shall contain a report title.

I. Utility Reports: Prepare Project-specific reports.

1. Electric Report:
   a. Include weekly report showing daily electrical consumption and peak electrical demand with time and date stamp for each meter.
   b. Include monthly report showing the daily electrical consumption and peak electrical demand with time and date stamp for each meter.
   c. Include annual report showing the monthly electrical consumption and peak electrical demand with time and date stamp for each meter.
   d. For each weekly, monthly and annual report, include sum total of submeters combined by load type, such as lighting, receptacles and HVAC equipment showing daily electrical consumption and peak electrical demand.
   e. For each weekly, monthly and annual report, include sum total of all submeters in building showing electrical consumption and peak electrical demand.

2. Natural Gas Report:
a. Include weekly report showing daily natural gas consumption and peak natural gas demand with
time and date stamp for each meter.
b. Include monthly report showing the daily natural gas consumption and peak natural gas demand
with time and date stamp for each meter.
c. Include annual report showing the monthly natural gas consumption and peak natural gas demand
with time and date stamp for each meter.
d. For each weekly, monthly and annual report, include sum total of submeters combined by load
type, such as boilers and service water heaters showing daily natural gas consumption and peak
natural gas demand.
e. For each weekly, monthly and annual report, include sum total of all submeters in building showing
natural gas consumption and peak natural gas demand.

3. Service Water Report:

a. Include weekly report showing daily service water consumption and peak service water demand
with time and date stamp for each meter.
b. Include monthly report showing the daily service water consumption and peak service water
demand with time and date stamp for each meter.
c. Include annual report showing the monthly service water consumption and peak service water
demand with time and date stamp for each meter.
d. For each weekly, monthly and annual report, include sum total of submeters combined by load
type, such as cooling tower makeup and irrigation showing daily service water consumption and peak
service water demand.
e. For each weekly, monthly and annual report, include sum total of all submeters in building showing
service water consumption and peak service water demand.

J. Energy Reports: Prepare Project-specific daily, weekly, monthly and annual energy reports.

1. Prepare report for each purchased energy utility, indicating the following:

a. Time period being reported with beginning and end date, and time indicated.
b. Consumption in units of measure commonly used to report specific utility consumption over time.
c. Gross area served by utility.
d. Consumption per unit area served using utility-specific unit of measure.
e. Cost per utility unit.
f. Utility cost per unit area.
g. Convert all utilities to a common energy consumption unit of measure and report for each utility.
h. Consumption per unit area using common unit of measure.

2. Prepare Project total purchased energy utility report that combines all purchased energy
utilities and all areas served. Project total energy report shall indicate the following:

a. Time period being reported with beginning and end date, and time indicated.
b. Gross area served.
c. Energy consumption by energy utility type.
d. Energy consumption per unit area by energy utility type.
e. Total energy consumption of all utilities in common units of measure.
f. Total energy consumption of all utilities in common units of measure per unit area.
g. Unit energy cost by energy utility type.
h. Energy cost by energy utility type.
i. Energy cost per unit area by energy utility type.
j. Total cost of all energy utilities.
k. Total cost of all energy utilities per unit area.

K. HVAC System Efficiency Reports: Prepare Project-specific daily, weekly, monthly and annual
HVAC system efficiency reports.

Direct Digital Control (DDC) System For HVAC
1. Prepare report for hot-water system, indicating the following:
   a. Time period being reported with beginning and end date, and time indicated.
   b. Cooling energy supplied during time period.
   c. Fuel consumed during time period by boilers used to produce heating energy supplied.
   d. Energy efficiency determined by dividing heating energy supplied into fuel energy consumed.
   e. Units of measure used in report shall be consistent with units indicated for system.

L. Standard Trends:
   1. Trend all I/O point present values, set points, and other parameters indicated for trending.
   2. Trends shall be associated into groups, and a trend report shall be set up for each group.
   3. Trends shall be stored within DDC controller and uploaded to hard drives automatically on reaching 75% of DDC controller buffer limit, or by operator request, or by archiving time schedule.
   4. Preset trend intervals for each I/O point after review with Owner.
   5. Trend intervals shall be operator selectable from 10 seconds up to 60 minutes. Minimum number of consecutive trend values stored at one time shall be 100 per variable.
   6. When drive storage memory is full, most recent data shall overwrite oldest data.
   7. Archived and real-time trend data shall be available for viewing numerically and graphically by operators.

M. Custom Trends: Operator shall be able to define a custom trend log for any I/O point in DDC system.
   1. Each trend shall include interval, start time, and stop time.
   2. Data shall be sampled and stored on DDC controller, within storage limits of DDC controller, and then uploaded to archive on workstation hard drives.
   3. Data shall be retrievable for use in spreadsheets and standard database programs.

N. Programming Software:
   1. Include programming software to execute sequences of operation indicated.
   2. Include programming routines in simple and easy to follow logic with detailed text comments describing what the logic does and how it corresponds to sequence of operation.
   3. Programming software shall be as follows:
      a. Graphic Based: Programming shall use a library of function blocks made from preprogrammed code designed for DDC control systems.
         1) Function blocks shall be assembled with interconnection lines that represent to control sequence in a flowchart.
         2) Programming tools shall be viewable in real time to show present values and logical results of each function block.
   4. Include means for detecting programming errors and testing software control strategies with a simulation tool before implementing in actual control. Simulation tool may be inherent with programming software or as a separate product.

O. Database Management Software:
   1. Where a separate SQL database is used for information storage, DDC system shall include database management software that separates database monitoring and managing functions by supporting multiple separate windows.
2. Database secure access shall be accomplished using standard SQL authentication including ability to access data for use outside of DDC system applications.

3. Database management function shall include summarized information on trend, alarm, event, and audit for the following database management actions:
   a. Backup.
   b. Purge.
   c. Restore.

4. Database management software shall support the following:
   a. Statistics: Display database server information and trend, alarm, event, and audit information on database.
   b. Maintenance: Include method of purging records from trend, alarm, event and audit databases by supporting separate screens for creating a backup before purging, selecting database, and allowing for retention of a selected number of day's data.
   c. Backup: Include means to create a database backup file and select a storage location.
   d. Restore: Include a restricted means of restoring a database by requiring operator to have proper security level.

5. Database management software shall include information of current database activity, including the following:
   a. Ready.
   b. Purging record from a database.
   c. Action failed.
   d. Refreshing statistics.
   e. Restoring database.
   f. Shrinking a database.
   g. Backing up a database.
   h. Resetting Internet information services.
   i. Starting network device manager.
   j. Shutting down the network device manager.
   k. Action successful.

6. Database management software monitoring functions shall continuously read database information once operator has logged on.

7. Include operator notification through on-screen pop-up display and e-mail message when database value has exceeded a warning or alarm limit.

8. Monitoring settings window shall have the following sections:
   a. Allow operator to set and review scan intervals and start times.
   b. E-mail: Allow operator to create and review e-mail and phone text messages to be delivered when a warning or an alarm is generated.
   c. Warning: Allow operator to define warning limit parameters, set reminder frequency and link e-mail message.
   d. Alarm: Allow operator to define alarm limit parameters, set reminder frequency and link e-mail message.
   e. Database Login: Protect system from unauthorized database manipulation by creating a read access and a write access for each of trend, alarm, event and audit databases as well as operator proper security access to restore a database.

9. Monitoring settings taskbar shall include the following informational icons:
a. Normal: Indicates by color and size, or other easily identifiable means that all databases are within their limits.
b. Warning: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their warning limit.
c. Alarm: Indicates by color and size, or other easily identifiable means that one or more databases have exceeded their alarm limit.

2.13 OFFICE APPLICATION SOFTWARE

A. Software shall be similar to Microsoft Corporation or approved equal

B. Include current version of office application software at time of Substantial Completion.

C. Office application software package shall include multiple separate applications and use a common platform for all applications, similar to Microsoft's "Office Professional."

1. Database.
2. E-mail.
3. Presentation.
4. Publisher.
5. Spreadsheet.

2.14 ASHRAE 135 GATEWAYS

A. Include BACnet communication ports, whenever available as an equipment OEM standard option, for integration via a single communication cable. BACnet-controlled plant equipment includes, but is not limited to, boilers, chillers, and variable-speed drives.

B. Include gateways to connect BACnet to legacy systems, existing non-BACnet devices, and existing non-BACnet DDC-controlled equipment, only when specifically requested and approved by Owner.

C. Include with each gateway an interoperability schedule showing each point or event on legacy side that BACnet "client" will read, and each parameter that BACnet network will write to. Describe this interoperability of BACnet services, or BIBBs, defined in ASHRAE 135, Annex K.

D. Gateway Minimum Requirements:

1. Read and view all readable object properties on non-BACnet network to BACnet network and vice versa where applicable.
2. Write to all writeable object properties on non-BACnet network from BACnet network and vice versa where applicable.
3. Include single-pass (only one protocol to BACnet without intermediary protocols) translation from non-BACnet protocol to BACnet and vice versa.
4. Comply with requirements of Data Sharing Read Property, Data Sharing Write Property, Device Management Dynamic Device Binding-B, and Device Management Communication Control BIBBs according to ASHRAE 135.
5. Hardware, software, software licenses, and configuration tools for operator-to-gateway communications.
6. Backup programming and parameters on CD media and the ability to modify, download, backup, and restore gateway configuration.
2.15 WIRELESS ROUTERS FOR OPERATOR INTERFACE

A. Single-Band Wireless Routers:
   1. Manufacturers
      a. Cisco Linksys
      b. D-Link Corporation
      c. NETGEAR, Inc
   2. Description: High-speed router with integral Ethernet ports.
   3. Technology: IEEE 802.11n; 2.4-GHz speed band.
   4. Speed: Up to 300 Mbps.
   5. Compatibility: IEEE 802.11n/g/b/a wireless devices.
   7. Wireless Security: Wi-Fi Protected Access (WPA) and WPA2 according to IEEE 802.11i.

2.16 DDC CONTROLLERS

A. DDC system shall consist of a combination of network controllers, programmable application controllers and application-specific controllers to satisfy performance requirements indicated.

B. DDC controllers shall perform monitoring, control, energy optimization and other requirements indicated.

C. DDC controllers shall use a multitasking, multiuser, real-time digital control microprocessor with a distributed network database and intelligence.

D. Each DDC controller shall be capable of full and complete operation as a completely independent unit and as a part of a DDC system wide distributed network.

E. Environment Requirements:
   1. Controller hardware shall be suitable for the anticipated ambient conditions.
   2. Controllers located in conditioned space shall be rated for operation at 32 to 120 deg F.
   3. Controllers located outdoors shall be rated for operation at 40 to 150 deg F.

F. Power and Noise Immunity:
   1. Controller shall operate at 90 to 110 percent of nominal voltage rating and shall perform an orderly shutdown below 80 percent of nominal voltage.
   2. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios with up to 5 W of power located within 36 inches of enclosure.

G. DDC Controller Spare Processing Capacity:
   1. Include spare processing memory for each controller. RAM, PROM, or EEPROM will implement requirements indicated with the following spare memory:
      a. Network Controllers: 50 percent.
      b. Programmable Application Controllers: Not less than 60 percent.
      c. Application-Specific Controllers: Not less than 70 percent.
2. Memory shall support DDC controller's operating system and database and shall include the following:

a. Monitoring and control.
b. Energy management, operation and optimization applications.
c. Alarm management.
d. Historical trend data of all connected I/O points.
e. Maintenance applications.
f. Operator interfaces.
g. Monitoring of manual overrides.

H. DDC Controller Spare I/O Point Capacity: Include spare I/O point capacity for each controller as follows:

1. Network Controllers:

a. 10 percent of each AI, AO, BI, and BO point connected to controller.
b. Minimum Spare I/O Points per Controller:

   1) AIs: Two.
   2) AOs: Two.
   3) BIs: Three.
   4) BOs: Three.

2. Programmable Application Controllers:

a. 10 percent of each AI, AO, BI, and BO point connected to controller.
b. Minimum Spare I/O Points per Controller:

   1) AIs: Two.
   2) AOs: Two.
   3) BIs: Three.
   4) BOs: Three.

3. Application-Specific Controllers:

   a. 10 insert number percent of each AI, AO, BI, and BO point connected to controller.
   b. Minimum Spare I/O Points per Controller:

      1) AIs: One.
      2) AOs: One.
      3) BIs: One.
      4) BOs: One.

I. Maintenance and Support: Include the following features to facilitate maintenance and support:

1. Mount microprocessor components on circuit cards for ease of removal and replacement.
2. Means to quickly and easily disconnect controller from network.
3. Means to quickly and easily access connect to field test equipment.
4. Visual indication that controller electric power is on, of communication fault or trouble, and that controller is receiving and sending signals to network.

J. Input and Output Point Interface:
1. Hardwired input and output points shall connect to network, programmable application and application-specific controllers.

2. Input and output points shall be protected so shorting of point to itself, to another point, or to ground will not damage controller.

3. Input and output points shall be protected from voltage up to 24 V of any duration so that contact will not damage controller.

4. AIs:
   a. AIs shall include monitoring of low-voltage (zero- to 10-V dc), current (4 to 20 mA) and resistance signals from thermistor and RTD sensors.
   b. AIs shall be compatible with, and field configurable to, sensor and transmitters installed.
   c. Controller AIs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
   d. Signal conditioning including transient rejection shall be provided for each AI.
   e. Capable of being individually calibrated for zero and span.
   f. Incorporate common-mode noise rejection of at least 50 dB from zero to 100 Hz for differential inputs, and normal-mode noise rejection of at least 20 dB at 60 Hz from a source impedance of 10000 ohms.

5. AOs:
   a. Controller AOs shall perform analog-to-digital (A-to-D) conversion with a minimum resolution of 8 bits or better to comply with accuracy requirements indicated.
   b. Output signals shall have a range of 4 to 20 mA dc or zero- to 10-V dc as required to include proper control of output device.
   c. Capable of being individually calibrated for zero and span.
   d. AOs shall not exhibit a drift of greater than 0.4 percent of range per year.

6. BIs:
   a. Controller BIs shall accept contact closures and shall ignore transients of less than 5-ms duration.
   b. Isolation and protection against an applied steady-state voltage of up to 180-V ac peak.
   c. BIs shall include a wetting current of at least 12 mA to be compatible with commonly available control devices and shall be protected against effects of contact bounce and noise.
   d. BIs shall sense "dry contact" closure without external power (other than that provided by the controller) being applied.
   e. Pulse accumulation input points shall comply with all requirements of BIs and accept up to 10 pulses per second for pulse accumulation. Buffer shall be provided to totalize pulses. Pulse accumulator shall accept rates of at least 20 pulses per second. The totalized value shall be reset to zero on operator's command.

7. BOs:
   a. Controller BOs shall include relay contact closures or triac outputs for momentary and maintained operation of output devices.
      1) Relay contact closures shall have a minimum duration of 0.1 second. Relays shall include at least 180 V of isolation. Electromagnetic interference suppression shall be provided on all output lines to limit transients to non-damaging levels. Minimum contact rating shall be 1 A at 24-V ac.
      2) Triac outputs shall include at least 180 V of isolation. Minimum contact rating shall be 1 A at 24-V ac.
   b. BOs shall include for two-state operation or a pulsed low-voltage signal for pulse-width modulation control.
c. BOs shall be selectable for either normally open or normally closed operation.
d. Include tristate outputs (two coordinated BOs) for control of three-point floating-type electronic actuators without feedback.
e. Limit use of three-point floating devices to VAV terminal unit control applications. Control algorithms shall operate actuator to one end of its stroke once every 24 hours for verification of operator tracking.

2.17 NETWORK CONTROLLERS

A. General Network Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. System shall consist of one or more independent, standalone, microprocessor-based network controllers to manage global strategies indicated.
3. Controller shall have enough memory to support its operating system, database, and programming requirements.
4. Data shall be shared between networked controllers and other network devices.
5. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
6. Controllers shall have a real-time clock.
7. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
8. Controllers shall be fully programmable.

B. Communication:

1. Network controllers shall communicate with other devices on DDC system Level one network.
2. Network controller also shall perform routing if connected to a network of programmable application and application-specific controllers.

C. Operator Interface:

1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or PDA.

D. Serviceability:

1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.18 PROGRAMMABLE APPLICATION CONTROLLERS

A. General Programmable Application Controller Requirements:

1. Include adequate number of controllers to achieve performance indicated.
2. Controller shall have enough memory to support its operating system, database, and programming requirements.
3. Data shall be shared between networked controllers and other network devices.
4. Operating system of controller shall manage input and output communication signals to allow distributed controllers to share real and virtual object information and allow for central monitoring and alarms.
5. Controllers shall have a real-time clock.
6. Controller shall continually check status of its processor and memory circuits. If an abnormal operation is detected, controller shall assume a predetermined failure mode and generate an alarm notification.
7. Controllers shall be fully programmable.

B. Communication:
1. Programmable application controllers shall communicate with other devices on network.

C. Operator Interface:
1. Controller shall be equipped with a service communications port for connection to a portable operator's workstation or PDA.

D. Serviceability:
1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall maintain BIOS and programming information in event of a power loss for at least 72 hours.

2.19 APPLICATION-SPECIFIC CONTROLLERS

A. Description: Microprocessor-based controllers, which through hardware or firmware design are dedicated to control a specific piece of equipment. Controllers are not fully user-programmable but are configurable and customizable for operation of equipment they are designed to control.
1. Capable of standalone operation and shall continue to include control functions without being connected to network.
2. Data shall be shared between networked controllers and other network devices.

B. Communication: Application-specific controllers shall communicate with other application-specific controller and devices on network, and to programmable application and network controllers.

C. Operator Interface: Controller shall be equipped with a service communications port for connection to a portable operator's workstation.

D. Serviceability:
1. Controller shall be equipped with diagnostic LEDs or other form of local visual indication of power, communication, and processor.
2. Wiring and cable connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.
3. Controller shall use nonvolatile memory and maintain all BIOS and programming information in event of power loss.

2.20 CONTROLLER SOFTWARE

A. General Controller Software Requirements:

1. Software applications shall reside and operate in controllers. Editing of applications shall occur at operator workstations.
2. I/O points shall be identified by up to 30-character point name and up to 16-character point descriptor. Same names shall be used at operator workstations.
3. Control functions shall be executed within controllers using DDC algorithms.
4. Controllers shall be configured to use stored default values to ensure fail-safe operation. Default values shall be used when there is a failure of a connected input instrument or loss of communication of a global point value.

B. Security:

1. Operator access shall be secured using individual security passwords and user names.
2. Passwords shall restrict operator to points, applications, and system functions as assigned by system manager.
3. Operator log-on and log-off attempts shall be recorded.
4. System shall protect itself from unauthorized use by automatically logging off after last keystroke. The delay time shall be operator-definable.

C. Scheduling: Include capability to schedule each point or group of points in system. Each schedule shall consist of the following:

1. Weekly Schedule:
   a. Include separate schedules for each day of week.
   b. Each schedule should include the capability for start, stop, optimal start, optimal stop, and night economizer.
   c. Each schedule may consist of up to 10 events.
   d. When a group of objects are scheduled together, include capability to adjust start and stop times for each member.

2. Exception Schedules:
   a. Include ability for operator to designate any day of the year as an exception schedule.
   b. Exception schedules may be defined up to a year in advance. Once an exception schedule is executed, it will be discarded and replaced by regular schedule for that day of week.

3. Holiday Schedules:
   a. Include capability for operator to define up to 99 special or holiday schedules.
   b. Schedules may be placed on scheduling calendar and will be repeated each year.
   c. Operator shall be able to define length of each holiday period.

D. System Coordination:

1. Include standard application for proper coordination of equipment.
2. Application shall include operator with a method of grouping together equipment based on function and location.
3. Group may then be used for scheduling and other applications.

E. Binary Alarms:

1. Each binary point shall be set to alarm based on operator-specified state.
2. Include capability to automatically and manually disable alarming.

F. Analog Alarms:

1. Each analog object shall have both high and low alarm limits.
2. Alarming shall be able to be automatically and manually disabled.

G. Alarm Reporting:

1. Operator shall be able to determine action to be taken in event of an alarm.
2. Alarms shall be routed to appropriate operator workstations based on time and other conditions.
3. Alarm shall be able to start programs, print, be logged in event log, generate custom messages, and display graphics.

H. Remote Communication:

1. System shall have ability to dial out in the event of an alarm.

I. Electric Power Demand Limiting:

1. Demand-limiting program shall monitor building or other operator-defined electric power consumption from signals connected to electric power meter or from a watt transducer or current transformer.
2. Demand-limiting program shall predict probable power demand such that action can be taken to prevent exceeding demand limit. When demand prediction exceeds demand limit, action will be taken to reduce loads in a predetermined manner. When demand prediction indicates demand limit will not be exceeded, action will be taken to restore loads in a predetermined manner.
3. Demand reduction shall be accomplished by the following means:
   a. Reset air-handling unit supply temperature set points.
   b. Reset space temperature set points.
   c. De-energize equipment based on priority.
4. Demand-limiting parameters, frequency of calculations, time intervals, and other relevant variables shall be based on the means by which electric power service provider computes demand charges.
5. Include demand-limiting prediction and control for any individual meter monitored by system or for total of any combination of meters.
6. Include means operator to make the following changes online:
   a. Addition and deletion of loads controlled.
   b. Changes in demand intervals.
   c. Changes in demand limit for meter(s).
   d. Maximum shutoff time for equipment.
   e. Minimum shutoff time for equipment.
   f. Select rotational or sequential shedding and restoring.
   g. Shed and restore priority.
7. Include the following information and reports, to be available on an hourly, daily, weekly, monthly and annual basis:

a. Total electric consumption.
b. Peak demand.
c. Date and time of peak demand.
d. Daily peak demand.

J. Maintenance Management: System shall monitor equipment status and generate maintenance messages based on operator-designated run-time, starts, and calendar date limits.

K. Sequencing: Include application software based on sequences of operation indicated to properly sequence chillers, boilers, and other applicable HVAC equipment.

L. Control Loops:

1. Support any of the following control loops, as applicable to control required:

a. Two-position (on/off, open/close, slow/fast) control.
b. Proportional control.
c. Proportional plus integral (PI) control.
d. Proportional plus integral plus derivative (PID) control.

1) Include PID algorithms with direct or reverse action and anti-windup.
2) Algorithm shall calculate a time-varying analog value used to position an output or stage a series of outputs.
3) Controlled variable, set point, and PID gains shall be operator-selectable.

e. Adaptive (automatic tuning).

M. Staggered Start: Application shall prevent all controlled equipment from simultaneously restarting after a power outage. Order which equipment (or groups of equipment) is started, along with the time delay between starts, shall be operator-selectable.

N. Energy Calculations:

1. Include software to allow instantaneous power or flow rates to be accumulated and converted to energy usage data.
2. Include an algorithm that calculates a sliding-window average (rolling average). Algorithm shall be flexible to allow window intervals to be operator specified (such as 15, 30, or 60 minutes).
3. Include an algorithm that calculates a fixed-window average. A digital input signal shall define start of window period (such as signal from utility meter) to synchronize fixed-window average with that used by utility.

O. Anti-Short Cycling:

1. BO points shall be protected from short cycling.
2. Feature shall allow minimum on-time and off-time to be selected.

P. On and Off Control with Differential:

1. Include an algorithm that allows a BO to be cycled based on a controlled variable and set point.
2. Algorithm shall be direct- or reverse-acting and incorporate an adjustable differential.
Q. Run-Time Totalization:

1. Include software to totalize run-times for all BI and BO points.
2. A high run-time alarm shall be assigned, if required, by operator.

2.21 ENCLOSURES

A. General Enclosure Requirements:

1. House each controller and associated control accessories in an enclosure. Enclosure shall serve as central tie-in point for control devices such as switches, transmitters, transducers, power supplies and transformers.
2. Do not house more than one controller in a single enclosure.
3. Include enclosure door with key locking mechanism. Key locks alike for all enclosures and include one pair of keys per enclosure.
4. Equip doors of enclosures housing controllers and components with analog or digital displays with windows to allow visual observation of displays without opening enclosure door.
5. Include wall-mounted enclosures with brackets suitable for mounting enclosures to wall or freestanding support stand as indicated.
6. Supply each enclosure with a complete set of as-built schematics, tubing, and wiring diagrams and product literature located in a pocket on inside of door. For enclosures with windows, include pocket on bottom of enclosure.

B. Internal Arrangement:

1. Internal layout of enclosure shall group and protect pneumatic, electric, and electronic components associated with a controller, but not an integral part of controller.
2. Arrange layout to group similar products together.
3. Include a barrier between line-voltage and low-voltage electrical and electronic products.
4. Factory or shop install products, tubing, cabling and wiring complying with requirements and standards indicated.
5. Terminate field cable and wire using heavy-duty terminal blocks.
6. Include spare terminals, equal to not less than 10 percent of used terminals.
7. Include spade lugs for stranded cable and wire.
8. Install a maximum of two wires on each side of a terminal.
9. Include enclosure field power supply with a toggle-type switch located at entrance inside enclosure to disconnect power.
10. Mount products within enclosure on removable internal panel(s).
11. Include products mounted in enclosures with engraved, laminated phenolic nameplates (black letters on a white background). The nameplates shall have at least 1/4-inch-high lettering.
12. Route tubing cable and wire located inside enclosure within a raceway with a continuous removable cover.
13. Label each end of cable, wire and tubing in enclosure following an approved identification system that extends from field I/O connection and all intermediate connections throughout length to controller connection.
14. Size enclosure internal panel to include at least 25 percent spare area on face of panel.

C. Environmental Requirements:

1. Evaluate temperature and humidity requirements of each product to be installed within each enclosure.
2. Calculate enclosure internal operating temperature considering heat dissipation of all products installed within enclosure and ambient effects (solar, conduction and wind) on enclosure.
3. Where required by application, include temperature-controlled electrical heat to maintain inside of enclosure above minimum operating temperature of product with most stringent requirement.
4. Where required by application, include temperature-controlled ventilation fans with filtered louver(s) to maintain inside of enclosure below maximum operating temperature of product with most stringent requirement.
5. Include temperature-controlled cooling within the enclosure for applications where ventilation fans cannot maintain inside temperature of enclosure below maximum operating temperature of product with most stringent requirement.
6. Where required by application, include humidity-controlled electric dehumidifier or cooling to maintain inside of enclosure below maximum relative humidity of product with most stringent requirement and to prevent surface condensation within enclosure.

D. Wall Mounted NEMA 250, Types 4 and 12:

1. Manufacturers – similar to Hoffman or approved equal
2. Enclosure shall be NRTL listed according to UL 508A.
3. Seam and joints are continuously welded and ground smooth.
4. Where recessed enclosures are indicated, include enclosures with face flange for flush mounting.
5. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
6. Single-door enclosure sizes up to 60 inches tall by 36 inches wide.
7. Double-door enclosure sizes up to 36 inches tall by 60 inches wide.
8. Construct enclosure of steel, not less than the following:
   a. Size Less Than 24 Inches: 0.053 inch thick.
   b. Size 24 Inches and Larger: 0.067 inch thick.
9. Finish enclosure with polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   a. Exterior color shall be.
   b. Interior color shall be manufacturer's standard.
10. Corner-formed door, full size of enclosure face, supported using multiple concealed hinges with easily removable hinge pins.
   a. Sizes through 24 Inches Tall: Two hinges.
   b. Sizes between 24 Inches through 48 Inches Tall: Three hinges.
   c. Sizes Larger 48 Inches Tall: Four hinges.
11. Double-door enclosures with overlapping door design to include unobstructed full-width access.
   a. Single-door enclosures 48 inches and taller, and all double-door enclosures, with three-point (top, middle and bottom) latch system.
12. Removable internal panel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
   a. Size Less Than 24 Inches: Solid or perforated steel, 0.053 inch thick.
b. Size 24 Inches and Larger: Solid aluminum, 0.10 inch or steel, 0.093 inch thick.

13. Internal panel mounting studs with hardware, grounding hardware, and sealing washers.
15. Thermoplastic pocket on inside of door for record Drawings and Product Data.

E. Wall-Mounted, NEMA 250, Type 4X SS:

1. Manufacturers – similar to Hoffman or approved equal
2. Enclosure shall be NRTL listed according to UL 508A.
3. Seam and joints are continuously welded and ground smooth.
4. Externally formed body flange around perimeter of enclosure face for continuous perimeter seamless gasket door seal.
5. Construct enclosure of Type 304 stainless steel, not less than the following:
   a. Size Less Than 24 Inches: 0.053 inch thick.
   b. Size 24 Inches and Larger: 0.067 inch thick.
6. Outside body and door of enclosure with brushed No. 4 finish.
7. Corner-formed door, full size of enclosure face, supported using continuous piano hinge full length of door.
8. Removable internal panel shall be 0.093-inch solid steel with a white polyester powder coating that is electrostatically applied and then baked to bond to substrate.
9. Internal panel mounting studs and hardware, grounding hardware, and sealing washers.
10. Install corrosion-resistant polyester vent drain in a stainless-steel sleeve at the bottom of enclosure.
11. Include enclosure with stainless-steel mounting brackets.

F. Accessories:

1. Electric Heater:
   a. Aluminum housing with brushed finish.
   b. Thermostatic control with adjustable set point from zero to 100 deg F.
   c. Capacity: 100, 200, 400, and 800 W as required by application.
   d. Fan draws cool air from bottom of enclosure and passes air across thermostat and heating elements before being released into enclosure cavity. Heated air is discharged through the top of heater.

2. Ventilation Fans, Filtered Intake and Exhaust Grilles:
   a. Number and size of fans, filters and grilles as required by application.
   b. Compact cooling fans engineered for 50,000 hours of continuous operation without lubrication or service.
   c. Fans capable of being installed on any surface and in any position within enclosure for spot cooling or air circulation.
   d. Thermostatic control with adjustable set point from 32 to 140 deg F.
   e. Airflow Capacity at Zero Pressure:
      1) 4-Inch Fan: 100 cfm.
      2) 6-Inch Fan: 240 cfm.
      3) 10-Inch Fan: 560 cfm.
   f. Maximum operating temperature of 158 deg F.
g. 4-inch fan thermally protected and provided with permanently lubricated ball-bearings.

h. 6- and 10-inch fans with ball-bearing construction and split capacitor motors thermally protected to avoid premature failure.

i. Dynamically balanced impellers molded from polycarbonate material.

j. Fan furnished with power cord and polarized plug for power connection.

k. Fan brackets, finger guards and mounting hardware provided with fans to complete installation.

l. Removable Intake and Exhaust Grilles: stainless steel of size to match fan size and suitable for NEMA 250, Types 1 and 12 enclosures.

m. Filters for NEMA 250, Type 12 Enclosures: Disposable, of a size to match intake grille.

3. Air Conditioner:

a. Electric-powered, self-contained air-conditioning unit specially designed for electrical enclosures to maintain temperature inside enclosure below ambient temperature outside enclosure.

b. Thermostatic control with adjustable set point from 60 to 120 deg F.

c. Enclosure side or top mounting with unit capacity as required by application.

d. Designed for closed-loop cooling with continuous operation in ambient environments up to 125 deg F.

e. HFC refrigerant.

f. Reusable and washable air filter.

g. High-performance, industrial-grade, and high-efficiency fans.

h. Furnished with power cord and polarized plug for power connection.

i. Condensate management system with base pan side drain.

j. Mounting hardware, gaskets, mounting template and instruction manual furnished with unit.

k. Outdoor units equipped with head pressure control for low ambient operation, compressor heater, coated condenser coil and thermostat.

4. Thermoelectric Humidifier:

a. ABS plastic enclosure.

b. Capacity of 8 oz. of water per 24 hours.

c. Built-in drain captures moisture and plastic hose directs moisture to outside enclosure through a drain.

d. Controlled to maintain enclosure relative humidity at an adjustable set point.

e. Unit power supply shall be internally wired to enclosure electrical power source.

5. Framed Fixed Window Kit for NEMA 250, Types 4, 4X, and 12 Enclosures:

a. 0.25-inch-thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.

b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.

c. Window kit shall be factory or shop installed before shipment to Project.

6. Frame Fixed or Hinged Window Kit for NEMA 250, Types 1 and 12 Enclosures:

a. 0.25-inch-thick, scratch-resistant acrylic or polycarbonate window mounted in a metal frame matching adjacent door material.

b. Enclosure types, except NEMA 250 Type 1, shall have a continuous gasket material around perimeter of window and frame to provide watertight seal.

c. Window kit shall be factory or shop installed before shipment to Project.

7. Bar handle with keyed cylinder lock set.
2.22 RELAYS

A. General-Purpose Relays:
   1. Relays shall be heavy duty and rated for at least 10 A at 250-V ac and 60 Hz.
   2. Relays shall be either double pole double throw (DPDT) or three-pole double throw, depending on the control application.
   3. Use a plug-in-style relay with an eight-pin octal plug for DPDT relays and an 11-pin octal plug for three-pole double-throw relays.
   4. Construct the contacts of either silver cadmium oxide or gold.
   5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
   6. Relays shall have LED indication and a manual reset and push-to-test button.
   7. Performance:
      a. Mechanical Life: At least 10 million cycles.
      b. Electrical Life: At least 100,000 cycles at rated load.
      c. Pickup Time: 15 ms or less.
      d. Dropout Time: 10 ms or less.
      e. Pull-in Voltage: 85 percent of rated voltage.
      f. Dropout Voltage: 50 percent of nominal rated voltage.
      g. Power Consumption: 2 VA.
      h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
   8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
   9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
   10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

B. Multifunction Time-Delay Relays:
   1. Relays shall be continuous duty and rated for at least 10 A at 240-V ac and 60 Hz.
   2. Relays shall be DPDT relay with up to eight programmable functions to provide on/off delay, interval and recycle timing functions.
   3. Use a plug-in-style relay with either an 8- or 11-pin octal plug.
   4. Construct the contacts of either silver cadmium oxide or gold.
   5. Enclose the relay in a dust-tight cover.
   6. Include knob and dial scale for setting delay time.
   7. Performance:
      a. Mechanical Life: At least 10 million cycles.
      b. Electrical Life: At least 100,000 cycles at rated load.
      c. Timing Ranges: Multiple ranges from 0.1 seconds to 100 minutes.
      d. Repeatability: Within 2 percent.
      e. Recycle Time: 45 ms.
      f. Minimum Pulse Width Control: 50 ms.
      g. Power Consumption: 5 VA or less at 120-V ac.
      h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
   8. Equip relays with coil transient suppression to limit transients to non-damaging levels.
   9. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
   10. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.
C.  Latching Relays:
   1. Relays shall be continuous duty and rated for at least 10 A at 250-V ac and 60 Hz.
   2. Relays shall be either DPDT or three-pole double throw, depending on the control application.
   3. Use a plug-in-style relay with a multibladed plug.
   4. Construct the contacts of either silver cadmium oxide or gold.
   5. Enclose the relay in a clear transparent polycarbonate dust-tight cover.
   6. Performance:
      a. Mechanical Life: At least 10 million cycles.
      b. Electrical Life: At least 100,000 cycles at rated load.
      c. Pickup Time: 15 ms or less.
      d. Dropout Time: 10 ms or less.
      e. Pull-in Voltage: 85 percent of rated voltage.
      f. Dropout Voltage: 50 percent of nominal rated voltage.
      g. Power Consumption: 2 VA.
      h. Ambient Operating Temperatures: Minus 40 to 115 deg F.
   7. Equip relays with coil transient suppression to limit transients to non-damaging levels.
   8. Plug each relay into an industry-standard, 35-mm DIN rail socket. Plug all relays located in control panels into sockets that are mounted on a DIN rail.
   9. Relay socket shall have screw terminals. Mold into the socket the coincident screw terminal numbers and associated octal pin numbers.

D.  Current Sensing Relay:
   1. Monitors ac current.
   2. Independent adjustable controls for pickup and dropout current.
   3. Energized when supply voltage is present and current is above pickup setting.
   4. De-energizes when monitored current is below dropout current.
   5. Dropout current is adjustable from 50 to 95 percent of pickup current.
   6. Include a current transformer, if required for application.
   7. House current sensing relay and current transformer in its own enclosure. Use NEMA 250, Type 12 enclosure for indoors and NEMA 250, Type 4 for outdoors.

E.  Combination On-Off Status Sensor and On-Off Relay:
   1. Description:
      a. On-off control and status indication in a single device.
      b. LED status indication of activated relay and current trigger.
      c. Closed-Open-Auto override switch located on the load side of the relay.
   2. Performance:
      a. Ambient Temperature: Minus 30 to 140 deg F.
   3. Status Indication:
      a. Current Sensor: Integral sensing for single-phase loads up to 20 A and external solid or split sensing ring for three-phase loads up to 150 A.
      b. Current Sensor Range: As required by application.
      c. Current Set Point: Fixed or adjustable as required by application.
d. Current Sensor Output:

1) Solid-state, single-pole double-throw contact rated for 30-V ac and dc and for 0.4 A.
2) Solid-state, single-pole double-throw contact rated for 120-V ac and 1.0 A.
3) Analog, zero- to 5- or 10-V dc.
4) Analog, 4 to 20 mA, loop powered.

5. Enclosure: NEMA 250, Type 1 enclosure.

2.23 ELECTRICAL POWER DEVICES

A. Transformers:

1. Transformer shall be sized for the total connected load, plus an additional 25 percent of connected load.
2. Transformer shall be at least 100 VA.
3. Transformer shall have both primary and secondary fuses.

B. Power-Line Conditioner:

1. General Power-Line Conditioner Requirements:
   a. Design to ensure maximum reliability, serviceability and performance.
   b. Overall function of the power-line conditioner is to receive raw, polluted electrical power and purify it for use by electronic equipment. The power-line conditioner shall provide isolated, regulated, transient and noise-free sinusoidal power to loads served.

   2. Standards: NRTL listed per UL 1012.
   3. Performance:
      a. Single phase, continuous, 100 percent duty rated KVA/KW capacity. Design to supply power for linear or nonlinear, high crest factor, resistive and reactive loads.
      b. Automatically regulate output voltage to within 2 percent or better with input voltage fluctuations of plus 10 to minus 20 percent of nominal when system is loaded 100 percent. Use Variable Range Regulation to obtain improved line voltage regulation when operating under less than full load conditions.

      1) At 75 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 35 percent of nominal.
      2) At 50 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 40 percent of nominal.
      3) At 25 Percent Load: Output voltage automatically regulated to within 3 percent with input voltage fluctuations of plus 10 to minus 45 percent of nominal.

   c. With input voltage distortion of up to 40 percent, limit the output voltage sine wave to a maximum harmonic content of 5 percent.
   d. Automatically regulate output voltage to within 2.5 percent when load (resistive) changes from zero percent to 100 percent to zero percent.
e. Output voltage returns to 95 percent of nominal level within two cycles and to 100 percent within three cycles when the output is taken from no load to full resistive load or vice-versa. Recovery from partial resistive load changes is corrected in a shorter period of time.

f. K Factor: 30, designed to operate with nonlinear, non-sinusoidal, high crest factor loads without overheating.

g. Input power factor within 0.95 approaching unity with load power factor as poor as 0.6.

h. Attenuate load-generated odd current harmonics 23 dB at the input.

i. Electrically isolate the primary from the secondary. Meet isolation criteria as defined in NFPA 70, Article 250-5D.

j. Lighting and Surge Protection: Compares to UL 1449 rating of 330 V when subjected to Category B3 (6000 V/3000 A) combination waveform as established by IEEE C62.41.

k. Common-mode noise attenuation of 140 dB.

l. Transverse-mode noise attenuation of 120 dB.

m. With loss of input power for up to 16.6 ms, the output sine wave remains at usable ac voltage levels.

n. Reliability of 200,000 hours' MTBF.

o. At full load, when measured at 1-m distance, audible noise is not to exceed 54 dB.

p. Approximately 92 percent efficient at full load.

4. Transformer Construction:

a. Ferroresonant, dry type, convection cooled, 600V class. Transformer windings of Class H (220 deg C) insulated copper.

b. Use a Class H installation system throughout with operating temperatures not to exceed 150 deg C over a 40-deg C ambient temperature.

c. Configure transformer primary for multi-input voltage. Include input terminals for source conductors and ground.

d. Manufacture transformer core using M-6 grade, grain-oriented, stress-relieved transformer steel.

e. Configure transformer secondary in a 240/120-V split with a 208-V tap or straight 120 V, depending on power output size.

f. Electrically isolate the transformer secondary windings from the primary windings. Bond neutral conductor to cabinet enclosure and output neutral terminal.

g. Include interface terminals for output power hot, neutral and ground conductors.

h. Label leads, wires and terminals to correspond with circuit wiring diagram.

i. Vacuum impregnate transformer with epoxy resin.

5. Cabinet Construction:

a. Design for panel or floor mounting.

b. NEMA 250, Type 1, general-purpose, indoor enclosure.

c. Manufacture the cabinet from heavy gauge steel complying with UL 50.

d. Include a textured baked-on paint finish.

C. Transient Voltage Suppression and High-Frequency Noise Filter Unit:

1. The maximum continuous operating voltage shall be at least 125 percent.

2. The operating frequency range shall be 47 to 63 Hz.

3. Protection modes according to NEMA LS-1.

4. The rated single-pulse surge current capacity, for each mode of protection, shall be no less than the following:

a. Line to Neutral: 45,000 A.

b. Neutral to Ground: 45,000 A.

c. Line to Ground: 45,000 A.

d. Per Phase: 90,000 A.
5. Clamping voltages shall be in compliance with test and evaluation procedures defined in NEMA LS-1. Maximum clamping voltage shall be as follows:

a. Line to Neutral: 360 V.
b. Line to Ground: 360 V.
c. Neutral to Ground: 360 V.

6. Electromagnetic interference and RF interference noise rejection or attenuation values shall comply with test and evaluation procedures defined in NEMA LS-1.

a. Line to Neutral:
   1) 100 kHz: 42 dB.
   2) 1 MHz: 25 dB.
   3) 10 MHz: 21 dB.
   4) 100 MHz: 36 dB.

b. Line to Ground:
   1) 100 kHz: 16 dB.
   2) 1 MHz: 55 dB.
   3) 10 MHz: 81 dB.
   4) 100 MHz: 80 dB.

7. Unit shall have LED status indicator that extinguishes to indicate a failure.
8. Unit shall be listed by an NRTL as a transient voltage surge suppressor per UL 1449, and as an electromagnetic interference filter per UL 1283.
9. Unit shall not generate any appreciable magnetic field.
10. Unit shall not generate an audible noise.

D. DC Power Supply:

1. Plug-in style suitable for mating with a standard eight-pin octal socket. Include the power supply with a mating mounting socket.
2. Enclose circuitry in a housing.
3. Include both line and load regulation to ensure a stable output. To protect both the power supply and the load, power supply shall have an automatic current limiting circuit.
4. Performance:
   a. Output voltage nominally 25-V dc within 5 percent.
   b. Output current up to 100 mA.
   c. Input voltage nominally 120-V ac, 60 Hz.
   d. Load regulation within 0.5 percent from zero- to 100-mA load.
   e. Line regulation within 0.5 percent at a 100-mA load for a 10 percent line change.
   f. Stability within 0.1 percent of rated volts for 24 hours after a 20-minute warmup.

2.24 UNINTERRUPTABLE POWER SUPPLY (UPS) UNITS

A. 250 through 1000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.
a. Larger-capacity units shall be provided for systems with larger connected loads.
b. UPS shall provide five minutes of battery power.

3. Performance:

a. Input Voltage: Single phase, 120- or 230-V ac, compatible with field power source.
b. Load Power Factor Range (Crest Factor): 0.65 to 1.0.
c. Output Voltage: 101- to 132-V ac, while input voltage varies between 89 and 152-V ac.
d. On Battery Output Voltage: Sine wave.
e. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
f. Recharge time shall be a maximum of six hours to 90 percent capacity after full discharge to cutoff.
g. Transfer Time: 6 ms.
h. Surge Voltage Withstand Capacity: IEEE C62.41, Categories A and B; 6 kV/200 and 500 A; 100-kHz ringwave.

4. UPS shall be automatic during fault or overload conditions.
5. Unit with integral line-interactive, power condition topology to eliminate all power contaminants.
6. Include front panel with power switch and visual indication of power, battery, fault and temperature.
7. Unit shall include an audible alarm of faults and front panel silence feature.
8. Unit with four NEMA WD 1, NEMA WD 6 Configuration 5-15R receptacles.
9. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
10. Batteries shall be sealed lead-acid type and be maintenance free. Battery replacement shall be front accessible by user without dropping load.
11. Include tower models installed in ventilated cabinets to the particular installation location.

B. 1000 through 3000 VA:

1. UPS units shall provide continuous, regulated output power without using their batteries during brown-out, surge, and spike conditions.
2. Load served shall not exceed 75 percent of UPS rated capacity, including power factor of connected loads.

a. Larger-capacity units, or multiple units, shall be provided for systems with larger connected loads.
b. UPS shall provide five minutes of battery power.

3. Performance:

a. Input Voltage: Single phase, 120-V ac, plus 20 to minus 30 percent.
b. Power Factor: Minimum 0.97 at full load.
c. Output Voltage: Single phase, 120-V ac, within 3 percent, steady state with rated output current of 10.0 A, 30.0-A peak.
d. Inverter overload capacity shall be minimum 150 percent for 30 seconds.
e. Recharge time shall be a maximum of eight hours to 90 percent capacity.

4. UPS bypass shall be automatic during fault or overload conditions.
5. UPS shall include dry contacts (digital output points) for low battery condition and battery-on (primary utility power failure) and connect the points to the DDC system.
6. Batteries shall be sealed lead-acid type and be maintenance free.
7. Include tower models installed in ventilated cabinets or rack models installed on matching racks, as applicable to the particular installation location and space availability/configuration.
2.25 CONTROL WIRE AND CABLE

A. Wire: Single conductor control wiring above 24 V.
   1. Wire size shall be at least No. 16 AWG.
   2. Conductor shall be 7/24 soft annealed copper strand with 2- to 2.5-inch lay.
   3. Conductor insulation shall be 600 V, Type THWN or Type THHN, and 90 deg C according to UL 83.
   4. Conductor colors shall be black (hot), white (neutral), and green (ground).
   5. Furnish wire on spools.

B. Single Twisted Shielded Instrumentation Cable above 24 V:
   1. Wire size shall be a minimum No. 20 AWG.
   2. Conductors shall be a twisted, 7/24 soft annealed copper strand with a 2- to 2.5-inch lay.
   3. Conductor insulation shall have a Type THHN/THWN or Type TFN rating.
   4. Shielding shall be 100 percent type, 0.35/0.5-mil aluminum/Mylar tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
   5. Outer jacket insulation shall have a 600-V, 90-deg C rating and shall be Type TC cable.
   6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
   7. Furnish wire on spools.

C. Single Twisted Shielded Instrumentation Cable 24 V and Less:
   1. Wire size shall be a minimum No. 20 AWG.
   2. Conductors shall be a twisted, 7/24 soft annealed copper stranding with a 2- to 2.5-inch lay.
   3. Conductor insulation shall have a nominal 15-mil thickness, constructed from flame-retardant PVC.
   4. Shielding shall be 100 percent type, 1.35-mil aluminum/polymer tape, helically applied with 25 percent overlap, and aluminum side in with tinned copper drain wire.
   5. Outer jacket insulation shall have a 300-V, 105-deg C rating and shall be Type PLTC cable.
   6. For twisted pair, conductor colors shall be black and white. For twisted triad, conductor colors shall be black, red and white.
   7. Furnish wire on spools.

D. LAN and Communication Cable: Comply with DDC system manufacturer requirements for network being installed.
   1. Cable shall be plenum rated.
   2. Cable shall comply with NFPA 70.
   3. Cable shall have a unique color that is different from other cables used on Project.
   4. Copper Cable for Ethernet Network:
      a. 100BASE-TX 1000BASE-T or 1000BASE-TX.
      b. TIA/EIA 586, Category 5e or Category 6.
      c. Minimum No. 22 AWG solid.
      d. Shielded Twisted Pair (STP) or Unshielded Twisted Pair (UTP).
      e. Thermoplastic insulated conductors, enclosed in a thermoplastic outer jacket, Class CMP as plenum rated.
2.26 RACEWAYS FOR CONTROL WIRING, CABLING, AND TUBING

A. Metal Conduits, Tubing, and Fittings:

1. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. GRC: Comply with NEMA ANSI C80.1 and UL 6.
3. IMC: Comply with NEMA ANSI C80.6 and UL 1242.
4. PVC-Coated Steel Conduit: PVC-coated rigid steel conduit.
   a. Comply with NEMA RN 1.
   b. Coating Thickness: 0.040 inch, minimum.
5. EMT: Comply with NEMA ANSI C80.3 and UL 797.
6. FMC: Comply with UL 1; zinc-coated steel.
7. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
8. Fittings for Metal Conduit: Comply with NEMA ANSI FB 1 and UL 514B.
   a. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 1203 and NFPA 70.
   b. Fittings for EMT:
      1) Material: Steel.
      2) Type: Setscrew.
   c. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
   d. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch, with overlapping sleeves protecting threaded joints.
9. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

B. Metal Wireways and Auxiliary Gutters:

1. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 4 unless otherwise indicated, and sized according to NFPA 70.
   a. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
   b. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.
   c. Wireway Covers: Screw-cover type unless otherwise indicated.
   d. Finish: Manufacturer's standard enamel finish.

C. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Prime coated, ready for field painting.
2.27 CONTROL POWER WIRING AND RACEWAYS

A. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" electrical power conductors and cables.

B. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

2.28 FIBER-OPTIC CABLE, CONNECTORS, AND RACEWAY

A. Cables:
   1. Performance Requirements:
      a. Fiber: Multimode graded index. Core/cladding size shall be either 62.5/125 or 100/140 micrometers.
      b. Numerical Aperture:
         1) 62.5/125 Micrometer Fiber: 0.275 plus or minus 0.015.
         2) 100/140 Micrometer Fiber: 0.29 plus or minus 0.015.
      c. Maximum Attenuation:
         1) 850 nm: 6.0 dB/km.
         2) 1300 nm: 5.0 dB/km.
      d. Minimum Bandwidth Dispersion: 300 Mhz-km at 850 nm.
      e. Core/Cladding Index Difference: 0.3 percent plus or minus 0.05 percent, measured using refractive rear field measurement procedure.
      f. Color-code finished fibers for easy identification.
      g. Splice Loss: Fibers shall be spliced together to form a longer fiber using a commercially available fiber splicing machine recommended by cable manufacturer. Maximum loss per fiber splice shall be 0.20 dB.
      h. Connection: Fibers shall be connected using fiber-optic connectors. Nominal connector loss shall not be greater than 1 dB.
      i. Fiber-optic cable shall be suitable for use with 100Base-FX or 100Base-SX standard (as applicable) as defined in IEEE 802.3.

   2. Mechanical and Environmental Requirements:
      a. Tensile Strength: Fiber cable shall withstand a minimum tensile strength of 2700 N with maximum elongation of less than 0.5 percent.
      b. Bending Radius: Minimum static bending radius for cable shall be 10 times outside diameter for non-armored cables and 20 times outside diameter for armored cables. Non-armored cables shall withstand being flexed at minimum static bending radius plus or minus 90 degrees for at least 20 cycles at 20 to 40 cycles per minute at 20 deg C. Armored cables shall withstand being flexed at minimum static bending radius plus or minus 90 degrees for at least 10 cycles at 20 to 40 cycles per minute at 20 deg C.
      c. Vibration: Cable shall withstand a vibration test with vibration amplitude of 5 mm and frequency of 10 cycles per second for at least five hours.
      d. Twist: Cable shall withstand twisting of 360 degrees over a length of 2 m for at least 10 cycles at 10 cycles per minute.
      e. Temperature: Cable shall withstand the following temperatures:
1) Installation: Minus 30 to 70 deg C.
2) Operation: Minus 40 to 70 deg C.
3) Storage/Shipping: Minus 40 to 70 deg C.

f. Lifetime: Average lifetime of a 2-km, 12-fiber cable shall be at least 20 years when installed in a natural ambient environment. End of useful life shall be reached if failing to comply with requirements indicated or a spontaneous catastrophic fiber failure.
g. Crush Resistance: Cable shall withstand a compressive force of 705 N/cm for armored cables and 600 N/cm for non-armored cables. There shall be no attenuation increase after force is removed.

3. Cable Structure:
   a. Number of Fibers: Supply the required number of fibers in each cable for DDC system indicated, plus not less than 50 percent spare. Cable structure shall have fibers grouped for easy handling.
   b. Strength Members: Include cable with strength members to satisfy mechanical and environmental conditions indicated.
   c. Cable Core: Core shall consist of stranded buffer tubes around a central member of appropriate geometric size and shall be filled and bound to maintain core integrity. A fibrous strength member may be stranded around core to provide necessary strength for cable.
   d. Cable Jacket: Protect cable by an extruded-polyethylene jacket.
   e. Cable Armor: For cables requiring extra mechanical protection, one or two layers of galvanized corrugated steel tape coated by an anticorrosive compound shall be either helically or longitudinally applied over standard outer jacket. Apply a second outer jacket of polyethylene over coated steel tape. Thickness of sheaths and jackets are not specified as long as mechanical and environmental conditions are satisfied.
   f. Cable Installation: Cables shall be suitable for a semiprotected outdoor installation.

4. Packaging and Shipping:
   a. Seal both ends of each length of cable.
   b. Test individual fibers in each cable before shipping to verify compliance with Specifications.

B. Connectors:
   1. Performance Requirements:
      a. Type: Fiber-optic connectors shall be either Type ST or Type SMA. Use either connector type exclusively. No substitutions are allowed.
      b. Insertion Loss: Connector shall have an insertion loss of not greater than 1 dB.
      c. Coupling Tolerance: Connector shall withstand at least 500 couplings with insertion loss within 0.25-dB tolerance limit.
      d. Mechanical Requirements:
         1) Connector shall enclose outermost coating of single fiber cable and be able to be mated or unmated without using a tool.
         2) Mount connector rigidly in a metal frame.
         3) Connector shall allow a semiskilled person to properly install connector to a single fiber easily in a field environment with simple tools.

C. Splice Organizer Cabinet:
   1. Minimum Capacity: Each splice organizer shall accommodate number of connectors required for DDC system indicated, plus 100 percent spare.
   2. Mounting: Wall mount the splice organizer cabinet.
D. Raceways:
   1. Mechanical and Performance Requirements:
      a. Construction: Nonmetallic, flexible raceway system manufactured specifically for routing fiber-optic cables.
      b. Suitable for use in return-air plenums, air-handling rooms, above ceilings and under access floors.
      c. Exhibit low smoke generation and flame-spread characteristics, and have high-temperature service tolerance.
      d. Size raceway according to NFPA 70 requirements for communications cables.
      e. Tensile Strength at Yield: 10,800 psi.
      f. Elongation at Break: 25 percent.

E. Cable Identification:
   1. Labeling product shall be self-laminating cable marker.
   2. Cable labeling shall include numeric designation, source, destination, and cable type.

2.29 ACCESSORIES
A. Damper Blade Limit Switches:
   1. Sense positive open and/or closed position of the damper blades.
   2. NEMA 250, Type 13, oil-tight construction.
   3. Arrange for the mounting application.
   4. Additional waterproof enclosure when required by its environment.
   5. Arrange to prevent "over-center" operation.

2.30 IDENTIFICATION
A. Control Equipment, Instruments, and Control Devices:
   1. Engraved tag bearing unique identification.
      a. Include instruments with unique identification identified by equipment being controlled or monitored, followed by point identification.
   2. Letter size shall be as follows:
      a. Operator Workstations: Minimum of 0.5 inch high.
      b. Servers: Minimum of 0.5 inch high.
      c. Printers: Minimum of 0.5 inch high.
      d. DDC Controllers: Minimum of 0.5 inch high.
      e. Gateways: Minimum of 0.5 inch high.
      f. Repeaters: Minimum of 0.5 inch high.
      g. Enclosures: Minimum of 0.5 inch high.
      h. Electrical Power Devices: Minimum of 0.25 inch high.
      i. UPS units: Minimum of 0.5 inch high.
      j. Accessories: Minimum of 0.25 inch high.
      k. Instruments: Minimum of 0.25 inch high.
      l. Control Damper and Valve Actuators: Minimum of 0.25 inch high.
   3. Tag shall consist of white lettering on black background.
4. Tag shall be engraved phenolic consisting of three layers of rigid laminate. Top and bottom layers are color-coded black with contrasting white center exposed by engraving through outer layer.
5. Tag shall be fastened with drive pins.
6. Instruments, control devices and actuators with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

B. Valve Tags:

1. Brass tags and brass chains attached to valve.
2. Tags shall be at least 1.5 inches in diameter.
3. Include tag with unique valve identification indicating control influence such as flow, level, pressure, or temperature; followed by location of valve, and followed by three-digit sequential number. For example: TV-1.001.
4. Valves with Project-specific identification tags having unique identification numbers following requirements indicated and provided by original manufacturer do not require an additional tag.

C. Raceway and Boxes:

1. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."
2. Paint cover plates on junction boxes and conduit same color as the tape banding for conduits. After painting, label cover plate "HVAC Controls," using an engraved phenolic tag.

D. Equipment Warning Labels:

1. Acrylic label with pressure-sensitive adhesive back and peel-off protective jacket.
2. Lettering size shall be at least 14-point type with white lettering on red background.
3. Warning label shall read "CAUTION-Equipment operated under remote automatic control and may start or stop at any time without warning. Switch electric power disconnecting means to OFF position before servicing."
4. Lettering shall be enclosed in a white line border. Edge of label shall extend at least 0.25 inch beyond white border.

2.31 SOURCE QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to evaluate the following according to industry standards for each product, and to verify DDC system reliability specified in performance requirements:

1. DDC controllers.
2. Gateways.
3. Routers.
4. Operator workstations.

B. Product(s) and material(s) will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.
PART 3 - EXECUTION

3.01 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify compatibility with and suitability of substrates.

B. Examine roughing-in for products to verify actual locations of connections before installation.

1. Examine roughing-in for instruments installed in piping to verify actual locations of connections before installation.
2. Examine roughing-in for instruments installed in duct systems to verify actual locations of connections before installation.

C. Examine walls, floors, roofs, and ceilings for suitable conditions where product will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.

E. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 DDC SYSTEM INTERFACE WITH OTHER SYSTEMS AND EQUIPMENT

A. Communication Interface to Equipment with Integral Controls:

1. DDC system shall have communication interface with equipment having integral controls and having a communication interface for remote monitoring or control.

B. Communication Interface to Other Building Systems:

1. DDC system shall have a communication interface with systems having a communication interface.

3.03 CONTROL DEVICES FOR INSTALLATION BY INSTALLERS

A. Deliver selected control devices, specified in indicated HVAC instrumentation and control device Sections, to identified equipment and systems manufacturers for factory installation and to identified installers for field installation.

B. Deliver the following to duct fabricator and Installer for installation in ductwork. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control dampers
2. Airflow sensors and switches
3. Pressure sensors

C. Deliver the following to plumbing and HVAC piping installers for installation in piping. Include installation instructions to Installer and supervise installation for compliance with requirements.

1. DDC control valves
2. Pipe-mounted flow meters
3. Pipe-mounted sensors
4. Tank-mounted sensors, switches and transmitters. Pressure sensors, switches, and transmitters
5. Pipe- and tank-mounted thermowells

3.04 GENERAL INSTALLATION REQUIREMENTS

A. Install products to satisfy more stringent of all requirements indicated.

B. Install products level, plumb, parallel, and perpendicular with building construction.

C. Support products, tubing, piping wiring and raceways. Brace products to prevent lateral movement and sway or a break in attachment when subjected to a \(<\text{Insert value}\>\text{ force}.

D. If codes and referenced standards are more stringent than requirements indicated, comply with requirements in codes and referenced standards.

E. Fabricate openings and install sleeves in ceilings, floors, roof, and walls required by installation of products. Before proceeding with drilling, punching, and cutting, check for concealed work to avoid damage. Patch, flash, grout, seal, and refinish openings to match adjacent condition.

F. Firestop penetrations made in fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

G. Seal penetrations made in acoustically rated assemblies. Comply with requirements in Section 079200 "Joint Sealants."

H. Welding Requirements:
   1. Restrict welding and burning to supports and bracing.
   2. No equipment shall be cut or welded without approval. Welding or cutting will not be approved if there is risk of damage to adjacent Work.
   3. Welding, where approved, shall be by inert-gas electric arc process and shall be performed by qualified welders according to applicable welding codes.
   4. If requested on-site, show satisfactory evidence of welder certificates indicating ability to perform welding work intended.

I. Fastening Hardware:
   1. Stillson wrenches, pliers, and other tools that damage surfaces of rods, nuts, and other parts are prohibited for work of assembling and tightening fasteners.
   2. Tighten bolts and nuts firmly and uniformly. Do not overstress threads by excessive force or by oversized wrenches.
   3. Lubricate threads of bolts, nuts and screws with graphite and oil before assembly.

J. If product locations are not indicated, install products in locations that are accessible and that will permit service and maintenance from floor, equipment platforms, or catwalks without removal of permanently installed furniture and equipment.

K. Corrosive Environments:
   1. Avoid or limit use of materials in corrosive airstreams and environments, including, but not limited to, the following:
a. Laboratory exhaust-air streams.
b. Process exhaust-air streams.

2. When conduit is in contact with a corrosive airstream and environment, use Type 316 stainless-steel conduit and fittings or conduit and fittings that are coated with a corrosive-resistant coating that is suitable for environment. Comply with requirements for installation of raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

3. Where instruments are located in a corrosive airstream and are not corrosive resistant from manufacturer, field install products in NEMA 250, Type 4X enclosure constructed of Type 316L stainless steel.

3.05 OPERATOR WORKSTATION INSTALLATION

A. Desktop Operator Workstations Installation:

1. Install operator workstation(s) at location(s) directed by Owner.
2. Install multiple-receptacle power strip with cord for use in connecting multiple workstation components to a single duplex electrical power receptacle.
3. Install software on workstation(s) and verify software functions properly.
4. Develop Project-specific graphics, trends, reports, logs and historical database.
5. Power workstation through a UPS unit. Locate UPS adjacent to workstation.

3.06 POT INSTALLATION

A. Install one portable operator terminal(s).

B. Turn over POTs to Owner at Substantial Completion.

C. Install software on each POT and verify that software functions properly.

3.07 PRINTER INSTALLATION

A. Provide the following printer(s) at location(s) directed by Owner:

B. Install printer software on workstations and verify that software functions properly.

3.08 GATEWAY INSTALLATION

A. Install gateways if required for DDC system communication interface requirements indicated.

1. Install gateway(s) required to suit indicated requirements.

B. Test gateway to verify that communication interface functions properly.

3.09 ROUTER INSTALLATION

A. Install routers if required for DDC system communication interface requirements indicated.

1. Install router(s) required to suit indicated requirements.
B. Test router to verify that communication interface functions properly.

3.10 CONTROLLER INSTALLATION

A. Install controllers in enclosures to comply with indicated requirements.

B. Connect controllers to field power supply and to UPS units where indicated.

C. Install controller with latest version of applicable software and configure to execute requirements indicated.

D. Test and adjust controllers to verify operation of connected I/O to achieve performance indicated requirements while executing sequences of operation.

E. Installation of Network Controllers:
   1. Quantity and location of network controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
   2. Install controllers in a protected location that is easily accessible by operators.
   3. Top of controller shall be within 72 inches of finished floor.

F. Installation of Programmable Application Controllers:
   1. Quantity and location of programmable application controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
   2. Install controllers in a protected location that is easily accessible by operators.
   3. Top of controller shall be within 72 inches of finished floor.

G. Application-Specific Controllers:
   1. Quantity and location of application-specific controllers shall be determined by DDC system manufacturer to satisfy requirements indicated.
   2. For controllers not mounted directly on equipment being controlled, install controllers in a protected location that is easily accessible by operators.

3.11 INSTALLATION OF WIRELESS ROUTERS FOR OPERATOR INTERFACE

A. Install wireless routers to achieve optimum performance and best possible coverage.

B. Mount wireless routers in a protected location that is within 60 inches of floor and easily accessible by operators.

C. Connect wireless routers to field power supply and to UPS units if network controllers are powered through UPS units.

D. Install wireless router with latest version of applicable software and configure wireless router with WPA2 security and password protection. Create access password with not less than 12 characters consisting of letters and numbers and at least one special character. Document password in operations and maintenance manuals for reference by operators.

E. Test and adjust wireless routers for proper operation with portable workstation and other wireless devices intended for use by operators.
3.12 ENCLOSURES INSTALLATION

A. Install the following items in enclosures, to comply with indicated requirements:

1. Gateways.
2. Routers.
3. Controllers.
4. Electrical power devices.
5. UPS units.
6. Relays.
7. Accessories.
8. Instruments.
9. Actuators

B. Attach wall-mounted enclosures to wall using the following types of steel struts:

1. For NEMA 250, Type 1 Enclosures: Use painted steel strut and hardware.
2. For NEMA 250, Type 4 and Type 4X Enclosures and Enclosures Located Outdoors: Use stainless-steel strut and hardware.
3. Install plastic caps on exposed cut edges of strut.

C. Align top or bottom of adjacent enclosures.

D. Install floor-mounted enclosures located in mechanical equipment rooms on concrete housekeeping pads. Attach enclosure legs using stainless-steel anchors.

E. Install continuous and fully accessible wireways to connect conduit, wire, and cable to multiple adjacent enclosures. Wireway used for application shall have protection equal to NEMA 250 rating of connected enclosures.

3.13 ELECTRIC POWER CONNECTIONS

A. Connect electrical power to DDC system products requiring electrical power connections.

B. Design of electrical power to products not indicated with electric power is delegated to DDC system provider and installing trade. Work shall comply with NFPA 70 and other requirements indicated.

C. Comply with requirements in Section 262816 "Enclosed Switches and Circuit Breakers" for electrical power circuit breakers.

D. Comply with requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables" for electrical power conductors and cables.

E. Comply with requirements in Section 260533 "Raceways and Boxes for Electrical Systems" for electrical power raceways and boxes.

3.14 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements in Section 260553 "Identification for Electrical Systems" for identification products and installation.

B. Install engraved phenolic nameplate with unique identification on face for each of the following:
1. Operator workstation.
2. Server.
3. Printer.
4. Gateway.
5. Router.
7. DDC controller.
8. Enclosure.
9. Electrical power device.
10. UPS unit.
11. Accessory.

C. Install engraved phenolic nameplate with unique instrument identification on face of each instrument connected to a DDC controller.

D. Install engraved phenolic nameplate with identification on face of each control damper and valve actuator connected to a DDC controller.

E. Where product is installed above accessible tile ceiling, also install matching engraved phenolic nameplate with identification on face of ceiling grid located directly below.

F. Where product is installed above an inaccessible ceiling, also install engraved phenolic nameplate with identification on face of access door directly below.

G. Warning Labels:

1. Shall be permanently attached to equipment that can be automatically started by DDC control system.
2. Shall be located in highly visible location near power service entry points.

3.15 NETWORK INSTALLATION

A. Install fiber-optic cable when connecting between the following network devices and when located in different buildings on campus, or when distance between devices exceeds 100 feet:

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

B. Install copper or fiber-optic cable when connecting between the following network devices:

1. Operator workstations.
2. Operator workstations and network controllers.
3. Network controllers.

C. Install copper cable when connecting between the following:

1. Gateways.
2. Gateways and network controllers or programmable application controllers.
3. Routers.
4. Routers and network controllers or programmable application controllers.
5. Network controllers and programmable application controllers.
6. Programmable application controllers.
7. Programmable application controllers and application-specific controllers.

D. Install network cable in continuous raceway.

1. Where indicated on Drawings, cable trays may be used for copper cable in lieu of conduit.

3.16 NETWORK NAMING AND NUMBERING

A. Coordinate with Owner and provide unique naming and addressing for networks and devices.

B. ASHRAE 135 Networks:

1. MAC Address:

   a. Every network device shall have an assigned and documented MAC address unique to its network.
   b. Ethernet Networks: Document MAC address assigned at its creation.
   c. ARCNET or MS/TP networks: Assign from 00 to 64.

2. Network Numbering:

   a. Assign unique numbers to each new network.
   b. Provide ability for changing network number through device switches or operator interface.
   c. DDC system, with all possible connected LANs, can contain up to 65,534 unique networks.

3. Device Object Identifier Property Number:

   a. Assign unique device object identifier property numbers or device instances for each device network.
   b. Provide for future modification of device instance number by device switches or operator interface.
   c. LAN shall support up to 4,194,302 unique devices.

4. Device Object Name Property Text:

   a. Device object name property field shall support 32 minimum printable characters.
   b. Assign unique device "Object Name" property names with plain-English descriptive names for each device.

      1) Example 1: Device object name for device controlling boiler plant at Building 1000 would be "HW System B1000."
      2) Example 2: Device object name for a VAV terminal unit controller could be "VAV unit 102."

5. Object Name Property Text for Other Than Device Objects:

   a. Object name property field shall support 32 minimum printable characters.
   b. Assign object name properties with plain-English names descriptive of application.

      1) Example 1: "Zone 1 Temperature."
      2) Example 2 "Fan Start and Stop."

6. Object Identifier Property Number for Other Than Device Objects:

   a. Assign object identifier property numbers according to Drawings or tables indicated.
b. If not indicated, object identifier property numbers may be assigned at Installer's discretion but must be approved by Owner in advance, be documented and be unique for like object types within device.

3.17 CONTROL WIRE, CABLE AND RACEWAYS INSTALLATION

A. Comply with NECA 1.

B. Comply with TIA 568-C.1.

C. Wiring Method: Install cables in raceways and cable trays except in accessible ceiling spaces and in gypsum board partitions where unenclosed wiring method may be used. Conceal raceway and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.
2. Comply with requirements for cable trays specified in Section 260536 "Cable Trays for Electrical Systems."
3. Comply with requirements for raceways and boxes specified in Section 260533 "Raceways and Boxes for Electrical Systems."

D. Wiring Method: Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

E. Field Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

F. Conduit Installation:

1. Install conduit expansion joints where conduit runs exceed 200 feet, and conduit crosses building expansion joints.
2. Coordinate conduit routing with other trades to avoid conflicts with ducts, pipes and equipment and service clearance.
3. Maintain at least 3-inch separation where conduits run axially above or below ducts and pipes.
4. Limit above-grade conduit runs to 100 feet without pull or junction box.
5. Do not install raceways or electrical items on any "explosion-relief" walls, or rotating equipment.
6. Do not fasten conduits onto the bottom side of a metal deck roof.
7. Flexible conduit is permitted only where flexibility and vibration control is required.
8. Limit flexible conduit to 3 feet long.
9. Conduit shall be continuous from outlet to outlet, from outlet to enclosures, pull and junction boxes, and shall be secured to boxes in such manner that each system shall be electrically continuous throughout.
10. Direct bury conduits underground or install in concrete-encased duct bank where indicated.

a. Use rigid, nonmetallic, Schedule 80 PVC.

b. Provide a burial depth according to NFPA 70, but not less than 24 inches.

11. Secure threaded conduit entering an instrument enclosure, cabinet, box, and trough, with a locknut on outside and inside, such that conduit system is electrically continuous throughout. Provide a metal bushing on inside with insulated throats. Locknuts shall be the type designed to bite into the metal or, on inside of enclosure, shall have a grounding wedge lug under locknut.
12. Conduit box-type connectors for conduit entering enclosures shall have an insulated throat.
13. Connect conduit entering enclosures in wet locations with box-type connectors or with watertight sealing locknuts or other fittings.
14. Offset conduits where entering surface-mounted equipment.
15. Seal conduit runs used by sealing fittings to prevent the circulation of air for the following:
   a. Conduit extending from interior to exterior of building.
   b. Conduit extending into pressurized duct and equipment.
   c. Conduit extending into pressurized zones that are automatically controlled to maintain different pressure set points.

G. Wire and Cable Installation:

1. Cables serving a common system may be grouped in a common raceway. Install control wiring and cable in separate raceway from power wiring. Do not group conductors from different systems or different voltages.
2. Install cables with protective sheathing that is waterproof and capable of withstanding continuous temperatures of 90 deg C with no measurable effect on physical and electrical properties of cable.
   a. Provide shielding to prevent interference and distortion from adjacent cables and equipment.

3. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
4. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIMM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
5. UTP Cable Installation:
   a. Comply with TIA 568-C.2.
   b. Do not untwist UTP cables more than 1/2 inch from the point of termination, to maintain cable geometry.

6. Installation of Cable Routed Exposed under Raised Floors:
   a. Install plenum-rated cable only.
   b. Install cabling after the flooring system has been installed in raised floor areas.
   c. Coil cable 6 feet long not less than 12 inches in diameter below each feed point.

7. Identify each wire on each end and at each terminal with a number-coded identification tag. Each wire shall have a unique tag.
8. Provide strain relief.
9. Terminate wiring in a junction box.
   a. Clamp cable over jacket in junction box.
   b. Individual conductors in the stripped section of the cable shall be slack between the clamping point and terminal block.

10. Terminate field wiring and cable not directly connected to instruments and control devices having integral wiring terminals using terminal blocks.
11. Install signal transmission components according to IEEE C2, REA Form 511a, NFPA 70, and as indicated.
12. Keep runs short. Allow extra length for connecting to terminal boards. Do not bend flexible coaxial cables in a radius less than 10 times the cable OD. Use sleeves or grommets to
13. Ground wire shall be copper and grounding methods shall comply with IEEE C2. Demonstrate ground resistance.

14. Wire and cable shall be continuous from terminal to terminal without splices.

15. Use insulated spade lugs for wire and cable connection to screw terminals.

16. Use shielded cable to transmitters.

17. Use shielded cable to temperature sensors.

18. Perform continuity and meager testing on wire and cable after installation.

19. Do not install bruised, kinked, scored, deformed, or abraded wire and cable. Remove and discard wire and cable if damaged during installation, and replace it with new cable.

20. Cold-Weather Installation: Bring cable to room temperature before dereeling. Heat lamps shall not be used for heating.

21. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

22. Protection from Electro-Magnetic Interference (EMI): Provide installation free of (EMI). As a minimum, comply with the following requirements:

   a. Comply with BICSI TDMM and TIA 569-C for separating unshielded cable from potential EMI sources, including electrical power lines and equipment.

   b. Separation between open cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

      1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches.
      2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches.

   c. Separation between cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

      1) Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches.
      2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches.

   d. Separation between cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

      1) Electrical Equipment Rating Less Than 2 kVA: No requirement.
      2) Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches.

   e. Separation between Cables and Electrical Motors and Transformers, 5 kVA or 5 HP and Larger: A minimum of 48 inches.

   f. Separation between Cables and Fluorescent Fixtures: A minimum of 5 inches.

3.18 FIBER-OPTIC CABLE SYSTEM INSTALLATION

A. Comply with TIA 568-C.3, except where requirements indicated are more stringent.

B. Raceway Installation:

   1. Install continuous raceway for routing fiber-optic cables.
   2. Install raceways continuously between pull boxes and junction boxes. Raceways shall enter and be secured to enclosures.
3. Make bends in raceway using large-radius preformed ells. Field bending shall be according to NFPA 70 minimum radii requirements. Use only equipment specifically designed for material and size involved.

4. Install no more than the equivalent of two 90-degree bends in any pathway run. Support within 12 inches of changes in direction. Use long radius elbows for all fiber-optic cables.

5. Entire raceway shall be complete and raceway interior cleaned before installation of fiber-optic cables.

6. Securely fasten raceway to building structure using clamps and clips designed for purpose.

7. Install nylon or polyethylene pulling line in raceways. Clearly label as "pulling line," indicating source and destination.

C. Fiber-Optic Cable Installation:

1. Route cables as efficiently as possible, minimizing amount of cable required.
2. Continuously lubricate cables during pulling-in process.
3. Do not exceed maximum pulling tensions provided by cable manufacturer. Monitor cable pulling tension with a mechanical tension meter.
4. Arrange cables passing through pull boxes to obtain maximum clearance among cables within box.
5. As cables emerge from intermediate point pull boxes, coil cable in a figure eight pattern with loops not less than 24 inches in diameter.
6. Terminate fiber-optic cables in a fiber-optic splice organizer cabinet, unless connected equipment can accept fiber-optic cables directly. Terminate cables with connectors.
7. Install and connect appropriate opto-electronic equipment and fiber jumper cables between opto-electronic equipment and fiber-optic cable system to DDC system fiber-optic cable system. Verify interface compatibility.

D. Cable and Raceway Identification:

1. Label cables at both ends. Labels shall be typed, not handwritten.
2. Mark raceways at each pull box indicating the type and number of cables within.

3.19 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and installations, including connections.

C. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Testing of Pneumatic and Air-Signal Tubing:
   a. Test for leaks and obstructions.
   b. Disconnect each pipe and tubing line before a test is performed, and blowout dust, dirt, trash, condensate and other foreign materials with compressed air. Use commercially pure compressed air or nitrogen as distributed in gas cylinders. Air from an oil-free compressor with an air dryer is an acceptable alternative for the test.
   c. After foreign matter is expelled and line is free from obstructions, plug far end of tubing run.
d. Connect a pressure source to near end of run with a needle valve between air supply and tubing run.

e. Connect a pressure gage accurate to within 0.5 percent of test between the shutoff needle valve and tubing run under test.

f. For system pressures above 30 psig, apply a pressure of 1.5 times operating pressure. Record pressure in tubing run every 10 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 1 psig.

g. For system pressures 30 psig and below, apply a pressure of 2.0 times operating pressure to piping and tubing run. Record pressure in tubing run every 5 minutes for one hour. Allowable drop in pressure in one-hour period shall not exceed 0.5 psig.

D. Testing:

1. Perform preinstallation, in-progress, and final tests, supplemented by additional tests, as necessary.

2. Preinstallation Cable Verification: Verify integrity and serviceability for new cable lengths before installation. This assurance may be provided by using vendor verification documents, testing, or other methods. As a minimum, furnish evidence of verification for cable attenuation and bandwidth parameters.

3. In-Progress Testing: Perform standard tests for correct pair identification and termination during installation to ensure proper installation and cable placement. Perform tests in addition to those specified if there is any reason to question condition of material furnished and installed. Testing accomplished is to be documented by agency conducting tests. Submit test results for Project record.

4. Final Testing: Perform final test of installed system to demonstrate acceptability as installed. Testing shall be performed according to a test plan supplied by DDC system manufacturer. Defective Work or material shall be corrected and retested. As a minimum, final testing for cable system, including spare cable, shall verify conformance of attenuation, length, and bandwidth parameters with performance indicated.

5. Test Equipment: Use a fiber-optic time domain reflectometer for testing of length and optical connectivity.

6. Test Results: Record test results and submit copy of test results for Project record.

3.20 DDC SYSTEM I/O CHECKOUT PROCEDURES

A. Check installed products before continuity tests, leak tests and calibration.

B. Check instruments for proper location and accessibility.

C. Check instruments for proper installation on direction of flow, elevation, orientation, insertion depth, or other applicable considerations that will impact performance.

D. Check instrument tubing for proper isolation, fittings, slope, dirt legs, drains, material and support.

E. For pneumatic products, verify that air supply for each product is properly installed.

F. Control Damper Checkout:

1. For pneumatic dampers, verify that pressure gages are provided in each air line to damper actuator and positioner.

2. Verify that control dampers are installed correctly for flow direction.

3. Verify that proper blade alignment, either parallel or opposed, has been provided.

4. Verify that damper frame attachment is properly secured and sealed.
5. Verify that damper actuator and linkage attachment is secure.
6. Verify that actuator wiring is complete, enclosed and connected to correct power source.
7. Verify that damper blade travel is unobstructed.

G. Control Valve Checkout:

1. For pneumatic valves, verify that pressure gages are provided in each air line to valve actuator and positioner.
2. Verify that control valves are installed correctly for flow direction.
3. Verify that valve body attachment is properly secured and sealed.
4. Verify that valve actuator and linkage attachment is secure.
5. Verify that actuator wiring is complete, enclosed and connected to correct power source.
6. Verify that valve ball, disc or plug travel is unobstructed.
7. After piping systems have been tested and put into service, but before insulating and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace the valve if leaks persist.

H. Instrument Checkout:

1. Verify that instrument is correctly installed for location, orientation, direction and operating clearances.
2. Verify that attachment is properly secured and sealed.
3. Verify that conduit connections are properly secured and sealed.
4. Verify that wiring is properly labeled with unique identification, correct type and size and is securely attached to proper terminals.
5. Inspect instrument tag against approved submittal.
6. For instruments with tubing connections, verify that tubing attachment is secure and isolation valves have been provided.
7. For flow instruments, verify that recommended upstream and downstream distances have been maintained.
8. For temperature instruments:
   a. Verify sensing element type and proper material.
   b. Verify length and insertion.

3.21 DDC SYSTEM I/O ADJUSTMENT, CALIBRATION AND TESTING:

A. Calibrate each instrument installed that is not factory calibrated and provided with calibration documentation.

B. Provide a written description of proposed field procedures and equipment for calibrating each type of instrument. Submit procedures before calibration and adjustment.

C. For each analog instrument, make a three-point test of calibration for both linearity and accuracy.

D. Equipment and procedures used for calibration shall comply with instrument manufacturer's written instructions.

E. Provide diagnostic and test equipment for calibration and adjustment.

F. Field instruments and equipment used to test and calibrate installed instruments shall have accuracy at least twice the instrument accuracy being calibrated. An installed instrument with an accuracy of 1 percent shall be checked by an instrument with an accuracy of 0.5 percent.
G. Calibrate each instrument according to instrument instruction manual supplied by manufacturer.

H. If after calibration indicated performance cannot be achieved, replace out-of-tolerance instruments.

I. Comply with field testing requirements and procedures indicated by ASHRAE’s Guideline 11, “Field Testing of HVAC Control Components,” in the absence of specific requirements, and to supplement requirements indicated.

J. Analog Signals:

1. Check analog voltage signals using a precision voltage meter at zero, 50, and 100 percent.
2. Check analog current signals using a precision current meter at zero, 50, and 100 percent.
3. Check resistance signals for temperature sensors at zero, 50, and 100 percent of operating span using a precision-resistant source.

K. Digital Signals:

1. Check digital signals using a jumper wire.
2. Check digital signals using an ohmmeter to test for contact making or breaking.

L. Control Dampers:

1. Stroke and adjust control dampers following manufacturer’s recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control dampers with pilot positioners. Adjust damper and positioner following manufacturer’s recommended procedure, so damper is 100 percent closed, 50 percent closed and 100 percent open at proper air pressure.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control dampers equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

M. Control Valves:

1. Stroke and adjust control valves following manufacturer’s recommended procedure, from 100 percent open to 100 percent closed and back to 100 percent open.
2. Stroke control valves with pilot positioners. Adjust valve and positioner following manufacturer’s recommended procedure, so valve is 100 percent closed, 50 percent closed and 100 percent open at proper air pressures.
3. Check and document open and close cycle times for applications with a cycle time less than 30 seconds.
4. For control valves equipped with positive position indication, check feedback signal at multiple positions to confirm proper position indication.

N. Meters: Check sensors at zero, 50, and 100 percent of Project design values.

O. Sensors: Check sensors at zero, 50, and 100 percent of Project design values.

P. Switches: Calibrate switches to make or break contact at set points indicated.

Q. Transmitters:

1. Check and calibrate transmitters at zero, 50, and 100 percent of Project design values.
2. Calibrate resistance temperature transmitters at zero, 50, and 100 percent of span using a precision-resistant source.

3.22 DDC SYSTEM CONTROLLER CHECKOUT

A. Verify power supply.
   1. Verify voltage, phase and hertz.
   2. Verify that protection from power surges is installed and functioning.
   3. Verify that ground fault protection is installed.
   4. If applicable, verify if connected to UPS unit.
   5. If applicable, verify if connected to a backup power source.
   6. If applicable, verify that power conditioning units, transient voltage suppression and high-frequency noise filter units are installed.

B. Verify that wire and cabling is properly secured to terminals and labeled with unique identification.

C. Verify that spare I/O capacity is provided.

3.23 DDC CONTROLLER I/O CONTROL LOOP TESTS

A. Testing:
   1. Test every I/O point connected to DDC controller to verify that safety and operating control set points are as indicated and as required to operate controlled system safely and at optimum performance.
   2. Test every I/O point throughout its full operating range.
   3. Test every control loop to verify operation is stable and accurate.
   4. Adjust control loop proportional, integral and derivative settings to achieve optimum performance while complying with performance requirements indicated. Document testing of each control loop's precision and stability via trend logs.
   5. Test and adjust every control loop for proper operation according to sequence of operation.
   6. Test software and hardware interlocks for proper operation. Correct deficiencies.
   7. Operate each analog point at the following:
      a. Upper quarter of range.
      b. Lower quarter of range.
      c. At midpoint of range.
   8. Exercise each binary point.
   9. For every I/O point in DDC system, read and record each value at operator workstation, at DDC controller and at field instrument simultaneously. Value displayed at operator workstation, at DDC controller and at field instrument shall match.
   10. Prepare and submit a report documenting results for each I/O point in DDC system and include in each I/O point a description of corrective measures and adjustments made to achieve desire results.

3.24 DDC SYSTEM VALIDATION TESTS

A. Perform validation tests before requesting final review of system. Before beginning testing, first submit Pretest Checklist and Test Plan.
B. After approval of Test Plan, execute all tests and procedures indicated in plan.

C. After testing is complete, submit completed test checklist.

D. Pretest Checklist: Submit the following list with items checked off once verified:

1. Detailed explanation for any items that are not completed or verified.
2. Required mechanical installation work is successfully completed and HVAC equipment is working correctly.
3. HVAC equipment motors operate below full-load amperage ratings.
4. Required DDC system components, wiring, and accessories are installed.
5. Installed DDC system architecture matches approved Drawings.
6. Control electric power circuits operate at proper voltage and are free from faults.
7. Required surge protection is installed.
8. DDC system network communications function properly, including uploading and downloading programming changes.
9. Using BACnet protocol analyzer, verify that communications are error free.
10. Each controller’s programming is backed up.
11. Equipment, products, tubing, wiring cable and conduits are properly labeled.
12. All I/O points are programmed into controllers.
13. Testing, adjusting and balancing work affecting controls is complete.
14. Dampers and actuators zero and span adjustments are set properly.
15. Each control damper and actuator goes to failed position on loss of power.
16. Valves and actuators zero and span adjustments are set properly.
17. Each control valve and actuator goes to failed position on loss of power.
18. Meter, sensor and transmitter readings are accurate and calibrated.
19. Control loops are tuned for smooth and stable operation.
20. View trend data where applicable.
21. Each controller works properly in standalone mode.
22. Safety controls and devices function properly.
23. Interfaces with fire-alarm system function properly.
24. Electrical interlocks function properly.
25. Operator workstations and other interfaces are delivered, all system and database software is installed, and graphic are created.
26. Record Drawings are completed.

E. Test Plan:

1. Prepare and submit a validation test plan including test procedures for performance validation tests.
2. Test plan shall address all specified functions of DDC system and sequences of operation.
3. Explain detailed actions and expected results to demonstrate compliance with requirements indicated.
4. Explain method for simulating necessary conditions of operation used to demonstrate performance.
5. Include a test checklist to be used to check and initial that each test has been successfully completed.
6. Submit test plan documentation 10 business days before start of tests.

F. Validation Test:

1. Verify operating performance of each I/O point in DDC system.

   a. Verify analog I/O points at operating value.
   b. Make adjustments to out-of-tolerance I/O points.
1) Identify I/O points for future reference.
2) Simulate abnormal conditions to demonstrate proper function of safety devices.
3) Replace instruments and controllers that cannot maintain performance indicated after adjustments.

2. Simulate conditions to demonstrate proper sequence of control.
3. Readjust settings to design values and observe ability of DDC system to establish desired conditions.
4. After 24 Hours following Initial Validation Test:
   a. Re-check I/O points that required corrections during initial test.
   b. Identify I/O points that still require additional correction and make corrections necessary to achieve desired results.

5. After 24 Hours of Second Validation Test:
   a. Re-check I/O points that required corrections during second test.
   b. Continue validation testing until I/O point is normal on two consecutive tests.

6. Completely check out, calibrate, and test all connected hardware and software to ensure that DDC system performs according to requirements indicated.
7. After validation testing is complete, prepare and submit a report indicating all I/O points that required correction and how many validation re-tests it took to pass. Identify adjustments made for each test and indicate instruments that were replaced.

G. DDC System Response Time Test:
1. Simulate HLC.
   a. Heavy load shall be an occurrence of 50 percent of total connected binary COV, one-half of which represent an "alarm" condition, and 50 percent of total connected analog COV, one-half of which represent an "alarm" condition, that are initiated simultaneously on a one-time basis.

   2. Initiate 10 successive occurrences of HLC and measure response time to typical alarms and status changes.
   3. Measure with a timer having at least 0.1-second resolution and 0.01 percent accuracy.
   4. Purpose of test is to demonstrate DDC system, as follows:
      a. Reaction to COV and alarm conditions during HLC.
      b. Ability to update DDC system database during HLC.

   5. Passing test is contingent on the following:
      a. Alarm reporting at printer beginning no more than two seconds after the initiation (time zero) of HLC.
      b. All alarms, both binary and analog, are reported and printed; none are lost.
      c. Compliance with response times specified.

   6. Prepare and submit a report documenting HLC tested and results of test including time stamp and print out of all alarms.

H. DDC System Network Bandwidth Test:
1. Test network bandwidth usage on all DDC system networks to demonstrate bandwidth usage under DDC system normal operating conditions and under simulated HLC.
2. To pass, none of DDC system networks shall use more than 70 percent of available bandwidth under normal and HLC operation.

3.25 DDC SYSTEM WIRELESS NETWORK VERIFICATION

A. DDC system Installer shall design wireless DDC system networks to comply with performance requirements indicated.

B. Installer shall verify wireless network performance through field testing and shall document results in a field test report.

C. Testing and verification of all wireless devices shall include, but not be limited to, the following:
   1. Speed.
   2. Online status.
   3. Signal strength.

3.26 FINAL REVIEW

A. Submit written request to Construction Manager when DDC system is ready for final review. Written request shall state the following:
   1. DDC system has been thoroughly inspected for compliance with contract documents and found to be in full compliance.
   2. DDC system has been calibrated, adjusted and tested and found to comply with requirements of operational stability, accuracy, speed and other performance requirements indicated.
   3. DDC system monitoring and control of HVAC systems results in operation according to sequences of operation indicated.
   4. DDC system is complete and ready for final review.

B. Review by Engineer and Construction Manager shall be made after receipt of written request. A field report shall be issued to document observations and deficiencies.

C. Take prompt action to remedy deficiencies indicated in field report and submit a second written request when all deficiencies have been corrected. Repeat process until no deficiencies are reported.

D. Should more than two reviews be required, DDC system manufacturer and Installer shall compensate entity performing review for total costs, labor and expenses, associated with third and subsequent reviews. Estimated cost of each review shall be submitted and approved by DDC system manufacturer and Installer before making the review.

E. Prepare and submit closeout submittals when no deficiencies are reported.

F. A part of DDC system final review shall include a demonstration to parties participating in final review.
   1. Provide staff familiar with DDC system installed to demonstrate operation of DDC system during final review.
2. Provide testing equipment to demonstrate accuracy and other performance requirements of DDC system that is requested by reviewers during final review.

3. Demonstration shall include, but not be limited to, the following:

   a. Accuracy and calibration of 10 I/O points randomly selected by reviewers. If review finds that some I/O points are not properly calibrated and not satisfying performance requirements indicated, additional I/O points may be selected by reviewers until total I/O points being reviewed that satisfy requirements equals quantity indicated.

   b. HVAC equipment and system hardwired and software safeties and life-safety functions are operating according to sequence of operation. Up to 10 I/O points shall be randomly selected by reviewers. Additional I/O points may be selected by reviewers to discover problems with operation.

   c. Correct sequence of operation after electrical power interruption and resumption after electrical power is restored for randomly selected HVAC systems.

   d. Operation of randomly selected dampers and valves in normal-on, normal-off and failed positions.

   e. Reporting of alarm conditions for randomly selected alarms, including different classes of alarms, to ensure that alarms are properly received by operators and operator workstations.

   f. Trends, summaries, logs and reports set-up for Project.

   g. For up to three HVAC systems randomly selected by reviewers, use graph trends to show that sequence of operation is executed in correct manner and that HVAC systems operate properly through complete sequence of operation including different modes of operations indicated. Show that control loops are stable and operating at set points and respond to changes in set point of 20 percent or more.

   h. Software's ability to communicate with controllers, operator workstations, uploading and downloading of control programs.

   i. Software's ability to edit control programs off-line.

   j. Data entry to show Project-specific customizing capability including parameter changes.

   k. Step through penetration tree, display all graphics, demonstrate dynamic update, and direct access to graphics.

   l. Execution of digital and analog commands in graphic mode.

   m. Spreadsheet and curve plot software and its integration with database.

   n. Online user guide and help functions.

   o. Multitasking by showing different operations occurring simultaneously on four quadrants of split screen.

   p. System speed of response compared to requirements indicated.

   q. For Each Network and Programmable Application Controller:

      1) Memory: Programmed data, parameters, trend and alarm history collected during normal operation is not lost during power failure.

      2) Operator Interface: Ability to connect directly to each type of digital controller with a portable operator workstation and PDA. Show that maintenance personnel interface tools perform as indicated in manufacturer's technical literature.

      3) Standalone Ability: Demonstrate that controllers provide stable and reliable standalone operation using default values or other method for values normally read over network.

      4) Electric Power: Ability to disconnect any controller safely from its power source.

      5) Wiring Labels: Match control drawings.

      6) Network Communication: Ability to locate a controller's location on network and communication architecture matches Shop Drawings.

      7) Nameplates and Tags: Accurate and permanently attached to control panel doors, instrument, actuators and devices.

   r. For Each Operator Workstation:

      1) I/O points lists agree with naming conventions.
2) Graphics are complete.
3) UPS unit, if applicable, operates.

s. Communications and Interoperability: Demonstrate proper interoperability of data sharing, alarm and event management, trending, scheduling, and device and network management. Use ASHRAE 135 protocol analyzer to help identify devices, view network traffic, and verify interoperability. Requirements must be met even if only one manufacturer's equipment is installed.

1) Data Presentation: On each operator workstation, demonstrate graphic display capabilities.
2) Reading of Any Property: Demonstrate ability to read and display any used readable object property of any device on network.
3) Set Point and Parameter Modifications: Show ability to modify set points and tuning parameters indicated. Modifications are made with messages and write services initiated by an operator using workstation graphics, or by completing a field in a menu with instructional text.
4) Peer-to-Peer Data Exchange: Network devices are installed and configured to perform without need for operator intervention to implement Project sequence of operation and to share global data.
5) Alarm and Event Management: Alarms and events are installed and prioritized according to Owner. Demonstrate that time delays and other logic are set up to avoid nuisance tripping. Show that operators with sufficient privileges are permitted.
6) Schedule Lists: Schedules are configured for start and stop, mode change, occupant overrides, and night setback as defined in sequence of operations.
7) Schedule Display and Modification: Ability to display any schedule with start and stop times for calendar year. Show that all calendar entries and schedules are modifiable from any connected operator workstation by an operator with sufficient privilege.
8) Archival Storage of Data: Data archiving is handled by operator workstation and server and local trend archiving and display is accomplished.
9) Modification of Trend Log Object Parameters: Operator with sufficient privilege can change logged data points, sampling rate, and trend duration.
10) Device and Network Management:
   a) Display of network device status.
   b) Display of BACnet Object Information.
   c) Silencing devices transmitting erroneous data.
   d) Time synchronization.
   e) Remote device re-initialization.
   f) Backup and restore network device programming and master database(s).
   g) Configuration management of routers.

3.27 ADJUSTING

A. 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.
3.28  MAINTENANCE SERVICE
A. Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months’ full maintenance by DDC system manufacturer's authorized service representative. Include annual preventive maintenance, repair or replacement of worn or defective components, cleaning, calibration and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.

3.29  SOFTWARE SERVICE AGREEMENT
A. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for one year(s).
B. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within one year(s) from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.

1. Upgrade Notice: At least 30 days to allow Owner to schedule and access system and to upgrade computer equipment if necessary.

3.30  DEMONSTRATION
A. Engage a factory-authorized service representative with complete knowledge of Project-specific system installed to train Owner's maintenance personnel to adjust, operate, and maintain DDC system.
B. Extent of Training:
   1. Base extent of training on scope and complexity of DDC system indicated and training requirements indicated. Provide extent of training required to satisfy requirements indicated even if more than minimum training requirements are indicated.
   2. Inform Owner of anticipated training requirements if more than minimum training requirements are indicated.
   3. Minimum Training Requirements:
      a. Provide not less than five days of training total.
      b. Stagger training over multiple training classes to accommodate Owner's requirements. All training shall occur before end of warranty period.
      c. Total days of training shall be broken into not more than two separate training classes.
      d. Each training class shall be not less than one consecutive day(s).
C. Training Schedule:
   1. Schedule training with Owner 20 business days before expected Substantial Completion.
   2. Schedule training to provide Owner with at least 10 business days of notice in advance of training.
   3. Provide staggered training schedule as requested by Owner.
D. On-Site Training:
   1. Owner will provide conditioned classroom or workspace with ample desks or tables, chairs, power and data connectivity for instructor and each attendee.
2. Instructor shall provide training materials, projector and other audiovisual equipment used in training.

3. Provide as much of training located on-site as deemed feasible and practical by Owner.

4. On-site training shall include regular walk-through tours, as required, to observe each unique product type installed with hands-on review of operation, calibration and service requirements.

5. Operator workstation provided with DDC system shall be used in training. If operator workstation is not indicated, provide a temporary workstation to convey training content.

E. Training Content for Daily Operators:

1. Basic operation of system.
2. Understanding DDC system architecture and configuration.
3. Understanding each unique product type installed including performance and service requirements for each.
4. Understanding operation of each system and equipment controlled by DDC system including sequences of operation, each unique control algorithm and each unique optimization routine.
5. Operating operator workstations, printers and other peripherals.
6. Logging on and off system.
7. Accessing graphics, reports and alarms.
8. Adjusting and changing set points and time schedules.
9. Recognizing DDC system malfunctions.
10. Understanding content of operation and maintenance manuals including control drawings.
11. Understanding physical location and placement of DDC controllers and I/O hardware.
12. Accessing data from DDC controllers.
14. Review of DDC testing results to establish basic understanding of DDC system operating performance and HVAC system limitations as of Substantial Completion.
15. Running each specified report and log.
16. Displaying and demonstrating each data entry to show Project-specific customizing capability. Demonstrating parameter changes.
17. Stepping through graphics penetration tree, displaying all graphics, demonstrating dynamic updating, and direct access to graphics.
18. Executing digital and analog commands in graphic mode.
19. Demonstrating control loop precision and stability via trend logs of I/O for not less than 10 percent of I/O installed.
20. Demonstrating DDC system performance through trend logs and command tracing.
22. Demonstrating spreadsheet and curve plot software, and its integration with database.
23. Demonstrating on-line user guide, and help function and mail facility.
24. Demonstrating multitasking by showing dynamic curve plot, and graphic construction operating simultaneously via split screen.
25. Demonstrating the following for HVAC systems and equipment controlled by DDC system:

a. Operation of HVAC equipment in normal-off, -on and failed conditions while observing individual equipment, dampers and valves for correct position under each condition.

b. For HVAC equipment with factory-installed software, show that integration into DDC system is able to communicate with DDC controllers or gateways, as applicable.

c. Using graphed trends, show that sequence of operation is executed in correct manner, and HVAC systems operate properly through complete sequence of operation including seasonal change, occupied and unoccupied modes, warm-up and cool-down cycles and other modes of operation indicated.

d. Hardware interlocks and safeties function properly and DDC system performs correct sequence of operation after electrical power interruption and resumption after power is restored.
e. Reporting of alarm conditions for each alarm, and confirm that alarms are received at assigned locations, including operator workstations.
f. Each control loop responds to set point adjustment and stabilizes within time period indicated.
g. Sharing of previously graphed trends of all control loops to demonstrate that each control loop is stable and set points are being maintained.

F. Training Content for Advanced Operators:

1. Making and changing workstation graphics.
2. Creating, deleting and modifying alarms including annunciation and routing.
3. Creating, deleting and modifying point trend logs including graphing and printing on an ad-hoc basis and operator-defined time intervals.
4. Creating, deleting and modifying reports.
5. Creating, deleting and modifying points.
6. Creating, deleting and modifying programming including ability to edit control programs offline.
7. Creating, deleting and modifying system graphics and other types of displays.
8. Adding DDC controllers and other network communication devices such as gateways and routers.
10. Performing DDC system checkout and diagnostic procedures.
11. Performing DDC controllers operation and maintenance procedures.
12. Performing operator workstation operation and maintenance procedures.
13. Configuring DDC system hardware including controllers, workstations, communication devices and I/O points.
14. Maintaining, calibrating, troubleshooting, diagnosing and repairing hardware.
15. Adjusting, calibrating and replacing DDC system components.

G. Training Content for System Managers and Administrators:

1. DDC system software maintenance and backups.
2. Uploading, downloading and off-line archiving of all DDC system software and databases.
3. Interface with Project-specific, third-party operator software.
4. Understanding password and security procedures.
5. Adding new operators and making modifications to existing operators.
6. Operator password assignments and modification.
7. Operator authority assignment and modification.
8. Workstation data segregation and modification.

H. Video of Training Sessions:

1. Provide a digital video and audio recording of each training session. Create a separate recording file for each session.
2. Stamp each recording file with training session number, session name and date.
3. Provide Owner with two copies of digital files on DVDs or flash drives for later reference and for use in future training.
4. Owner retains right to make additional copies for intended training purposes without having to pay royalties.

END OF SECTION
SECTION 15950
TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.01 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.02 SUMMARY
A. This Section includes TAB to produce design objectives for the following:
   1. Air Systems:
      a. Constant-volume air systems.
      b. Variable air volume systems.
   2. Hydronic Piping Systems:
      a. Constant-flow systems.
   3. HVAC equipment quantitative-performance settings.
   4. Verifying that automatic control devices are functioning properly.
   5. Reporting results of activities and procedures specified in this Section.

1.03 DEFINITIONS
A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.
B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.
C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.
D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.
E. NC: Noise criteria.
F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.
G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment.

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.04 SUBMITTALS

A. Qualification Data: Within 15 days from Contractor's Notice to Proceed, submit 2 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.


D. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

E. Sample Report Forms: Submit two sets of sample TAB report forms.

F. Warranties specified in this Section.

1.05 QUALITY ASSURANCE

A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

B. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers’ authorized service
representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:
   a. Submittal distribution requirements.
   c. TAB plan.
   d. Work schedule and Project-site access requirements.
   e. Coordination and cooperation of trades and subcontractors.
   f. Coordination of documentation and communication flow.

C. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:
   1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
   2. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.


E. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems," Section II, "Required Instrumentation for NEBB Certification."

F. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.
   1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.06 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.

B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.07 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.08 WARRANTY

A. National Project Performance Guarantee: Provide a guarantee on AABC’s "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee includes the following provisions:

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.01 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.

1. Contract Documents are defined in the General and Supplementary Conditions of Contract.
2. Verify that balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are required by the Contract Documents. Verify that quantities and locations of these balancing devices are accessible and appropriate for effective balancing and for efficient system and equipment operation.

B. Examine approved submittal data of HVAC systems and equipment.

C. Examine Project Record Documents described in Division 1 Section "Project Record Documents."

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. 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. Calculate system effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from those presented when the equipment was performance tested at the factory. To calculate system effects for air systems, use tables and charts found in AMCA 201,
"Fans and Systems," Sections 7 through 10; or in SMACNA's "HVAC Systems--Duct Design," Sections 5 and 6. Compare this data with the design data and installed conditions.

F. Examine system and equipment installations to verify that they are complete and that testing, cleaning, adjusting, and commissioning specified in individual Sections have been performed.

G. Examine system and equipment test reports.

H. Examine HVAC system and equipment installations to verify that indicated balancing devices, such as test ports, gage cocks, thermometer wells, flow-control devices, balancing valves and fittings, and manual volume dampers, are properly installed, and that their locations are accessible and appropriate for effective balancing and for efficient system and equipment operation.

I. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

J. Examine HVAC equipment to ensure that clean filters have been installed, bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.

K. Examine terminal units, such as variable-air-volume boxes, to verify that they are accessible and their controls are connected and functioning.

L. Examine plenum ceilings used for supply air to verify that they are airtight. Verify that pipe penetrations and other holes are sealed.

M. Examine strainers for clean screens and proper perforations.

N. Examine three-way valves for proper installation for their intended function of diverting or mixing fluid flows.

O. Examine heat-transfer coils for correct piping connections and for clean and straight fins.

P. Examine system pumps to ensure absence of entrained air in the suction piping.

Q. Examine equipment for installation and for properly operating safety interlocks and controls.

R. Examine automatic temperature system components to verify the following:

1. Dampers, valves, and other controlled devices are operated by the intended controller.
2. Dampers and valves are in the position indicated by the controller.
3. Integrity of valves and dampers for free and full operation and for tightness of fully closed and fully open positions. This includes dampers in multizone units, mixing boxes, and variable-air-volume terminals.
4. Automatic modulating and shutoff valves, including two-way valves and three-way mixing and diverting valves, are properly connected.
5. Thermostats and humidistats are located to avoid adverse effects of sunlight, drafts, and cold walls.
6. Sensors are located to sense only the intended conditions.
7. Sequence of operation for control modes is according to the Contract Documents.
8. Controller set points are set at indicated values.
9. Interlocked systems are operating.
10. Changeover from heating to cooling mode occurs according to indicated values.
S. 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.

3.02 PREPARATION

A. Prepare a TAB plan that includes strategies and step-by-step procedures.

B. Complete system readiness checks and prepare system readiness reports. Verify the following:
   1. Permanent electrical power wiring is complete.
   2. Hydronic systems are filled, clean, and free of air.
   3. Automatic temperature-control systems are operational.
   4. Equipment and duct access doors are securely closed.
   5. Balance, smoke, and fire dampers are open.
   6. Isolating and balancing valves are open and control valves are operational.
   7. Ceilings are installed in critical areas where air-pattern adjustments are required and access to balancing devices is provided.
   8. Windows and doors can be closed so indicated conditions for system operations can be met.

3.03 GENERAL PROCEDURES FOR TESTING AND BALANCING

A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and this Section.

B. Cut insulation, ducts, pipes, and equipment cabinets for installation of test probes to the minimum extent necessary to allow adequate performance of procedures. After testing and balancing, close probe holes and patch insulation with new materials identical to those removed. Restore vapor barrier and finish according to insulation Specifications for this Project.

C. Mark equipment and balancing device settings with paint or other suitable, permanent identification material, including damper-control positions, valve position indicators, fan-speed-control levers, and similar controls and devices, to show final settings.

D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.04 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. Determine the best locations in main and branch ducts for accurate duct airflow measurements.

D. Check airflow patterns from the outside-air louvers and dampers and the return- and exhaust-air dampers, through the supply-fan discharge and mixing dampers.
E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.

F. Verify that motor starters are equipped with properly sized thermal protection.

G. Check dampers for proper position to achieve desired airflow path.

H. Check for airflow blockages.

I. Check condensate drains for proper connections and functioning.

J. Check for proper sealing of air-handling unit components.

K. Check for proper sealing of new air duct system.

3.05 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 fan static pressures to determine actual static pressure as follows:
   a. Measure outlet static pressure as far downstream from the fan as practicable 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 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.

2. Measure static pressure across each component that makes up an air-handling unit.

   a. Simulate dirty filter operation and record the point at which maintenance personnel must change filters.

3. Compare design data with installed conditions to determine variations in design static pressures versus actual static pressures. Compare actual system effect factors with calculated system effect factors to identify where variations occur. Recommend corrective action to align design and actual conditions.

4. Obtain approval from Architect for adjustment of fan speed higher or lower than indicated speed. Make required adjustments to pulley sizes, motor sizes, and electrical connections to accommodate fan-speed changes.

5. 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 modes 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 static pressure at a point downstream from the balancing damper and adjust volume dampers until the proper static pressure is achieved.
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. 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 terminal inlets in existing toilet exhaust system without making adjustments.

1. Measure terminal outlets using a direct-reading hood or outlet manufacturer's written instructions and calculating factors.

D. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using 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.

3.06 PROCEDURES FOR VARIABLE AIR 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.

C. Pressure-Dependent, Variable-Air-Volume Systems without Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Balance variable-air-volume systems the same as described for constant-volume air systems.
2. Set terminal units and supply fan at full-airflow condition.
3. Adjust inlet dampers of each terminal unit to indicated airflow and verify operation of the static-pressure controller. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
4. Readjust fan airflow for final maximum readings.
5. Measure operating static pressure at the sensor that controls the supply fan if one is installed, and verify operation of the static-pressure controller.
6. Set supply fan at minimum airflow if minimum airflow is indicated. Measure static pressure to verify that it is being maintained by the controller.
7. 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 the outlets balanced for maximum airflow.

8. Measure 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.

D. Pressure-Dependent, Variable-Air-Volume Systems with Diversity: After the fan systems have been adjusted, adjust the variable-air-volume systems as follows:

1. Set system at maximum indicated airflow by setting the required number of terminal units at minimum airflow. Select the reduced-airflow terminal units so they are distributed evenly among the branch ducts.
2. Adjust supply fan to maximum indicated airflow with the variable-airflow controller set at maximum airflow.
3. Set terminal units at full-airflow condition.
4. Adjust terminal units starting at the supply-fan end of the system and continuing progressively to the end of the system. Adjust inlet dampers of each terminal unit to indicated airflow. When total airflow is correct, balance the air outlets downstream from terminal units the same as described for constant-volume air systems.
5. Adjust terminal units for minimum airflow.
6. Measure static pressure at the sensor.
7. Measure the return airflow to the fan while operating at maximum return airflow and minimum outdoor airflow. Adjust the fan and balance the return-air ducts and inlets the same as described for constant-volume air systems.
3.07 GENERAL PROCEDURES FOR HYDRONIC SYSTEMS

A. Prepare test reports with pertinent design data and number in sequence starting at pump to end of system. Check the sum of branch-circuit flows against approved pump flow rate. Correct variations that exceed plus or minus 5 percent.

B. Prepare schematic diagrams of systems' "as-built" piping layouts.

C. Prepare hydronic systems for testing and balancing according to the following, in addition to the general preparation procedures specified above:

1. Open all manual valves for maximum flow.
2. Check expansion tank liquid level.
3. Check makeup-water-station pressure gage for adequate pressure for highest vent.
4. Check flow-control valves for specified sequence of operation and set at indicated flow.
5. Set differential-pressure control valves at the specified differential pressure. Do not set at fully closed position when pump is positive-displacement type unless several terminal valves are kept open.
6. Set system controls so automatic valves are wide open to heat exchangers.
7. Check pump-motor load. If motor is overloaded, throttle main flow-balancing device so motor nameplate rating is not exceeded.
8. Check air vents for a forceful liquid flow exiting from vents when manually operated.

3.08 PROCEDURES FOR HYDRONIC SYSTEMS

A. Measure water flow at pumps. Use the following procedures, except for positive-displacement pumps:

1. Verify impeller size by operating the pump with the discharge valve closed. Read pressure differential across the pump. Convert pressure to head and correct for differences in gage heights. Note the point on manufacturer's pump curve at zero flow and verify that the pump has the intended impeller size.
2. Check system resistance. With all valves open, read pressure differential across the pump and mark pump manufacturer's head-capacity curve. Adjust pump discharge valve until indicated water flow is achieved.
3. Verify pump-motor brake horsepower. Calculate the intended brake horsepower for the system based on pump manufacturer's performance data. Compare calculated brake horsepower with nameplate data on the pump motor. Report conditions where actual amperage exceeds motor nameplate amperage.
4. Report flow rates that are not within plus or minus 5 percent of design.

B. Set calibrated balancing valves, if installed, at calculated presettings.

C. Measure flow at all stations and adjust, where necessary, to obtain first balance.

1. System components that have Cv rating or an accurately cataloged flow-pressure-drop relationship may be used as a flow-indicating device.

D. Measure flow at main balancing station and set main balancing device to achieve flow that is 5 percent greater than indicated flow.

E. Adjust balancing stations to within specified tolerances of indicated flow rate as follows:

1. Determine the balancing station with the highest percentage over indicated flow.
2. Adjust each station in turn, beginning with the station with the highest percentage over indicated flow and proceeding to the station with the lowest percentage over indicated flow.

3. Record settings and mark balancing devices.

F. Measure pump flow rate and make final measurements of pump amperage, voltage, rpm, pump heads, and systems' pressures and temperatures including outdoor-air temperature.

G. Measure the differential-pressure control valve settings existing at the conclusions of balancing.

3.09 PROCEDURES FOR MOTORS
A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:

1. Manufacturer, model, and serial numbers.
4. Efficiency rating.
5. Nameplate and measured voltage, each phase.
6. Nameplate and measured amperage, each phase.
7. Starter thermal-protection-element rating.

3.10 PROCEDURES FOR BOILERS
A. If hydronic, measure entering- and leaving-water temperatures and water flow.

3.11 PROCEDURES FOR HEAT-TRANSFER COILS
A. Water Coils: Measure the following data for each coil:

1. Entering- and leaving-water temperature.
2. Water flow rate.
3. Water pressure drop.
4. Dry-bulb temperature of entering and leaving air.
5. Wet-bulb temperature of entering and leaving air for cooling coils.
6. Airflow.
7. Air pressure drop.

B. Refrigerant Coils: Measure the following data for each coil:

1. Dry-bulb temperature of entering and leaving air.
2. Wet-bulb temperature of entering and leaving air.
3. Airflow.
4. Air pressure drop.
5. Refrigerant suction pressure and temperature.

3.12 PROCEDURES FOR TEMPERATURE MEASUREMENTS
A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
B. Measure indoor wet- and dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings. Measure when the building or zone is occupied.

C. Measure outside-air, wet- and dry-bulb temperatures.

3.13 TEMPERATURE-CONTROL VERIFICATION

A. Verify that controllers are calibrated and commissioned.

B. Check transmitter and controller locations and note conditions that would adversely affect control functions.

C. Record controller settings and note variances between set points and actual measurements.

D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).

E. Check free travel and proper operation of control devices such as damper and valve operators.

F. Check the sequence of operation of control devices. Note air pressures and device positions and correlate with airflow and water flow measurements. Note the speed of response to input changes.

G. Check the interaction of electrically operated switch transducers.

H. Check the interaction of interlock and lockout systems.

I. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.

J. Note operation of electric actuators using spring return for proper fail-safe operations.

3.14 TOLERANCES

A. Set HVAC system airflow and water flow rates within the following tolerances:

1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus 5 to plus 10 percent.
2. Air Outlets and Inlets: 0 to minus 10 percent.
3. Heating-Water Flow Rate: 0 to minus 10 percent.

3.15 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: As Work progresses, prepare 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.

3.16 FINAL REPORT

A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.

B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.

1. Include a list of instruments used for procedures, along with proof of calibration.

C. Final Report Contents: In addition to certified field report data, include the following:

1. Pump curves.
2. Fan curves.
3. Manufacturers’ test data.
4. Field test reports prepared by system and equipment installers.
5. Other information relative to equipment performance, but do not include Shop Drawings and Product Data.

D. General Report Data: In addition to form titles and entries, include the following data in the final report, as applicable:

1. Title page.
2. Name and address of TAB firm.
3. Project name.
4. Project location.
5. Architect’s name and address.
6. Engineer’s name and address.
7. Contractor’s name and address.
9. Signature of TAB firm 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. Notes to explain why certain final data in the body of reports varies from indicated values.
14. Test conditions for fans and pump performance forms including the following:

a. Settings for outside-, return-, and exhaust-air dampers.
b. Conditions of filters.
c. Cooling coil, wet- and dry-bulb conditions.
d. Fan drive settings including settings and percentage of maximum pitch diameter.
e. Other system operating conditions that affect performance.
E. System Diagrams: Include schematic layouts of air and hydronic distribution systems. Present each system with single-line diagram and include the following:

1. Quantities of outside, supply, return, and exhaust airflows.
2. Water flow rates.
3. Duct, outlet, and inlet sizes.
4. Pipe and valve sizes and locations.
5. Position of balancing devices.

F. Air-Handling Unit Test Reports: For air-handling units with coils, include the following:

1. Unit Data: Include the following:
   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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
   j. Number of belts, make, and size.
   k. Number of filters, type, and size.

2. Motor Data:
   a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.

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. 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. Outside airflow in cfm.
   i. Return airflow in cfm.
   j. Outside-air damper position.
   k. Return-air damper position.

G. Apparatus-Coil Test Reports:

1. Coil Data:
   a. System identification.
   b. Location.
   c. Coil type.
d. Number of rows.
e. Fin spacing in fins per inch o.c.
f. Make and model number.
g. Face area in sq. ft..
h. Tube size in NPS.
i. Tube and fin materials.
j. Circuiting arrangement.

2. Test Data (Indicated and Actual Values):
   a. Airflow rate in cfm.
   b. Average face velocity in fpm.
   c. Air pressure drop in inches wg.
   d. Outside-air, wet- and dry-bulb temperatures in deg F.
   e. Return-air, wet- and dry-bulb temperatures in deg F.
   f. Entering-air, wet- and dry-bulb temperatures in deg F.
   g. Leaving-air, wet- and dry-bulb temperatures in deg F.
   h. Water flow rate in gpm.
   i. Water pressure differential in feet of head or psig.
   j. Entering-water temperature in deg F.
   k. Leaving-water temperature in deg F.
   l. Refrigerant expansion valve and refrigerant types.
   m. Refrigerant suction pressure in psig.
   n. Refrigerant suction temperature in deg F.
   o. Inlet steam pressure in psig.

H. Fan Test Reports: For 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Motor Data:
   a. 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
   g. Number of belts, make, and size.

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.

I. Compressor and Condenser Reports: For refrigerant side of unitary systems, stand-alone refrigerant compressors, air-cooled condensing units, or water-cooled condensing units, include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Unit make and model number.
   d. Compressor make.
   e. Compressor model and serial numbers.
   f. Refrigerant weight in lb.
   g. Low ambient temperature cutoff in deg F.

2. Test Data (Indicated and Actual Values):
   a. Inlet-duct static pressure in inches wg.
   b. Outlet-duct static pressure in inches wg.
   c. Entering-air, dry-bulb temperature in deg F.
   d. Leaving-air, dry-bulb temperature in deg F.
   e. Condenser entering-water temperature in deg F.
   f. Condenser leaving-water temperature in deg F.
   g. Condenser-water temperature differential in deg F.
   h. Condenser entering-water pressure in feet of head or psig.
   i. Condenser leaving-water pressure in feet of head or psig.
   j. Condenser-water pressure differential in feet of head or psig.
   k. Control settings.
   l. Unloader set points.
   m. Low-pressure-cutout set point in psig.
   n. High-pressure-cutout set point in psig.
   o. Suction pressure in psig.
   p. Suction temperature in deg F.
   q. Condenser refrigerant pressure in psig.
   r. Condenser refrigerant temperature in deg F.
   s. Oil pressure in psig.
   t. Oil temperature in deg F.
   u. Voltage at each connection.
   v. Amperage for each phase.
   w. Kilowatt input.
   x. Crankcase heater kilowatt.
   y. Number of fans.
   z. Condenser fan rpm.
   aa. Condenser fan airflow rate in cfm.
   bb. Condenser fan motor make, frame size, rpm, and horsepower.
   cc. Condenser fan motor voltage at each connection.
   dd. Condenser fan motor amperage for each phase.

J. Pump Test Reports: Calculate impeller size by plotting the shutoff head on pump curves and include the following:

1. Unit Data:
   a. Unit identification.
   b. Location.
c. Service.
d. Make and size.
e. Model and serial numbers.
f. Water flow rate in gpm.
g. Water pressure differential in feet of head or psig.
h. Required net positive suction head in feet of head or psig.
i. Pump rpm.
j. Impeller diameter in inches.
k. Motor make and frame size.
l. Motor horsepower and rpm.
m. Voltage at each connection.
n. Amperage for each phase.
o. Full-load amperage and service factor.
p. Seal type.

2. Test Data (Indicated and Actual Values):
   a. Static head in feet of head or psig.
   b. Pump shutoff pressure in feet of head or psig.
   c. Actual impeller size in inches.
   d. Full-open flow rate in gpm.
   e. Full-open pressure in feet of head or psig.
   f. Final discharge pressure in feet of head or psig.
   g. Final suction pressure in feet of head or psig.
   h. Final total pressure in feet of head or psig.
   i. Final water flow rate in gpm.
   j. Voltage at each connection.
   k. Amperage for each phase.

K. Boiler Test Reports:

1. Unit Data:
   a. Unit identification.
   b. Location.
   c. Service.
   d. Make and type.
   e. Model and serial numbers.
   f. Fuel type and input in Btuh.
   g. Number of passes.
   h. Ignition type.
   i. Burner-control types.
   j. Voltage at each connection.
   k. Amperage for each phase.

2. Test Data (Indicated and Actual Values):
   a. Operating pressure in psig.
   b. Operating temperature in deg F.
   c. Entering-water temperature in deg F.
   d. Leaving-water temperature in deg F.
   e. Number of safety valves and sizes in NPS.
   f. Safety valve settings in psig.
   g. High-limit setting in psig.
   h. Operating-control setting.
   i. High-fire set point.
j. Low-fire set point.
k. Voltage at each connection.
l. Amperage for each phase.
m. Draft fan voltage at each connection.
n. Draft fan amperage for each phase.
o. Manifold pressure in psig.

L. Instrument Calibration Reports:

1. Report Data:
   a. Instrument type and make.
   b. Serial number.
   c. Application.
   d. Dates of use.
   e. Dates of calibration.

3.17 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. Randomly check the following for each system:
   a. Measure airflow of at least 10 percent of air inlets.
   b. Measure water flow at the air handling unit heating coils.
   c. Verify that balancing devices are marked with final balance position.

B. Final Inspection:

1. After initial inspection is complete and evidence 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 Architect.
2. TAB firm test and balance engineer shall conduct the inspection in the presence of Architect.
3. Architect shall randomly select measurements documented in the final report to be rechecked. The 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 the 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.
6. TAB firm shall recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes and resubmit the final report.
7. Request a second final inspection. If the second final inspection also fails, Owner shall contract the services of another TAB firm to complete the testing and balancing in accordance with the Contract Documents and deduct the cost of the services from the final payment.
3.18 ADDITIONAL TESTS

A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION
SECTION 16010
BASIC ELECTRICAL REQUIREMENTS

PART 1  GENERAL

1.01 DESCRIPTION

A. Comply with all Contract requirements and Section 01011 Summary of Project Multiple Prime Contracts.

B. Unless specifically dimensioned, the Work shown on the drawings is diagrammatic only to show general arrangement.

C. The work in accordance with drawings and specifications shall consist of furnishing all equipment, materials, labor, services and performing all operations for complete installation of electrical work.

D. Any equipment, materials, labor or services not specifically mentioned herein which may be necessary to complete or perfect any part of installation in a substantial manner shall be furnished with no extra cost to the Owner.

1.02 RELATED SECTIONS

A. Section 16050 – Basic Electrical Materials and Methods.

B. Section 16060 – Grounding and Bonding.

C. Section 16070 – Hangers and Supports.

D. Section 16075 – Electrical Identification.

E. Section 16120 – Conductors and Cables.

F. Section 16130 – Raceways and Boxes.

G. Section 16140 – Wiring Devices.

H. Section 16150 – Wiring Connections.

I. Section 16410 – Enclosed Switches and Circuit Breakers.

J. Section 16510 – Interior Luminaires.

K. Section 16970 – Testing and Commissioning.

1.03 SUBMITTALS

A. Submit catalogue cuts, specifications, capacities, electrical characteristics, installation instructions and dimension drawings for each type of equipment specified and operating maintenance manuals for record.

B. Submit shop drawings for review in accordance with the requirements of this section and other sections of the technical specification.
C. In order to facilitate the review of submittals, identify the proposed products with the identical markings, symbols and nomenclature used in the contract documents.

D. Submit complete set of as-built drawings after completion of work.

1.04 CUTTING AND PATCHING

A. Provide cutting and patching as required for the completion of the electrical work.

1.05 STORAGE, AND HANDLING

A. Where possible, store materials and equipment inside to protect from weather. Where necessary to store outside, elevate above grade and enclose with durance waterproof wrapping.

1.06 COMPLIANCE WITH CODES, STANDARDS AND REGULATIONS

A. In absence of specific instructions in technical specifications, electrical equipment and their installation shall conform to the following applicable codes, standards and regulations, latest editions:

1. National Fire Protection Association (NFPA)

2. Occupational Safety and Health Administration (OSHA)

3. Underwriter’s Laboratories, Inc. (UL)

END OF SECTION
SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1  GENERAL

1.01 DESCRIPTION

A. This Section includes the following:
   1. Electrical equipment coordination and installation.
   2. Sleeves for raceways and cables.
   3. Sleeve seals.
   4. Common electrical installation requirements.

1.02 RELATED SECTIONS

A. Section 16010 – Basic Electrical Requirements.
B. Section 16060 – Grounding and Bonding.
C. Section 16120 – Conductors and Cables.
D. Section 16130 – Raceways and Boxes.
E. Section 16140 – Wiring Devices.

1.03 SUBMITTALS

A. Section 01300 – Submittals.
   1. Sleeves for Raceways and Cables.
   2. Sleeve seals.
B. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical components used.
   1. Annotate to indicate application of each product submitted and compliance with requirements.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with City of Philadelphia Standards.
B. Test Equipment Suitability and Calibration: Comply with NETA ATS, "Suitability of Test Equipment" and "Test Instrument Calibration."

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Protect from construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.
PART 2  PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 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. Sleeves for Rectangular Openings: Galvanized sheet steel with minimum 0.052- or 0.138-inch thickness as indicated and of length to suit application.

2.03 SLEEVE SEALS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
   1. Manufacturers:
      a. Advance Products & Systems, Inc.
      b. Calpico, Inc.
      c. Metraflex Co.
   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.

PART 3  EXECUTION

3.01 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 raceways and piping systems installed at a required slope.

3.02 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Electrical penetrations occur when raceways, cables, wireways, penetrate concrete slabs, concrete or masonry walls.

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 and no side greater than 16 inches, thickness shall be 0.052 inch.
   2. For sleeve cross-section rectangle perimeter equal to, or greater than, 50 inches and 1 or more sides equal to, or greater than, 16 inches, thickness shall be 0.138 inch.

E. 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.

3.03 SLEEVE-SEAL INSTALLATION

A. 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.

3.04 FIELD QUALITY CONTROL

A. Inspect installed sleeve and sleeve-seal for damage and faulty work.

END OF SECTION
SECTION 16060
GROUNDING AND BONDING

PART 1 GENERAL
1.01 DESCRIPTION

A. This Section includes grounding of electrical systems and equipment. Grounding requirements specified in this Section may be supplemented by special requirements of systems described in other Sections.

1.02 RELATED SECTIONS

A. Section 16010 – Basic Electrical Requirements.
B. Section 16050 – Basic Electrical Materials and Methods.
C. Section 16120 – Conductors and Cables.
D. Section 16130 – Raceways and Boxes.
E. Section 16140 – Wiring Devices.
F. Section 16410 – Enclosed Switches and Circuit Breakers.
G. Section 16510 – Interior Luminaires.

1.03 SUBMITTALS

A. Section 01300 – Submittals.
B. Product Data: For each type of product indicated.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with City of Philadelphia Standards.
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. Comply with UL 467.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Grounding Conductors, Cables, Connectors, and Rods:
      a. Copperweld Corp.
c. Raco, Inc.; Division of Hubbell.
d. Thomas & Betts, Electrical.

2.02 GROUNDING CONDUCTORS

A. Equipment Grounding Conductors: Insulated with green-colored insulation.

B. Grounding Electrode Conductors: Stranded cable.

C. Bare Copper Conductors: Comply with the following:

D. Copper Bonding Conductors: As follows:
   1. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG copper conductor, 1/4 inch in diameter.
   2. Bonding Conductor: No. 4 or No. 6 AWG, stranded copper conductor.
   3. Bonding Jumper: Bare copper tape, braided bare copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.
   4. Tinned Bonding Jumper: Tinned-copper tape, braided copper conductors, terminated with copper ferrules; 1-5/8 inches wide and 1/16 inch thick.

2.03 CONNECTOR PRODUCTS

A. Comply with IEEE 837 and UL 467; listed for use for specific types, sizes, and combinations of conductors and connected items.

B. Bolted Connectors: Bolted-pressure-type connectors, or compression type.

C. Welded Connectors: Exothermic-welded type, in kit form, and selected per manufacturer's written instructions.

PART 3 EXECUTION

3.01 APPLICATION

A. In raceways, use insulated equipment grounding conductors.

B. Exothermic-Welded Connections: Use for connections to structural steel and for underground connections, except those at test wells.

C. Equipment Grounding Conductor Terminations: Use bolted pressure clamps.
3.02 EQUIPMENT GROUNDING CONDUCTORS

A. Comply with NFPA 70, Article 250, for types, sizes, and quantities of equipment grounding conductors, unless specific types, larger sizes, or more conductors than required by NFPA 70 are indicated.

B. Install equipment grounding conductors in all feeders and circuits.

C. Install insulated equipment grounding conductor with circuit conductors for the following items, in addition to those required by NEC:
   1. Feeders and branch circuits.
   2. Lighting circuits.
   3. Receptacle circuits.
   5. Three-phase motor and appliance branch circuits.
   6. Flexible raceway runs.
   7. Armored and metal-clad cable runs.

D. Nonmetallic Raceways: Install an equipment grounding conductor in nonmetallic raceways unless they are designated for telephone or data cables.

E. Signal and Communication Systems: For telephone, alarm, voice and data, and other communication systems, provide No. 4 AWG minimum insulated grounding conductor in raceway from grounding electrode system to each service location, terminal cabinet, wiring closet, and central equipment location.
   1. Terminal Cabinets: Terminate grounding conductor on cabinet grounding terminal.

3.03 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible, unless otherwise indicated. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Bonding Straps and Jumpers: Install so vibration by equipment mounted on vibration isolation hangers and supports is not transmitted to rigidly mounted equipment. Use exothermic-welded connectors for outdoor locations, unless a disconnect-type connection is required; then, use a bolted clamp. Bond straps directly to the basic structure taking care not to penetrate any adjacent parts. Install straps only in locations accessible for maintenance.

C. Metal Water Service Pipe: Provide insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes by grounding clamp connectors. Where a dielectric main water fitting is installed, connect grounding conductor to street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
3.04 CONNECTIONS

A. General: Make connections so galvanic action or electrolysis possibility is minimized. Select connectors, connection hardware, conductors, and connection methods so metals in direct contact will be galvanically compatible.

1. Use electroplated or hot-tin-coated materials to ensure high conductivity and to make contact points closer to order of galvanic series.

2. Make connections with clean, bare metal at points of contact.


5. Coat and seal connections having dissimilar metals with inert material to prevent future penetration of moisture to contact surfaces.

B. Exothermic-Welded Connections: Comply with manufacturer's written instructions. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable.

C. Equipment Grounding Conductor Terminations: For No. 8 AWG and larger, use pressure-type grounding lugs. No. 10 AWG and smaller grounding conductors may be terminated with winged pressure-type connectors.

D. Noncontact Metal Raceway Terminations: If metallic raceways terminate at metal housings without mechanical and electrical connection to housing, terminate each conduit with a grounding bushing. Connect grounding bushings with a bare grounding conductor to grounding bus or terminal in housing. Bond electrically noncontinuous conduits at entrances and exits with grounding bushings and bare grounding conductors, unless otherwise indicated.

E. Tighten screws and bolts for grounding and bonding 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.

F. Compression-Type Connections: Use hydraulic compression tools to provide correct circumferential pressure for compression connectors. Use tools and dies recommended by connector manufacturer. Provide embossing die code or other standard method to make a visible indication that a connector has been adequately compressed on grounding conductor.

G. Moisture Protection: If insulated grounding conductors are connected to ground rods or grounding buses, insulate entire area of connection and seal against moisture penetration of insulation and cable.

3.05 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing grounding system but before permanent electrical circuitry has 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, and at ground test wells. Measure ground resistance not less than two full days after the last trace of precipitation, and without the 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. Perform tests, by the fall-of-potential method according to IEEE 81.
   a. Equipment Rated 500 kVA and Less: 10 ohms.
   b. Pad-Mounted Switching Equipment: 5 ohms.

3. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Owner's Representative promptly and include recommendations to reduce ground resistance.

END OF SECTION
SECTION 16070

HANGERS AND SUPPORTS

PART 1   GENERAL

1.01 DESCRIPTION
   A. This Section includes the following:
      1. Hangers and supports for electrical equipment and systems.

1.02 RELATED SECTIONS
   A. Section 16010 – Basic Electrical Requirements.
   B. Section 16050 – Basic Electrical Materials and Methods.
   C. Section 16130 – Raceways and Boxes.
   D. Section 16410 – Enclosed Switches and Circuit Breakers.
   E. Section 16510 – Interior Luminaires.

1.03 SUBMITTALS
   A. Product Data: Illustrate and indicate style, material, strength, fastening provision, and finish for each type and size of electrical support component used.
      1. Annotate to indicate application of each product submitted and compliance with requirements.

1.04 QUALITY ASSURANCE
   A. Perform work in accordance with City of Philadelphia Standards.
   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. Comply with UL 467.

1.05 DELIVERY, STORAGE AND HANDLING
   A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
   B. Protect from construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2   PRODUCTS

2.01 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      1. Manufacturers:
2.02 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Finishes:
   1. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-3.

B. Channel Dimensions: Selected for structural loading forces.

C. Raceway and Cable Supports: As described in NECA 1.

D. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. 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.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:
   1. 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:
         1) Cooper B-Line; a division of Cooper Industries.
         2) Empire Tool and Manufacturing Co., Inc
         3) Hilti, Inc.
         4) ITW Construction Products.
         5) MKT Fastening, LLC.
         6) Powers Fasteners.
   2. Concrete Inserts: Steel or malleable-iron slotted-support-system units similar to MSS Type 18; complying with MFMA-3 or MSS SP-58.
   3. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.
   5. Toggle Bolts: All-steel springhead type.

2.03 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.
PART 3  EXECUTION

3.01  APPLICATION

A. Comply with NECA 1 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 required by NFPA 70. Minimum rod size shall be 1/4 inch in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

D. Secure raceways and cables to trapeze member with clamps approved for application by an agency acceptable to authorities having jurisdiction

E. Secure raceways and cables to these supports with single-bolt conduit clamps.

F. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.02  INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 05500 – Metal Fabrications for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.03  FIELD QUALITY CONTROL

A. Testing: Test pullout resistance of anchorage devices.
   1. Provide evidence of recent calibration of test equipment by a testing agency acceptable to authorities having jurisdiction.
   2. Schedule test with Owner before connecting anchorage device to restrained component (unless postconnection testing has been approved), and with at least seven days' advance notice.
   3. Obtain Owner's approval before transmitting test loads to structure. Provide temporary load-spreading members.
   4. Test to 90 percent of rated proof load of device.
   5. If a device fails test, modify all installations of same type and retest until satisfactory results are achieved.

B. Record test results.

END OF SECTION
SECTION 16075

ELECTRICAL IDENTIFICATION

PART 1 GENERAL

1.01 DESCRIPTION

A. This Section includes the following:
   1. Identification for raceway and metal-clad cable.
   2. Warning labels and signs.
   3. Instruction signs.
   4. Equipment identification labels.
   5. Miscellaneous identification products.

1.02 RELATED DOCUMENTS

A. Section 16010 – Basic Electrical Requirements.
B. Section 16070 – Hangers and Supports.
C. Section 16120 – Conductors and Cables.
D. Section 16130 – Raceways and Boxes.
E. Section 16410 – Enclosed Switches and Circuit Breakers.

1.03 SUBMITTALS

A. Product Data: For each electrical identification product indicated.
B. Samples: Submit two tags, labels, conduit markers, size used on project.
C. Manufacturer’s Installation Instructions: Indicate installation instructions, special procedures, and installation.
D. Manufacturer’s Certificate: Certify products meet or exceed specified requirements.

1.04 QUALITY ASSURANCE

A. Comply with NFPA 70.
C. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

PART 2 PRODUCTS

2.01 RACEWAY AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Color for Printed Legend:
   1. Power Circuits: Black letters on an orange field.
   2. Legend: Indicate system or service and voltage, if applicable.

B. Self-Adhesive Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound adhesive tape for securing ends of legend label.

C. 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.

D. Snap-Around, Color-Coding Bands: Slit, pretensioned, flexible, solid-colored acrylic sleeves, 2 inches long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches wide; compounded for outdoor use.

2.02 WARNING LABELS AND SIGNS


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 grommets in corners for mounting. Nominal size, 7 by 10 inches.

D. Metal-Backed, Butyrate Warning Signs: Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch galvanized-steel backing; and with colors, legend, and size required for application. 1/4-inch grommets in corners for mounting. Nominal size, 10 by 14 inches.

E. Warning label and sign shall include, but are not limited to, the following legends:
   1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
   2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."
2.03 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. in. and 1/8 inch thick for larger sizes.
   1. Engraved legend with black letters on white face.
   2. Punched or drilled for mechanical fasteners.
   3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.04 EQUIPMENT IDENTIFICATION LABELS


2.05 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Cable Ties: Fungus-inert, self-extinguishing, 1-piece, self-locking, Type 6/6 nylon cable ties.
   2. Tensile Strength: 50 lb, minimum.
   3. Temperature Range: Minus 40 to plus 185 deg F.

B. Paint: Paint materials and application requirements are specified in Division 9 painting Sections.
   1. Interior Ferrous Metal:
      a. Semigloss Acrylic-Enamel Finish: One finish coat over a primer.
         1) Primer: Interior ferrous-metal primer.
         2) Finish Coats: Interior semigloss acrylic enamel.
   2. Interior Zinc-Coated Metal (except Raceways):
      a. Semigloss Acrylic-Enamel Finish: One finish coat over a primer.
         1) Primer: Interior zinc-coated metal primer.
         2) Finish Coats: Interior semigloss acrylic enamel.

C. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.
PART 3 EXECUTION

3.01 APPLICATION

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A: Identify with orange snap-around label.

B. Accessible Raceways and Cables of Auxiliary Systems: Identify the following systems with color-coded, self-adhesive vinyl tape applied in bands:
   1. Mechanical and Electrical Supervisory System: Green and blue.
   2. Control Wiring: Green and red.

C. Power-Circuit Conductor Identification: For primary and secondary conductors No. 1/0 AWG and larger in vaults, pull and junction boxes use color-coding conductor tape write-on tags. Identify source and circuit number of each set of conductors. For single 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. Identify each ungrounded conductor according to source and circuit number.

   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.

F. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Comply with 29 CFR 1910.145 and apply self-adhesive warning labels. Identify system voltage with black letters on an orange background. Apply to exterior of door, cover, or other access.
   1. Equipment with Multiple Power or Control Sources: Apply to door or cover of equipment including, but not limited to, the following:
      a. Power transfer switches.
      b. Controls with external control power connections.

   2. 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.

G. 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.
2. Emergency Operating Instructions: Install instruction signs with white legend on a red background with minimum 3/8-inch-high letters for emergency instructions at equipment used for power transfer.

H. 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: Engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch-high letters on 1-1/2-inch-high label; where 2 lines of text are required, use labels 2 inches high.
   b. 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. Transformers.
   c. Disconnect switches.
   d. Enclosed circuit breakers.
   e. Motor starters.
   f. Push-button stations.

3.02 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. 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 maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

F. 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:
   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 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.

G. Painted Identification: Prepare surface and apply paint according to Division 9 painting Sections.

END OF SECTION
SECTION 16120

CONDUCTORS AND CABLES

PART 1   GENERAL

1.01 DESCRIPTION
A. This Section includes building wires and cables and associated connectors, splices, and terminations for wiring systems rated 600 V and less.

1.02 RELATED DOCUMENTS
A. Section 16010 – Basic Electrical Requirements.
B. Section 16050 – Basic Electrical Materials and Methods.
C. Section 16070 – Hangers and Supports.
D. Section 16130 – Raceways and Boxes.
E. Section 16410 – Enclosed Switches and Circuit Breakers.

1.03 SUBMITTALS
A. Product Data: For each type of product indicated.

1.04 QUALITY ASSURANCE
A. Comply with NFPA 70.
B. Perform work in accordance with City of Philadelphia Standards.

1.05 DELIVERY, STORAGE AND HANDLING
A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Protect from construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2   PRODUCTS

2.01 MANUFACTURERS
A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
   1. The Okonite Company.
   3. General Cable Corporation.
4. Senator Wire & Cable Company.
5. Southwire Company.

2.02 CONDUCTORS AND CABLES

A. Conductor Material: Copper complying with NEMA WC 7; solid conductor for No. 10 AWG and smaller, stranded for No. 8 AWG and larger.

B. Conductor Insulation Types: Type THHN-THWN and SO complying with NEMA WC 7.

C. Multiconductor Cable:
   1. Armored cable, Type AC, and Type SO with ground wire.
   2. Galvanized Steel Interlocked Armor able, Type MC with PVX jacket.

2.03 CONNECTORS AND SPLICES

A. Manufacturers:
   1. AFC Cable Systems, Inc.
   2. AMP Incorporated/Tyco International.
   3. Hubbell/Anderson.
   4. O-Z/Gedney; EGS Electrical Group LLC.
   5. 3M Company; Electrical Products Division.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 EXECUTION

3.01 GENERAL

A. Inspect and verify the locations of all existing electrical work, such as lighting fixtures, electrical conduit, wiring, fittings, controls, starters, communication cables and outlets, and other electrical construction, and provide for the removing, relocating, rerouting and reconnecting of this work as required to accommodate demolition and new construction. Coordinate all relocation and demolition work with SEPTA and other trades.

B. Where existing equipment and systems, such as power and telecommunications, will remain in service during construction, provide rerouting and reconnection of electrical and other system services as required to accommodate demolition schedule and new equipment installation.

C. Wiring and conduit for all items of electrical construction to be removed or relocated shall be removed, unless otherwise noted. This shall include, but not be limited to, lighting fixtures, panelboards, switches, motors, starters, motor control centers, etc. Remove wiring and conduit back to source of power.
D. Material to be removed shall first be offered to the Owner and, if accepted, shall be delivered by the Contractor to designated locations at the site. If not accepted by the Owner, such material shall become the property of the Contractor who shall remove same from the site.

E. Where new work interferes with existing work of other trades, relocate such existing work without additional cost. Approval by the Owner’s Representative must be given before any relocation work can begin. The relocation work shall be done in a manner acceptable to the Owner. Engage Contractor of the appropriate trade to do the work.

F. Where relocation of existing utilities serving other areas of the building is involved, provide rerouting, reconnection and temporary interconnection to maintain electrical and communication services to these areas.

3.02 CONDUCTOR AND INSULATION APPLICATIONS

A. Exposed Feeders: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.

B. Exposed Branch Circuits, including in Crawlspace: Type THHN-THWN, single conductors in raceway, Armored cable, Type AC, Metal-clad cable, Type MC.

C. Branch Circuits Concealed in Concrete: Type THHN-THWN, single conductors in raceway.

3.03 INSTALLATION

A. 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.

B. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

C. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.04 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 6 inches of slack.

3.05 FIELD QUALITY CONTROL

A. Testing: Perform the following field quality-control testing:

1. After installing conductors and cables and before electrical circuitry has been energized, test for compliance with requirements.
2. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.3.1. Certify compliance with test parameters.

B. Test Reports: Prepare a written report to record the following:

1. Test procedures used.

2. Test results that comply with requirements.

END OF SECTION
SECTION 16130

RACEWAYS AND BOXES

PART 1   GENERAL

1.01 DESCRIPTION
   A. This Section includes raceways, fittings, boxes, enclosures, and cabinets for electrical wiring.

1.02 RELATED SECTIONS
   A. Section 16010 – Basic Electrical Requirements.
   B. Section 16050 – Basic Electrical Materials and Methods.
   C. Section 16060 – Grounding and Bonding.
   D. Section 16070 – Hangers and Supports.
   E. Section 16140 – Wiring Devices.
   F. Section 16410 – Enclosed Switches and Circuit Breakers.
   G. Section 16510 – Interior Luminaires.

1.03 SUBMITTALS
   A. Product Data: For surface raceways, wireways and fittings, junction and pull boxes, hinged-cover enclosures, and cabinets.

1.04 QUALITY ASSURANCE
   A. Perform work in accordance with City of Philadelphia Standards.
   B. Comply with NFPA 70.

1.05 DELIVERY, STORAGE AND HANDLING
   A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
   B. Protect from construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2   PRODUCTS

2.01 MANUFACTURERS
   A. Manufacturers: Subject to compliance with requirements, provide products by the manufacturers specified.
2.02 METAL CONDUIT AND TUBING

A. Manufacturers:
   1. AFC Cable Systems, Inc.
   2. Alflex Inc.
   3. Anamet Electrical, Inc.; Anaconda Metal Hose.
   4. Grinnell Co./Tyco International; Allied Tube and Conduit Div.
   5. O-Z Gedney; Unit of General Signal.
   6. Wheatland Tube Co.

B. Rigid Steel Conduit: ANSI C80.1.


D. FMC: Zinc-coated steel.

E. LFMC: Flexible steel conduit with PVC jacket.

F. Fittings: NEMA FB 1; compatible with conduit and tubing materials.

2.03 METAL WIREWAYS

A. Manufacturers:
   1. Hoffman.
   2. Square D.
   3. Steel City.

B. Material and Construction: Sheet metal sized and shaped as indicated, NEMA 3R.

C. Fittings and Accessories: Include couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Select features, unless otherwise indicated, as required to complete wiring system and to comply with NFPA 70.

E. Wireway Covers: Flanged-and-gasketed type.

F. Finish: Manufacturer's standard enamel finish.

2.04 BOXES, ENCLOSURES, AND CABINETS

A. Manufacturers:
   1. Cooper Crouse-Hinds; Div. of Cooper Industries, Inc.
   2. Emerson/General Signal; Appleton Electric Company.
   3. Hoffman.
   5. O-Z/Gedney; Unit of General Signal.
   6. RACO; Division of Hubbell, Inc.
   7. Robroy Industries, Inc.; Enclosure Division.
   8. Thomas & Betts Corporation.

B. Sheet Metal Outlet and Device Boxes: NEMA OS 1.

C. Cast-Metal Outlet and Device Boxes: NEMA FB 1, Type FD, with gasketed cover.
D. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

E. Cast-Metal Pull and Junction Boxes: NEMA FB 1, cast aluminum with gasketed cover.

F. Hinged-Cover Enclosures: NEMA 250, Type 1, with continuous hinge cover and flush latch.
   1. Metal Enclosures: Steel, finished inside and out with manufacturer’s standard enamel.

G. Cabinets: NEMA 250, Type 1, galvanized steel box with removable interior panel and removable front, finished inside and out with manufacturer’s standard enamel. Hinged door in front cover with flush latch and concealed hinge. Key latch to match panelboards. Include metal barriers to separate wiring of different systems and voltage and include accessory feet where required for freestanding equipment.

2.05 FACTORY FINISHES

A. Finish: For raceway, enclosure, or cabinet components, provide manufacturer’s standard prime-coat finish ready for field painting.

PART 3 EXECUTION

3.01 GENERAL

A. Inspect and verify the locations of all existing electrical work, such as lighting fixtures, electrical conduit, wiring, fittings, controls, starters, communication cables and outlets, and other electrical construction, and provide for the removing, relocating, rerouting and reconnecting of this work as required to accommodate demolition and new construction. Coordinate all relocation and demolition work with SEPTA and other trades.

B. Where existing equipment and systems, such as power and telecommunications, will remain in service during construction, provide rerouting and reconnection of electrical and other system services as required to accommodate demolition schedule and new equipment installation.

C. Wiring and conduit for all items of electrical construction to be removed or relocated shall be removed, unless otherwise noted. This shall include, but not be limited to, lighting fixtures, panelboards, switches, motors, starters, motor control centers, etc. Remove wiring and conduit back to source of power.

D. Material to be removed shall first be offered to the Owner and, if accepted, shall be delivered by the Contractor to designated locations at the site. If not accepted by the Owner, such material shall become the property of the Contractor who shall remove same from the site.

E. Where new work interferes with existing work of other trades, relocate such existing work without additional cost. Approval by the Owner’s Representative must be given before any relocation work can begin. The relocation work shall be done in a manner acceptable to the Owner. Engage Contractor of the appropriate trade to do the work.

F. Where relocation of existing utilities serving other areas of the building is involved, provide rerouting, reconnection and temporary interconnection to maintain electrical and communication services to these areas.

3.02 RACEWAY APPLICATION

A. Indoors:
1. Exposed: RSC.
2. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC; except use LFMC in damp or wet locations.
3. Damp or Wet Locations: Rigid steel conduit.
4. Boxes and Enclosures: NEMA 250, Type 1, except as follows:
   a. Damp or Wet Locations: NEMA 250, Type 4, stainless steel.

B. Minimum Raceway Size: 3/4-inch trade size.

C. Raceway Fittings: Compatible with raceways and suitable for use and location.
   1. PVC Externally Coated, Rigid Steel Conduits: Use only fittings approved for use with that material. Patch all nicks and scrapes in PVC coating after installing conduits.

3.03 INSTALLATION

A. Install horizontal raceway runs above water piping.

B. Complete raceway installation before starting conductor installation.

C. Install temporary closures to prevent foreign matter from entering raceways.

D. Protect stub-ups from damage where conduits rise through floor slabs. Arrange so curved portions of bends are not visible above the finished slab.

E. Make bends and offsets so ID is not reduced. Keep legs of bends in the same plane and keep straight legs of offsets parallel, unless otherwise indicated.

F. Install exposed raceways parallel or at right angles to nearby surfaces or structural members and follow surface contours as much as possible.
   1. Run parallel or banked raceways together on common supports.
   2. Make parallel bends in parallel or banked runs. Use factory elbows only where elbows can be installed parallel; otherwise, provide field bends for parallel raceways.

G. Join raceways with fittings designed and approved for that purpose and make joints tight.
   1. Use insulating bushings to protect conductors.

H. Tighten set screws of threadless fittings with suitable tools.

I. Terminations:
   1. Where raceways are terminated with locknuts and bushings, align raceways to enter squarely and install locknuts with dished part against box. Use two locknuts, one inside and one outside box.
   2. Where raceways are terminated with threaded hubs, screw raceways or fittings tightly into hub so end bears against wire protection shoulder. Where chase nipples are used, align raceways so coupling is square to box; tighten chase nipple so no threads are exposed.

J. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire.

K. Install raceway sealing fittings at suitable, approved, and accessible locations and fill them with UL-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.
   1. Where otherwise required by NFPA 70.
L. Flexible Connections: Use maximum of 72 inches of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for all motors. Use LFMC in damp or wet locations. Install separate ground conductor across flexible connections.

M. Surface Raceways: Install a separate, green, ground conductor in raceways from junction box supplying raceways to receptacle or fixture ground terminals.

N. Install hinged-cover enclosures and cabinets plumb. Support at each corner.

3.04 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.

3.05 CLEANING

A. Section 01710 – Final Cleaning

B. After completing installation of exposed, factory-finished raceways and boxes, inspect exposed finishes and repair damaged finishes.

END OF SECTION
SECTION 16140

WIRING DEVICES

PART 1  GENERAL

1.01 DESCRIPTION

A. This Section includes the following:
   1. Single and duplex receptacles, ground-fault circuit interrupters.
   3. Device wall plates.

1.02 RELATED DOCUMENTS

A. Section 16010 – Basic Electrical Requirement.
B. Section 16050 – Basic Electrical Materials and Methods.
C. Section 16060 – Grounding and Bonding.
D. Section 16070 – Hangers and Supports.
E. Section 16120 – Conductors and Cables.

1.03 SUBMITTALS

A. Product Data: For each type of product indicated.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with City of Philadelphia Standards.
B. Source Limitations: Obtain each type of wiring device through one source from a single manufacturer.
C. Comply with NFPA 70.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
B. Protect from construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2  PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. Wiring Devices:
b. Eagle Electric Manufacturing Co., Inc.
c. Hubbell Incorporated; Wiring Device-Kellems.
d. Leviton Mfg. Company Inc.
e. Pass & Seymour/Legrand; Wiring Devices Div.
f. Wiring Devices for Hazardous (Classified) Locations:
g. Crouse-Hinds/Cooper Industries, Inc.; Arrow Hart Wiring Devices.
h. EGS/Appleton Electric Company.
i. Killark Electric Manufacturing Co./Hubbell Incorporated.

2.02 RECEPTACLES

A. Straight-Blade-Type Receptacles: Comply with NEMA WD 1, NEMA WD 6, DSCC W-C-596G, and UL 498.

B. Straight-Blade and Locking Receptacles: General-Duty grade.

C. GFCI Receptacles: Straight blade, non-feed-through type, Heavy-Duty grade, with integral NEMA WD 6, Configuration 5-20R duplex receptacle; complying with UL 498 and UL 943. Design units for installation in a 2-3/4-inch-deep outlet box without an adapter.

2.03 SWITCHES


B. Snap Switches General-Duty grade, quiet type.

C. Combination Switch and Receptacle: Both devices in a single gang unit with plaster ears and removable tab connector that permit separate or common feed connection.
   2. Receptacle: NEMA WD 6, Configuration 5-15R.

2.04 OCCUPANCY SENSOR

A. Occupancy sensor Dual Technology; PIR (Passive Infrared) & US (Ultrasonic)
   1. Use in: office small and large, conference room small & large, lounge room.
   2. 

B. Occupancy sensor US (Ultrasonic) type;
   1. Use in: open office, small and large restroom, hall.

C. Occupancy sensor PIR (Passive Infrared) type;
   1. Use in: storage room, small office (single desk)
   2. Use in: small restroom without partitions.

D. Occupancy sensor AT (Adaptive Technology); (microprocessor based with build in software that makes all decisions for setting and adjustments instead of manually adjusting the sensor for seasonal changes, modified airflow, occupancy pattern changes or room layout change.
   1. Use in: all types of office environments, except in small restroom and small storage and small office.

E. Wall mounted occupancy sensors to be used in: small and large office, small storage, small rooms, small restroom and small conference room.
F. Ceiling mounted occupancy sensors or occupancy sensors integrated with the lighting fixtures to be used in: large and open offices, large storage rooms, large restrooms, lounge rooms and other large areas and room.

G. Occupancy sensors integrated with dimmers shall be compatible with lighting fixture LED dimming drivers. Consult with lighting supplier to determine best compatibility of lighting controller with LED dimming driver.
   1. 0-10V dimming.
   2. Lighting fixture line voltage is 277V, or 120/277V,
   3. Frequency 50-60Hz.,
   4. Time delay adjustment 5 minutes or less, to 30 minutes,
   5. Field: 100deg minimum vertical, 180deg minimum horizontal
   6. Field for ceiling mounted devices: 360deg.
   7. Indicator light LED
   8. Auto/off switch:
      a. Auto-On, auto-Off; (Occupancy)
      b. Manual-On, auto-Off; (Vacancy)
   9. Sensitivity 0-100%

2.05 DAYLIGH SENSOR

A. 5 years warranty.

B. Ceiling mounted or integrated with lighting fixture:
   1. 0-10V continuous dimming output compatible with LED driver,
   2. Adjustable sensitivity: 10 – 120 Fc,
   3. Voltage range: 120/277V
   4. For indoor use: 32F – 104F
   5. Viewing angle: 60deg.

2.06 DIMMING SENSOR

A. 5 years warranty.

B. Dimming wiring device wall mounted.
   1. Dimmer shall be integrated with occupancy sensor or shall be stand-alone wall mounted unit where the occupancy sensor is integrated with lighting fixture.

C. Single gang wiring device:
   1. Dimming output voltage: 0-10V,
   2. Dimming range: 100% - 1%,
   3. Operating temperature: 0F – 120F
   4. Adjustable preset up to 100% of dimming range,
   5. 

2.07 WALL PLATES

A. Single and combination types to match corresponding wiring devices.
   1. Plate-Securing Screws: Metal with head color to match plate finish.
   2. Material for Finished Spaces: 0.035-inch-thick, satin-finished stainless steel.
   3. Material for Wet Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in "wet locations."

Wiring Devices 16140 - 3
2.08 FINISHES

A. Color:
   1. Wiring Devices Connected to Normal Power System: Ivory, unless otherwise indicated or required by NFPA 70.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install devices and assemblies level, plumb, and square with building lines.

B. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical, and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

C. Remove wall plates and protect devices and assemblies during painting.

3.02 IDENTIFICATION

A. Comply with Section 16075 “Electrical Identification.”
   1. Receptacles: Identify panelboard and circuit number from which served. Use hot, stamped or engraved machine printing with black white-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.03 CONNECTIONS

A. Ground equipment according to Section 16060 “Grounding and Bonding.”

B. Connect wiring according to Section 16120 “Conductors and Cables.”

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.

D. Various manufacturer technology and device arrangement requires specific wiring. The contractor shall consult with manufacturer representative to obtain required compatibilities between LED drivers and the lighting control devices.

E. The contractor shall provide mockup for each type of fixture to test all components before purchasing all control wiring devices.

3.04 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:
   1. After installing wiring devices and after electrical circuitry has been energized, test for proper polarity, ground continuity, and compliance with requirements.
   2. Test GFCI operation with both local and remote fault simulations according to manufacturer’s written instructions.

B. Remove malfunctioning units, replace with new units, and retest as specified above.

END OF SECTION
SECTION 16150

WIRING CONNECTIONS

PART 1   GENERAL

1.01 DESCRIPTION

A. This section includes the following:

1. Complete furnishing and installing of electrical connections to equipment specified under this Contract or furnished by SEPTA.

2. Make all final connections, and leave apparatus in approved operating condition.

3. Provide materials, labor, tools, equipment, supervision, and all appurtenances as required for complete electrical connections to all equipment.

1.02 RELATED SECTIONS

A. Section 16010 – Basic Electrical Requirements.

B. Section 16050 – Basic Electrical Materials and Methods.

C. Section 16140 – Wiring Devices.

D. Section 16410 – Enclosed Switches and Circuit Breakers.

E. Section 16510 – Interior Luminaires.

1.03 QUALITY ASSURANCE

A. Perform work in accordance with City of Philadelphia Standards.

B. Comply with NFPA 70.

C. Perform Work in accordance with NECA Standard of Installation.

PART 2   PRODUCTS

2.01 GENERAL

A. Equipment and materials as specified elsewhere in Division 16 or as indicated on the Drawings.

PART 3   EXECUTION

3.01 GENERAL

A. Equipment Variations: Note that equipment sizes and capacities as shown on the Contract Documents are for bidding purposes and as such may not be the exact unit actually furnished. Contractor shall anticipate minor variations in equipment and shall include in his Bid all costs required to properly connect the equipment actually furnished.
B. Verification: Obtain and review shop drawings, product data and manufacturer’s instructions for equipment furnished by others. Examine actual equipment to verify proper connection locations and requirements.

C. Coordination: Sequence electrical rough-in and final connections to coordinate with installation and start-up schedule and work by other trades.

3.02 ROUGH-IN

A. Provide all required conduit, boxes, fittings, wire, connectors and miscellaneous accessories, etc. as necessary to rough in and make final connections to all equipment requiring electrical connections.

B. In general, motors and equipment shall be wired in conduit to a junction box (or safety switch) near the unit and from there to the unit in flexible metal or liquid-tight flexible metal conduit.

3.03 CONNECTIONS

A. Provide properly sized overload and short circuit protection for all equipment connected, whether furnished under this Contract or by others.

B. Verify a proper connection with manufacturer’s published diagrams and comply with same.

C. Verify that equipment is ready for electrical connections, wiring and energization, prior to performing same.

D. Provide all control wiring to remote devices or equipment as indicated or required. Modify equipment control wiring, install or disconnect jumpers, etc. as required.

END OF SECTION
SECTION 16410

ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1   GENERAL

1.01 DESCRIPTION

A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
   1. Fusible switches.
   2. Nonfusible switches.

1.02 RELATED SECTIONS

A. Section 16010 – Basic Electrical Requirements.
B. Section 16050 – Basic Electrical Materials and Methods.
C. Section 16060 – Grounding and Bonding.
D. Section 16070 – Hangers and Supports.
E. Section 16075 – Electrical Identification.
F. Section 16120 – Conductors and Cables.
G. Section 16130 – Raceways and Boxes.

1.03 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers’ technical data on features, performance, electrical characteristics, ratings, and finishes.
   1. Enclosure types and details for types other than NEMA 250, Type 1.
   2. Current and voltage ratings.
   4. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

B. Manufacturer’s field service report.
   1. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals.
1.04 QUALITY ASSURANCE

A. Perform work in accordance with City of Philadelphia Standards.

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.

D. 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.

1.05 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Protect from construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.02 FUSIBLE AND NONFUSIBLE SWITCHES

A. Manufacturers:
   1. Eaton Corporation; Cutler-Hammer Products.
   2. General Electric Co.; Electrical Distribution & Control Division.
   4. Square D/Group Schneider.

B. Fusible Switch, 600 A and Smaller: NEMA KS 1, Type GD, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Nonfusible Switch, 600 A and Smaller: NEMA KS 1, Type GD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

D. Accessories:
   1. Equipment Ground Kit: Internally mounted and labeled for copper ground conductors.
   2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
   3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.
2.03 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES

A. Manufacturers:

1. Eaton Corporation; Cutler-Hammer Products.
2. General Electric Co.; Electrical Distribution & Control Division.
5. Square D/Group Schneider.

B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.

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 $I^2t$ response.
4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

C. Molded-Case Circuit-Breaker Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.
2. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and conductor material.
3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
4. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay.
5. Key Interlock Kit: Externally mounted to prohibit circuit-breaker operation; key shall be removable only when circuit breaker is in off position.

D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating.

E. Molded-Case Switch Accessories:
   1. Lugs: Mechanical style with compression lug kits suitable for number, size, trip ratings, and material of conductors.
   2. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.
   3. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage with field-adjustable 0.1- to 0.6-second time delay. Provide "dummy" trip unit where required for proper operation.
   4. Auxiliary Switch Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
   5. Key Interlock Kit: Externally mounted to prohibit operation; key shall be removable only when switch is in off position.

2.04 ENCLOSURES

A. Section 16130 – Raceways and Boxes
   1. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.
   2. Enclosures in hazardous locations must be carefully selected to meet the division and group listing of the environment.
   3. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7C.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.

B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.03 IDENTIFICATION

A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Section 16075 "Electrical Identification."

B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Section 16075 "Electrical Identification."

3.04 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. Prepare for acceptance testing as follows:

1. Inspect mechanical and electrical connections.
2. Verify switch and relay type and labeling verification.
3. Verify rating of installed fuses.
4. Inspect proper installation of type, size, quantity, and arrangement of mounting or anchorage devices complying with manufacturer's certification.

C. Perform the following field tests and inspections and prepare test reports:

1. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

   a. Instruments, Equipment and Reports:

      1) Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

      2) Prepare a certified report that identifies enclosed switches and circuit breakers included and describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.05 ADJUSTING

A. Set field-adjustable switches and circuit-breaker trip ranges.

3.06 CLEANING

A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.

B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION
SECTION 16510
INTERIOR LUMINAIRES

PART 1 GENERAL

1.01 DESCRIPTION

A. This Section includes the following:
1. Interior lighting fixtures, lamps, and ballasts.
2. Emergency lighting units.

1.02 RELATED SECTIONS

A. Section 16010 – Basic Electrical Requirements.
B. Section 16050 – Basic Electrical Materials and Methods.
C. Section 16060 – Grounding and Bonding.
D. Section 16070 – Hangers and Supports.
E. Section 16075 – Electrical Identification.
F. Section 16120 – Conductors and Cables.
G. Section 16130 – Raceways and Boxes.

1.03 SUBMITTALS

A. Section 01300 – Submittals.

B. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:
1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
5. Life, output, and energy-efficiency data for lamps.
6. Photometric data, in IESNA format, based on laboratory tests of each lighting fixture type, outfitted with lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.
   a. For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by the manufacturer.

C. Shop Drawings: Show details of nonstandard or custom lighting fixtures. Indicate dimensions, weights, methods of field assembly, components, features, and accessories.

D. Coordination Drawings: Reflected ceiling plan(s) 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. Lighting fixtures.
2. Structural members to which suspension systems for lighting fixtures will be attached.

E. Samples for Verification: Interior lighting fixtures designated for sample submission in Interior Lighting Fixture Schedule. Each sample shall include the following:
1. Lamps: Specified units installed.
2. Accessories: Cords and plugs.

1.04 QUALITY ASSURANCE

A. Perform work in accordance with City of Philadelphia Standards.

B. Luminaire Photometric Data Testing Laboratory Qualifications: Provided by manufacturers’ laboratories that are accredited under the National Volunteer Laboratory Accreditation Program for Energy Efficient Lighting Products.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

D. Comply with NFPA 70.

E. FMG Compliance: Lighting fixtures for hazardous locations shall be listed and labeled for indicated class and division of hazard by FMG.

1.05 DESIGN OR PERFORMANCE REQUIREMENTS

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.06 QUALIFICATIONS

A. Qualification Data: For agencies providing photometric data for lighting fixtures.

1.07 DELIVERY, STORAGE AND HANDLING

A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.

B. Protect from construction traffic, dirt, water, chemical, and mechanical damage, by storing in original packaging.

1.08 OPERATIONAL AND MAINTENANCE DATA

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1.09 WARRANTY

A. Warranty Period for Electronic Ballasts: Manufacturer’s standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
1. Warranty Period: 5 years (Manufacturer’s warranty) from date of Substantial Completion.
B. Manufacturer's standard form, made out to Owner and signed by lamp manufacturer agreeing to replace lamps that fail in materials or workmanship, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
   1. Warranty Period: 5 years (Manufacturer's warranty for luminaire, LED board and LED drive.) from date of Substantial Completion.
   2. Warranty Period: 3 years for emergency battery pack/drive from date of Substantial Completion

1.10 MAINTENANCE AND 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. Lamps: 2 for each type of fixture.
   2. Plastic Diffusers and Lenses: 2 for each type of fixture.
   3. Ballasts/ drivers: 2 for each type of fixture.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. In Interior Lighting Fixture Schedule where titles below are column or row headings that 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 specified manufacturers or approved equals.
      a. Philips, Day-Brite DualLED 2x4 & 2x2 (approved by SEPTA)
      b. Cooper Metalux
      c. Columbia Lighting, Inc..
      d. Lithonia Lighting
   2. Basis-of-Design Product: The design for each lighting fixture is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.02 LIGHTING FIXTURES AND COMPONENTS, GENERAL REQUIREMENTS

A. Fluorescent Fixtures: Comply with UL 1598. Where LER is specified, test according to NEMA LE 5 and NEMA LE 5A as applicable.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel, unless otherwise indicated. Form and support to prevent warping and sagging.

D. 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.

E. Painted after fabrication, matte white powder coating to create a durable high quality finish.

F. Reflecting surfaces shall have minimum reflectance as follows, unless otherwise indicated:
1. White Surfaces: 85 percent.
2. Specular Surfaces: 83 percent.
3. Diffusing Specular Surfaces: 75 percent.
4. Laminated Silver Metallized Film: 90 percent.

G. Plastic Diffusers, Covers, and Globes:
1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing
and other changes due to aging, exposure to heat, and UV radiation.
   a. Lens Thickness: At least 0.125 inch minimum unless different thickness is indicated.
   b. UV stabilized.
2. Glass: Annealed crystal glass, unless otherwise indicated.

H. Electromagnetic-Interference Filters: Factory installed to suppress conducted electromagneti-
ic-interference as required by MIL-STD-461E. Fabricate lighting fixtures with one filter on
each ballast or driver indicated to require a filter.

I. Listed for use in insulated ceiling unless surface of pendant fixture is used (Type IC.)

2.03 DRIVER FOR LED LAMPS, LED BOARDS AND ACCESSORIES

A. LED driver shall be easily accessible without the tools.
   1. Dimmable with 0-10V control voltage

B. Multiple of single LED boards shall be individually replaceable via plug in connectors to ensure
long service life.

C. Integral sensors options shall be available for:
   1. Occupancy sensor, factory installed integral to the fixture (optional external installation).
      The occupancy sensor should utilize dual technology.
      Occupancy sensors with embedded automatic dimming behaviors appropriate to multiple
      office application.
   2. The office application modes are selected using the handheld remote control.
   3. Daylight harvesting sensor, factory installed for additional energy saving, easy installation
      and no reduction in LED performance or life. The sensor shall provide 0-10V dimming
      control.
   4. Daylight sensing is integral to each luminaire, is automatic and re-calibration occurs when
      luminaires turns ON.

D. High efficiency LED with life time of 50,000h minimum before depreciation period.
   1. Occupancy sensor, factory installed integral to the fixture (optional external installation).
      The occupancy sensor should utilize dual technology.

E. Integral sensors options shall be available for:
   1. Occupancy sensor, factory installed integral to the fixture (optional external installation).
      The occupancy sensor should utilize dual technology.

F. Single Ballasts for Multiple Lighting Fixtures: Factory-wired with ballast arrangements and
bundled extension wiring to suit final installation conditions without modification or rewiring in
the field.

G. Ballasts/drivers for Low-Temperature Environments (Exterior):
   1. Temperatures Minus 10 Deg F and Higher:
H. Ballasts for Low Electromagnetic-Interference Environments: Comply with 47 CFR, Chapter 1, Part 18, Subpart C, for limitations on electromagnetic and radio-frequency interference for consumer equipment.

2.04 FIXTURE, LED LAMPS

A. Color temperature: 3500 K,

B. Average rated of life: 50,000 hours, unless otherwise indicated.

C. Color rating: 80 CRI (Color Rating Index)

D. Total Luminaire Efficacy: more than 90LPW (Lumens per Watt)

2.05 LIGHTING FIXTURE SUPPORT COMPONENTS

A. Comply with Section 16070 "Hangers and Supports".

PART 3 EXECUTION

3.01 INSTALLATION

A. Lighting fixtures: Set level, plumb, and square with ceilings and walls. Install lamps in each fixture.

3.02 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

END OF SECTION
SECTION 16970

TESTING AND COMMISSIONING

PART 1   GENERAL

1.01 DESCRIPTION

A. This specification section, along with the Contract Drawings, is intended to cover testing and commissioning requirements applicable to all electrical work involved with the project.

B. Provide materials, labor, tools, equipment, supervision, and all appurtenances as required for complete testing and commissioning.

1.02 RELATED SECTIONS

A. Section 16010 – Basic Electrical Requirements.

B. Section 16060 – Grounding and Bonding.

C. Section 16120 – Conductors and Cables.

D. Section 16140 – Wiring Devices.

E. Section 16410 – Enclosed Switches and Circuit Breakers.

F. Section 16510 – Interior Luminaires.

1.03 SUBMITTALS

A. Submit Testing and Commissioning report.

1.04 QUALITY ASSURANCE


B. National Electrical Manufacturers Association (NEMA).

C. American National Standard Institute (ANSI).


E. National Electrical Contractors Association (NECA) - Standard of Installation.


PART 2   PRODUCTS

2.01 GENERAL

A. Provide all instruments required for testing.

B. Test and calibrate all instruments for accuracy prior to use.
PART 3 EXECUTION

3.01 TESTS

A. All work shall be tested regularly during its progress. SEPTA shall have power to test any portion of work at any time, and all labor and material shall be furnished as necessary to assist in making such tests. Foreman in charge of work shall give his personal attention, together with any other assistance required, in order to investigate any portion of work. The following tests shall be performed: Insulation resistance, load balancing in panelboards, correct rotation of motors.

B. Perform all tests in the presence of SEPTA representatives. All fuses and circuit breakers are to be in place, splices made and all equipment connected at the time tests are made. Furnish labor, materials and instruments necessary to conduct the tests.

C. On completion, the work is to be inspected and must satisfactorily pass tests against short circuits and grounds.

D. The Electrical Contractor shall be present during the test operation of all mechanical equipment to which electrical connections have been made.

E. Contractor shall demonstrate the proper operation of all alarm devices.

3.02 RESPONSIBILITY DURING TESTS

A. The Contractor shall be fully responsible for the proper operation of equipment during tests and instruction periods and shall neither have nor make any claim for damage which may occur to equipment prior to the time when SEPTA formally takes over the operation thereof.

3.03 FAILURE OF TESTS

A. Any defects in the equipment, or deviations from the guarantees or requirements of the specifications, shall be promptly corrected by the Contractor by replacements or otherwise. If the Contractor fails to correct any defects or deviations, or if the replaced equipment when tested shall fail again to meet the guarantees or specified requirements, SEPTA notwithstanding there having made partial payment for work and materials, may reject the equipment and order the Contractor to remove it from the premises at the Contractor’s expense.

END OF SECTION